The Great Grid Upgrade

Sea Link

Preliminary Environmental Information Report

Volume: 1

Part 4 Offshore Scheme

Chapter 2 Physical Environment

Version A

October 2023

nationalgrid

Page intentionally blank

Contents

Table of Tables

Table of Images

Sea Link
Document control

Document Properties	
Organisation	AECOM
Author	AECOM
Approved by	AECOM
Title	Preliminary Environmental Information Report Part 4, Chapter 2, Physical Environment
Data Classification	Public

Version History

Date	Version	Status	Description/Changes
24/10/2023	A	FINAL	First Issue

4.2 Physical Environment

4.2.1 Introduction

4.2.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents information about the preliminary environmental assessment of the likely significant effects on the marine physical environment identified to date, that could result from the Proposed Project (**as described in Volume 1, Part 1, Chapter 4, Description of the Proposed Project**).

4.2.1.2 This chapter describes the methodology used, the datasets that have informed the preliminary assessment, baseline conditions, mitigation measures and the preliminary residual significant effects on the physical environment that could result from the Proposed Project.

4.2.1.3 The draft Order Limits, which illustrate the boundary of the Proposed Project, are illustrated on **Figure 1.1.1 Draft Order Limits** and the Offshore Scheme Boundary is illustrated on **Figure 1.1.4 Offshore Scheme Boundary**.

4.2.1.4 This chapter should be read in conjunction with:

- **Volume 1, Part 1, Chapter 4, Description of the Proposed Project**;
- **Volume 1, Part 1, Chapter 5, PEIR Approach and Methodology**;
- **Volume 1, Part 1, Chapter 6, Scoping Opinion and EIA Consultation**;
- **Volume 1, Part 4, Chapter 1, Evolution of the Offshore Scheme**; and
- **Volume 1, Part 4, Chapter 3, Benthic Ecology**.

4.2.1.5 This chapter is supported by the following figures:

- **Volume 3, Figure 4.2.1 Tidal excursion ellipses (mean tide), Suffolk Landfall. (ABPmer, 2017)**;
- **Volume 3, Figure 4.2.2 Superficial geology at the Suffolk Landfall**;
- **Volume 3, Figure 4.2.3 Bedrock geology at the Suffolk Landfall**;
- **Volume 3, Figure 4.2.4 Tidal excursion ellipse (mean tide), Kent Landfall (ABPmer, 2017)**;
- **Volume 3, Figure 4.2.5 Superficial geology at the Kent Landfall**;
- **Volume 3, Figure 4.2.6 Bedrock geology at the Kent Landfall**;
- **Volume 3, Figure 4.2.7 EMODnet Bathymetry – mean depth. Depicting the Goodwin Sandbanks situated 4-12 km offshore of Deal**;
- **Volume 3, Figure 4.2.8 Seabed sediments across the study area**; and
- **Volume 3, Figure 4.2.9 Cable corridor route relative to the Greater Thames Estuary sandbanks**.

4.2.1.6 This chapter is supported by the following appendices:

- **Volume 2, Appendix 1.4.A, Outline Code of Construction Practice**; and
- **Volume 2, Appendix 1.4.F, Outline Schedule of Environmental Commitments and Mitigation Measures**.

4.2.2 Regulatory and Planning Context

4.2.2.1 This section sets out the legislation and planning policy that is relevant to the preliminary physical environment assessment. A full review of compliance with relevant national and local planning policy will be provided within the Planning Statement, which will be submitted as part of the application for Development Consent.

4.2.2.2 Policy generally seeks to minimise physical environment effects from development and to avoid significant adverse effects. This applies particularly to coastline geomorphology, ocean current and sediment transport patterns, and features of geomorphological, geological, and scientific areas of interest.

Legislation

Marine and Coastal Access Act 2009

4.2.2.3 The Marine and Coastal Access Act 2009 (Ref 2.1) provides the legal mechanism to help ensure clean, healthy, safe, and productive and biologically diverse oceans and seas. The Act is designed to create a more integrated approach to effective marine management, enable the sustainable use and production of marine resources and provide a clear framework for consistent decision making.

European Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000

4.2.2.4 Commonly referred to as the Water Framework Directive, the full title of this directive is "*European Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*". This is an EU directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies (Ref 2.2). Since leaving the EU, the EU Water Framework Directive has been revoked and replaced in England, Wales and Northern Ireland by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, and the Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017.

European Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008

4.2.2.5 Commonly referred to as the Marine Strategy Framework Directive, the full title of this directive is *"European Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy"* (Ref 2.3). This Directive sets out a framework within which Member States must take the necessary measures to achieve or maintain good environmental status in the marine environment by the year 2020 at the latest. Since leaving the EU, the existing UK-wide framework has been maintained to allow for consistent marine environmental monitoring and standards across the UK.

National Policy

National Policy Statements

National Policy Statements (NPSs) set out the primary policy tests against which the application for a Development Consent Order (DCO) for the Proposed Project will be considered. A review of the NPS was announced in the 2020 Energy white paper: Powering our net zero future. This review was to ensure the NPSs were brought up to date to reflect the policies set out in the white paper. The below information reflects these updates currently under consultation. Table 4.2.1, Table 4.2.2 and Table 4.2.2 below provides details of the elements of NPS (EN-1) Overarching National Policy Statement for Energy (Ref. 2.4), NPS for Renewable Energy Infrastructure (EN-3) (Ref 2.73) and NPS for Electricity Networks Infrastructure (EN-5) (Ref. 2.5) that are relevant to this chapter, and how and where they are covered in the PEIR or will be covered within the Environmental Statement (ES).

Table 4.2.1: NPS EN-1 requirements relevant to the physical environment (Update for consultation 2023).

NPS EN-1 section (Ref 2.4)	Where this is covered in the PEIR
5.6.11 *"…Where relevant, applicants should undertake coastal geomorphological and sediment transfer modelling to predict and understand impacts and help identify relevant mitigating or compensatory measures."*	Whilst no new, site-specific geomorphological or sediment transport modelling of potential impacts has been undertaken (due to the limited scale of likely impacts and availability of information from other EIAs for locations subject to similar conditions), where appropriate, use has been made of results from similar studies where conditions are compatible with those found at key locations along the cable route. See section 4.2.7 and Table 4.2.17.
5.6.12 (part) *"…The ES (see Section 4.2) should include an assessment of the effects on the coast. In particular, applicants should assess the impact of the proposed project on coastal processes and geomorphology, including by taking account of potential impacts from climate change. If the development will have an impact on coastal processes the applicant must demonstrate how the impacts will be managed to minimise adverse impacts on other parts of the coast; and the implications of the proposed project on strategies for managing the coast as set out in Shoreline Management Plans (SMPs) (which provide a large-scale assessment of the physical risks associated with coastal processes*	Changes to coastal processes receptors, including pathways such as changes to sediment transport patterns that may change coastal geomorphology, are the focus of this chapter. They are assessed for the construction, operation and decommissioning stages of the Project in Table 4.2.17. Table 4.2.6 identifies the local planning policies relevant to the Proposed Project.

NPS EN-1 section (Ref 2.4)	Where this is covered in the PEIR
and present a long term policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner), any relevant Marine Plans, River Basin Management Plans, and capital programmes for maintaining flood and coastal defences and Coastal Change Management Areas."	
5.6.13 *"…For any projects involving dredging or deposit of any substance or object into the sea, the applicant should consult the MMO and Historic England, or the NRW in Wales. Where a project has the potential to have a major impact in this respect, this is covered in the technology specific NPSs."*	Pre-sweeping within the nearshore area of Kent, following a bathymetric survey is due to take place in Summer 2023. Following the survey, the area for pre-sweeping will be finalised and volumes of material will be derived from the bathymetric survey data. The potential impact of pre-sweeping activities are addressed in Table 4.2.17: Preliminary assessment of the physical environment effects.
5.6.14 *"…The applicant should be particularly careful to identify any effects of physical changes on the integrity and special features of Marine Conservation Zones, candidate marine Special Areas of Conservation (SACs), coastal SACs and candidate coastal SACs, coastal Special Protection Areas (SPAs) and potential coastal SPAs, Ramsar sites, Sites of Community Importance (SCIs) and potential SCIs and Sites of Special Scientific Interest."*	The baseline in section 4.2.7 presents information on the Sandwich Bay to Hacklinge Marshes Sites of Special Scientific Interest (SSSI), the Coraline Crag Formation Ridges, Goodwin Sands MCZ (**Figure 4.2.7 EMODnet Bathymetry – mean depth. Depicting the Goodwin Sandbanks situated 4-12 km offshore of Deal**) and the offshore Greater Thames Estuary characterized by large subtidal sandbanks and channels (including the Shipwash East Bank) The potential impact on these features of geological, morphological and scientific interest are addressed in Table 4.2.17: Preliminary assessment of the physical environment effects. The effects of the Proposed Project on marine ecology and biodiversity in association with

NPS EN-1 section (Ref 2.4)	Where this is covered in the PEIR
	protected sites is set out in **Part 4, Chapter 3 Benthic Ecology** and **Part 4, Chapter 4 Fish and Shellfish**.
5.6.16 *"…Applicants should propose appropriate mitigation measures to address adverse physical changes to the coast, in consultation with the MMO, the EA, LPAs[1], other statutory consultees, Coastal Partnerships and other coastal groups, as it considers appropriate. Where this is not the case the IPC should consider what appropriate mitigation requirements might be attached to any grant of development consent."*	Mitigation measures that address adverse physical changes to the coast are set out in section 4.2.8.
5.6.18 "…The Secretary of State should not normally consent new development in areas of dynamic shorelines where the proposal could inhibit sediment flow or have an adverse impact on coastal processes at other locations. Impacts on coastal processes must be managed to minimise adverse impacts on other parts of the coast. Where such proposals are brought forward consent should only be granted where the Secretary of State is satisfied that the benefits (including need) of the development outweigh the adverse impacts."	This assessment considers the ongoing shoreline change in the nearshore area that might impact coastal processes, as a direct result of the presence of the cable infrastructure and as a result of climate change. See Table 4.2.17: Preliminary assessment of the physical environment effects.

Table 4.2.2: NPS EN-3 requirements relevant to the physical environment (Update for consultation 2023).

NPS EN-3 section (Ref 2.73)	Where this is covered in the PEIR
3.8.120 "Any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational offshore wind farms should be referred to where appropriate."	This assessment references the relevant research and data collected by other operational and in development offshore infrastructure projects. See Section: Data Sources.
3.8.126 "Applicant assessments are expected to include predictions of the physical effects arising from modifications to hydrodynamics (waves and tides), sediments and sediment transport, and seabed morphology that will result from the	The possible impacts on the physical environment during each phase of the Project, including modification to baseline hydrodynamics, sediment transport, seabed

[1] The abbreviation LPA is short for Local Planning Authority.

NPS EN-3 section (Ref 2.73)	Where this is covered in the PEIR
construction, operation and decommissioning of the required infrastructure."	morphology is assessed in Table 4.2.17 Preliminary assessment of the physical environment effects. This assessment is supported by the Baseline study in section: 4.2.7.
3.8.127 "Assessments should also include effects such as the scouring that may result from the proposed development…"	Scour development and its impact on the seabed morphology is assessed in Table 4.2.17 Preliminary assessment of the physical environment effects.
3.8.128 "Applicants should undertake geotechnical investigations as part of the assessment, enabling the design of appropriate construction techniques to minimise any adverse effects."	Geotechnical surveys have previously been carried out and are referenced throughout this assessment to understand the physical environment baseline conditions. See section: 4.2.7.

Table 4.2.3: NPS EN-5 requirements relevant to the physical environment (Update for consultation 2023).

NPS EN-5 section (Ref 2.5)	Where this is covered in the PEIR
2.2.10 "...*As well as having duties under Section 9 of the Electricity Act 1989, (in relation to developing and maintaining an economical and efficient network), applicants must take into account Schedule 9 to the Electricity Act 1989, which places a duty on all transmission and distribution licence holders, in formulating proposals for new electricity networks infrastructure, to "have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and …do what [they] reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects".*	The Baseline in section 4.2.7 presents information on the Sandwich Bay to Hacklinge Marshes SSSI, the Coraline Crag Formation Ridges, Goodwin Sands MCZ and the offshore Greater Thames Estuary characterized by large subtidal sandbanks and channels. The potential impact on these features of geological, morphological and scientific interest are addressed in Table 4.2.17: Preliminary assessment of the physical environment effects. The effects of the Proposed Project on marine ecology and biodiversity in

NPS EN-5 section (Ref 2.5)	Where this is covered in the PEIR
	association with protected sites is set out in **Volume 1, Part 4, Chapter 3 Benthic Ecology** and **Part 4, Chapter 4 Fish and Shellfish**.
2.13.15 *"…The sensitivities of many coastal locations and of the marine environment as well as the potential environmental, community and other impacts in neighbouring onshore areas must be considered in the identification onshore connection points."*	Mitigation measures that address adverse physical changes to the coast are set out in section 4.2.8, this includes details on the use of trenchless techniques at landfall to minimise changes to the nearshore and coastal environment. The sensitivity of receptors within the coastal physical environments are discussed in Table 4.2.17: Preliminary assessment of the physical environment effects.

National Planning Policy Framework

4.2.2.6 The National Planning Policy Framework (NPPF) has the potential to be considered important and relevant to the Secretary of State (SoS) consideration of the Proposed Project. Table 4.2.4 below provides details of the elements of the NPPF that are relevant to this chapter, how and where they are covered in the PEIR or will be covered within the ES.

Table 4.2.4: NPPF requirements relevant to the physical environment.

NPPF section	Where this is covered in the PEIR
Paragraph 174 "*Planning policies and decisions should contribute to and enhance the natural and local environment by [inter alia] … protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan); … [and] recognising the intrinsic character and beauty of the countryside, and the wider benefits from natural capital and ecosystem services; … [and] minimising impacts on and providing net gains for biodiversity; …[and] preventing new and existing development from contributing to, being put at*	The baseline in section 4.2.6 presents information on the Sandwich Bay to Hacklinge Marshes SSSI, the Coraline Crag Formation Ridges, Goodwin Sands MCZ and the offshore Greater Thames Estuary characterized by large subtidal sandbanks and channels. The potential impact on these features of geological,

NPPF section	Where this is covered in the PEIR
unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability".	morphological and scientific interest are addressed in Table 4.2.17: Preliminary assessment of the physical environment effects. The effects of the Proposed Project on marine ecology and biodiversity in association with protected sites is set out in **Volume 1, Part 4, Chapter 3 Benthic Ecology** and **Part 4, Chapter 4 Fish and Shellfish**. The measures adopted to minimise and protect the impact on these features are presented in section 4.2.8.

National Planning Practice Guidance

4.2.2.7 Marine planning in England is the national approach to managing the seas and coasts around England. The UK Marine Policy Statement (MPS) (Ref 2.6) provides the policy framework for the national marine planning system.

4.2.2.8 The guidance on flood risk and coastal change advises how to take account of and address the risks associated with flooding and coastal change in the planning process. Marine planning is aligned with the principles of Integrated Coastal Zone Management (ICZM), ensuring that coastal areas and the activities taking place within them are managed in an integrated and holistic way.

Marine Planning Policy

4.2.2.9 The following marine plans have been considered relevant to a study of the physical environment and has informed the assessment of preliminary effects in this chapter are as follows:

- The UK MPS was adopted in 2011 (Ref 2.6);
- East Inshore and East Offshore Marine Plan (Ref 2.7); and
- South East Inshore Marine Plan (Ref 2.8).

Table 4.2.5: Marine Planning Policies relevant to the physical environment.

Marine Plan	How this is covered in the PEIR
The UK Marine Policy Statement	The UK MPS was adopted in 2011 and provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should

Marine Plan	How this is covered in the PEIR
	be made (Ref 2.6). Complying with the MPS ensures that marine resources are used in a sustainable way. The MPS promotes sustainable economic development; enables the UK's move towards a low-carbon economy, in order to mitigate the causes of climate change and ocean acidification and adapt to their effects; ensures a sustainable marine environment which promotes healthy, functioning marine ecosystems and protects marine habitats, species and our heritage assets; and contributes to the societal benefits of the marine area, including the sustainable use of marine resources to address local social and economic issues.
East Inshore and East Offshore Marine Plan (Ref 2.7)	The East Inshore and East Offshore Marine Plans provide guidance for sustainable development from Flamborough Head to Felixstowe. Any development or activity along the coastline must align with policies set out in the Marine Plan that may impact the marine area. The Marine Plan also sets out policies to manage and mitigate marine-based activities.
South East Inshore Marine Plan (Ref 2.8)	The south east inshore marine plan area stretches from Felixstowe in Suffolk to near Folkestone in Kent, covering approximately 1,400 kilometres of coastline. Adopting the Marine Plan provides a way of implementing government's marine policies at a local level. The Marine plans explain that the marine environment serves a critical role in mitigating climate change. Section 4.2.7 details the baseline physical environment conditions and Section 4.2.9 considers how the proposed development might impact the physical environment and its resilience to future climate change.

Local Planning Policy

4.2.2.10 The intertidal area of the Offshore Scheme lies within the jurisdiction of Suffolk County Council, East Suffolk Council, Suffolk Coastal Local Plan, Kent County Council and within the boundary of Thanet District Council Local Plan and Dover District Local Plan. However, as both landfalls will be achieved using trenchless techniques, there are no activities occurring at the surface in the intertidal area.

4.2.2.11 Local Plan policies that are relevant to the physical environment and will inform the assessment in the ES are detailed in Table 4.2.6.

Table 4.2.6: Local Planning Policies relevant to the physical environment.

Suffolk and Kent Coastal Local Plans – Policy	Where this is covered in the PEIR
Isle of Grain to South Foreland Shoreline Management Plan (SMP) (Ref 2.9)	See Section: Baseline Conditions 4.2.7
SMP 7 - Lowestoft and Felixstowe (Ref 2.10)	See Section: Baseline Conditions 4.2.7
Policy Suffolk Coastal Local Plan (SCLP) 9.3: Coastal Change Management Area (Ref 2.67)	See Section: Suffolk Landfall Coastal Environment
Policy SCLP9.4: Coastal Change Rollback or Relocation (Ref 2.67)	See Section: Future Baseline

4.2.3 Scoping Opinion and Consultation

Scoping

4.2.3.1 A Scoping Report (Ref 2.11) for the Proposed Project was issued to the Planning Inspectorate (PINS) on 24 October 2022 and a Scoping Opinion (Ref 2.12) was received from the SoS on 1 December 2022. Table 4.2.7 sets out the comments raised in the Scoping Opinion and how these have been addressed in this PEIR or will be addressed within the ES. The Scoping Opinion takes account of responses from prescribed consultees as appropriate.

Table 4.2.7: Comments raised in the Scoping Opinion

ID/ Scoping matter	Inspectorate's comments	Response
5.1.1	[*Water Quality*] The Applicant proposes to scope this matter out on the basis that changes in water quality are likely to be temporary and the significance of potential impacts is considered to be negligible due to the measures referred to within the outline Code of Construction Practice (CoCP). The Planning Inspectorate agrees that this matter can be scoped out on the basis that the mitigation measures proposed	Potential changes to water quality and the potential significance of the impact are addressed in Table 4.2.17: Preliminary assessment of the physical environment effects – Receptor: Water Quality

ID/ Scoping matter	Inspectorate's comments	Response
	within the outline CoCP should be sufficient to address the likely impacts and avoid a likely significant effect. The ES should include details of the mitigation and explain how its delivery is assured with reference to relevant documents.	
5.1.2	[*Nearshore/coastal morphological change*] The Applicant proposes to scope this matter out on the basis that installation of the subsea cable and the presence of other vessels and other equipment are considered to be relatively small-scale and transient and would therefore would not influence metocean conditions such as water levels, currents and waves. The Applicant is directed to the comments of Natural England (see Appendix 2 of this Opinion) who are of the view that in shallow nearshore areas there is potential for ancillary infrastructure or seabed excavation to cause modification of nearshore hydrodynamics and give rise to morphological change and in the absence of information regarding route selection, depth of water and likely cable crossings, changes in metocean conditions in the shallow nearshore areas should not be scoped out at this stage. The ES should provide an assessment of changes to metocean conditions in shallow nearshore areas and for cable landfall works areas, where likely significant effects could occur.	Potential changes to nearshore hydrodynamics, sediment transport, which may then result in morphological change, due to nearshore cable installation activities and the presence of cable protection measures are addressed in Table 4.2.17: Preliminary assessment of the physical environment effects – Receptors: - Seabed morphology, including seabed features such as bedforms and sandbanks; - Suffolk and Kent coastline morphology, including Sandwich Bay to Hacklinge Marshes SSSI and The Haven SSSI; - Coraline Crag Ridges; and - Seabed Bathymetry
5.1.3	[*Impact of climate change*] The Applicant has not provided a rationale for scoping this matter out. However, the Inspectorate	Further discussion on the impact of climate change on the landfall sites

ID/ Scoping matter	Inspectorate's comments	Response
	notes that this matter has been scoped in for the proposed landfalls. The Inspectorate considers that coastal erosion at the coastline resulting from climate change is unlikely to occur at the marine cable route area and therefore agrees that this matter can be scoped out from further assessment.	is provided in Table 4.2.17, Receptors: - Coraline Crags and associated role in the regional coastline morphology (Operational Phase); and - Suffolk and Kent coastline morphology, including Sandwich Bay to Hacklinge Marshes SSSI and The Haven SSSI (Operational Phase).
5.1.4	[*Potential impact of:* *Sediment deposition on seabed, alteration to sediment transport patterns and hydrodynamics*] Natural England has identified a number of potentially significant effects within their response (see Appendix 2 of this Opinion) which they advise should be scoped in for further assessment. The Applicant is strongly encouraged to seek to agree the assessment scope with relevant stakeholders and to provide evidence of that agreement in the ES.	Natural England identified the following areas, which they advise should be investigated as part of the baseline characterisation. Each includes details on where it has been addressed within this chapter: Smothering of seabed areas adjacent to the cable by the settling of disturbed material released into the water column during cable installation. This is addressed in Table 4.2.17, Receptor: Water column. Change of sediment type due to cable installation. This is addressed in Table 4.2.17, Receptor: Water column. Modifications to sediment transport patterns and resulting morphological change due to sandwave clearance. This is addressed in Table 4.2.17, Receptor: Seabed morphology, including seabed features such as bedforms and sandbanks. Modification of the nearshore hydrodynamics or diversion of sediment transport pathways resulting in morphological change (including to dunes, cliffs, saltmarsh and mudflats) due to the presence of cable protection measures in shallow nearshore

ID/ Scoping matter	Inspectorate's comments	Response
		water. This is addressed in Table 4.2.17 Receptors: - Seabed morphology, including seabed features such as bedforms and sandbanks; - Suffolk and Kent coastline morphology, including Sandwich Bay to Hacklinge Marshes (SSSI) and The Haven SSSI; - Coraline Crag Ridges; - Seabed Bathymetry; and - Coraline Crags and associated role in the regional coastline morphology. The extent to which sensitive areas of seabed/substratum may be disturbed during cable installation. Table 4.2.17, Receptors: - Seabed morphology, including seabed features such as bedforms and sandbanks; and - Water column. The extent to which seabed areas adjacent to the cable will be smothered by the settling of disturbed sediment. Table 4.2.17, Receptors: - Water column; and - Seabed morphology, including seabed features such as bedforms and sandbanks. Scour (and secondary scour), and removal of seabed sediments, due to cable exposure and/or protection measures, Receptors: - Seabed Bathymetry; and - Seabed.

ID/ Scoping matter	Inspectorate's comments	Response
5.1.5	[*Sensitive geological features*] The Applicant has not identified any sensitive geological features in the vicinity of the proposed cable route. However, as raised by Natural England in their advice (see Appendix 2 of this Opinion) geological interest features listed in the Sandwich Bay to Hacklinge Marshes SSSI citation are of high value. The ES should identify all sensitive geological features and provide an assessment where likely significant effects could occur.	The baseline description provided in section 4.2.7 presents information on the Sandwich Bay to Hacklinge Marshes SSSI, the Coraline Crag Formation Ridges, Goodwin Sands MCZ and the offshore Greater Thames Estuary characterized by large subtidal sandbanks and channels. The potential impact on these features of geological, morphological and scientific interest are addressed in Table 4.2.17: Preliminary assessment of the physical environment effects.

4.2.4 Approach and Methodology

4.2.4.1 **Volume 1, Part 1, Chapter 5, PEIR Approach and Methodology** sets out the overarching approach which has been used in developing the preliminary environmental information. This section describes the technical methods used to determine the baseline conditions, sensitivity of the receptors and magnitude of effects and sets out the significance criteria that have been used for the preliminary physical environment assessment.

Guidance Specific to the Physical Environment Assessment

4.2.4.2 The following has been used to inform this appraisal of potential effects on the physical environment, insofar as applicable to a cable installation project:

- The Rock Manual. The use of rock in hydraulic engineering. CIRIA Report C683 (Ref 2.74).
- Cumulative Impact Assessment Guidelines – Guiding Principles for Cumulative Impact Assessment in Offshore Wind Farms (Ref 2.13);
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Ref 2.14);
- Environmental Impact Assessment for offshore renewable energy projects (Ref 2.15);
- Guidance on Environmental Impact Assessment in Relation to Dredging Applications (Ref 2.16);
- Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to Inform EIA of Major Development Projects. (Ref 2.17);

- 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 2.18);
- Nature Conservation Guidance on Offshore Wind Farm Development (Ref 2.19);
- Marine Licensing: Sediment Analysis and Sample Plans. (Ref 2.20);
- High Level Review of Current UK Action Level Guidance: MMO Project No. 1053 (Ref 2.21);
- ME5226 C7590: Review of Action Levels used for assessing Dredging and Disposal Marine Licences (Ref 2.22);
- DNV-RP-F401 Electrical power cables in subsea applications (Ref 2.75); and
- DNV-RP-0360 Subsea power cables in shallow water (Ref 2.76).

Baseline Data Gathering and Forecasting Methods

4.2.4.3 Baseline data have been collected for the study areas described in section 4.2.6. This section sets out the data currently available. Using these data, the baseline environmental conditions have been summarised and presented in section 4.2.7.

Data Sources

4.2.4.4 Specific to the marine physical environment, the following will be considered:

- Admiralty Tide Tables (Ref 2.23);
- Anglian Coastal Monitoring Programme: 2016 - 2017 Survey Report (Ref 2.24);
- Assessment of Coastal Access Proposals between Aldeburgh and Sizewell on sites and features of nature conservation concern (Ref 2.25);
- Atlas of UK marine renewables resources: modelled wave, wind and tidal current; (Ref 2.26);
- Cefas Climatology Report (2016) Waters Suspended sediment concentrations (SSC) (Ref 2.27);
- Coastal Flood Boundary Dataset (CFB) (Ref 2.28);
- Coastal Morphology Report, Thorpeness (Phase 1) (Ref 2.29);
- EA ‘Flood Risk Assessments: Climate Change Allowances (Ref 2.30);
- East Anglia ONE North Offshore Windfarm, Appendix 4.6 Coastal Processes and landfall Site Selection, Environmental Statement (Ref 2.31);
- East Inshore and East Offshore Marine Plans (Refs 2.7 and 2.8);
- Five Estuaries Offshore Windfarm Array (Ref 2.32);
- GeoIndex Offshore (Ref 2.33);
- Isle of Grain to South Foreland SMP (Ref 2.9);
- Lowestoft to Felixstowe SMP (Ref 2.10);

- Marine Estate Research Report – Seabed mobility in the greater Thames estuary (Ref 2.34);
- National Network of Regional Coastal Monitoring Programmes of England, Meteorological Station Network Annual Report (2019) (Ref 2.35);
- Coastal Wave Network Annual Report (2018) (Ref 2.36);
- Seabed dynamics in a large coastal embayment: 180 years of morphological change in the outer Thames estuary (Ref 2.37);
- SEASTATES Associated British Ports Marine Environmental Research (ABPmer) (Ref 2.38);
- Shoreline – Shoreface Dynamics on the Suffolk Coast, Marine Research Report (Ref 2.39);
- Southeast Regional Coastal Monitoring Programme – North Foreland to Dover Harbour (Ref 2.40);
- Suffolk (SMP 7) Coastal Trends Report 2021, Lowestoft Ness to Landguard Point (Ref 2.41);
- The Sizewell C, Volume 2 Main Development Site Chapter 20 Coastal Geomorphology and Hydrodynamics, Appendix 20A Coastal Geomorphology and Hydrodynamics: Synthesis for Environmental Impact Assessment (Ref 2.42);
- Thorpeness Coastal Erosion Appraisal, Final Report (Ref 2.43);
- Thanet Extension Offshore Wind Farm, Environmental Statement Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (Ref 2.44).
- UK Climate Projections (UKCP): sea level rise (Ref 2.45);
- UK Renewables Atlas (Ref 2.46);
- South East Anglia Link Marine Survey Geophysical Survey, MMT (Ref 2.69);
- Sea Link Cable Burial Assessment Study, Red Penguin Marine (Ref 2.70);
- Sea Link Cable Burial Risk Assessment, Red Penguin Marine (Ref 2.71); and
- Technical Note reviewing potential Horizontal Directional Drilling (HDD) Landfall locations for Sea Link (Ref 2.72).

Assessment Criteria

4.2.4.5 **Volume 1, Part 1, Chapter 5, PEIR Approach and Methodology** sets out the overarching approach which has been used in developing the preliminary environmental information. This section describes the technical methods used to determine the baseline conditions, sensitivity of the receptors and magnitude of effects and sets out the significance criteria that have been used for the preliminary physical environment assessment.

Sensitivity

4.2.4.6 When defining sensitivity, the criteria levels set out in **Volume 1, Part 1, Chapter 5 PEIR Approach and Methodology** have been considered. To determine sensitivity of the receptor, the vulnerability of the receptor to the impact and its ability to recover and adapt are considered. The criteria for assessing the sensitivity of the receptor are defined in Table 4.2.8.

4.2.4.7 The importance, or value, of the receptor on an international, national and local scale has also been considered in assessing sensitivity.

Table 4.2.8. Receptor sensitivity criteria

Sensitivity criteria	Definition
High	Receptor has little or no ability to absorb change without fundamentally altering its character. For example: • The receptor has low/no capacity to return to baseline conditions within Project life (10 + years), e.g., low tolerance to change and low recoverability, such as the Coralline Crag ridges off the Suffolk coast formed over geological time-scales; • The receptor is a designated feature of a protected site, is rare or unique; or receptor is economically valuable.
Medium	Receptor has moderate capacity to absorb change without significantly altering its character. For example, • The receptor has a medium capacity to return to baseline condition, e.g., >5 up to 10 years; or • The receptor is valued but not protected.
Low	The receptor is tolerant to change without significant detriment to its character. For example, • Disturbance to unconsolidated seabed sediments or sandwaves; or • The receptor has a high capacity to return to baseline condition, e.g., within 1 year or up to 5 years; or • The receptor is common and/or widespread.
Very low	The receptor's character, survival or viability has a high tolerance to change

Magnitude

4.2.4.8 The magnitude of impact will be considered in terms of the spatial extent, duration, and timing of the impact in question. A summary of the magnitude criteria is detailed in Table 4.2.9.

Table 4.2.9. Magnitude criteria

Magnitude	General criteria
Large	Adverse: Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements Beneficial: Large scale or major improvement of resource = quality; extensive restoration; major improvement of attribute quality
Medium	Adverse; Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements Beneficial: benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality
Small	Adverse: Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements Beneficial: Minor benefit to, or in addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk or negative impact occurring
Negligible	Adverse: Very minor loss of detrimental alteration to one or more characteristics, features or elements. Beneficial: Very minor benefit to or positive addition of one or more characteristics, features or elements

Significance of effects

4.2.4.9 As set out in **Volume 1, Part 1, Chapter 5, PEIR Approach and Methodology**, the general approach taken to determining the significance of effect in this preliminary assessment is only to state whether effects are likely or unlikely to be significant, rather than assigning significance levels.

Assumptions and Limitations

4.2.4.10 The following assumptions and limitations apply to the assessment undertaken:

- The information/data used provides an appropriate level of spatial coverage which captures variations in conditions within the defined study area; and
- The available information provides sufficient temporal coverage to allow the typical range of natural variability in conditions to be defined.
- The 2021 geophysical survey (Ref 2.69) does not cover the full extent of the possible zone of influence, however further surveys are planned for Summer 2023, including sampling of the areas that might require pre-sweeping.

4.2.5 Basis of Assessment

4.2.5.1 This section sets out the assumptions that have been made in respect of design flexibility maintained within the Proposed Project and the consideration that has been given to alternative scenarios and the sensitivity of the preliminary assessment to changes in the construction commencement year.

4.2.5.2 Details of the available flexibility and assessment scenarios are presented in **Volume 1, Part 1, Chapter 4 Proposed Project Description** and **Part 1, Chapter 5 PEIR Approach and Methodology**.

Flexibility Assumptions

4.2.5.3 The main preliminary assessments have been undertaken based on the description of the Proposed Project provided in **Volume 1, Part 1 Chapter 4 Description of the Proposed Project**. To take account of the flexibility allowed in the Proposed Project, consideration has been given to the potential for preliminary effects to be of greater or different significance should any of the permanent or temporary infrastructure elements be moved within the Limits of Deviation (LoD) or draft order Limits.

4.2.5.4 The assumptions made regarding the use of flexibility for the main assessment, and any alternatives assumptions are set out in Table 4.2.10 below.

Table 4.2.10. Flexibility assumptions

Element of flexibility	Proposed Project assumption for initial preliminary assessment	Flexibility assumption considered
Lateral LoD marine HVDC cable	The extent of the draft Order Limits for the Proposed Project (Offshore Scheme Boundary).	The worst-case scenario assessed for the Offshore Scheme is one bundled HVDC (x2) and one fibre optic cable in once trench. This bundled scenario maybe placed anywhere within the Offshore Scheme Boundary.

Coordination Including Co-Location

4.2.5.5 The Proposed Project includes an option for co-location with National Grid Ventures proposed Nautilus and LionLink interconnector projects as explained in **Volume 1, Part 1, Chapter 5 PEIR Approach and Methodology.**

4.2.5.6 details where the option of co-location is relevant to the preliminary physical environment assessment and how this option has been assessed and reported in section 4.2.9 preliminary assessment of effects.

Table 4.2.11. Consideration of co-location

Element of coordination	How it has been considered within the preliminary assessment
Suffolk landfall	**Sea Link Only** Four HDD ducts (one per cable and one spare). **Sea Link (with co-location)** Up to ten HDD ducts.

Sensitivity Test

4.2.5.1 It is likely that under the terms of the draft DCO, construction could commence in any year up to five years from the granting of the DCO which is assumed to be 2026. Consideration has been given to whether the preliminary effects reported would be any different if the works were to commence in any year up to year five. Where there is a difference, this is reported in section 4.2.9, preliminary assessment of effects.

4.2.6 Study Area

4.2.6.1 The areas assessed in relation to the marine physical environment include:

- The Suffolk Landfall: this is the area where the cable route transitions between the marine and terrestrial environment in Suffolk. This is located between Aldeburgh and Thorpeness;
- The Kent Landfall: this is the area where the cable route transitions between the marine and terrestrial environment in Kent, located in Pegwell Bay; and
- The marine Cable Route: this is the cable route from the Suffolk Landfall up to Mean High Water Springs (MHWS) to the Kent Landfall up to MHWS. It is approximately 120 km in length and located entirely within UK territorial waters.
- The Study Area for the Physical Environment therefore extends beyond the Offshore Scheme to account for the potentially wider Zone of Influence (ZoI). Environmental baseline conditions have therefore been considered for a wider, regional scale Study Area, as considered appropriate.

4.2.7 Baseline Conditions

Suffolk Landfall Coastal Environment

4.2.7.1 The Suffolk landfall is located at a stretch of coast known as The Haven, a Special Site of Scientific Interest (SSSI). The Haven is a shingle beach and is characterized by a main shingle vegetated ridge that hosts rare and protected plants (Ref 2.47, Ref 2.72). The intertidal zone abuts the main ridge with a sharp shingle cliff, which in places experiences erosion resulting in root exposure (Ref 2.47).

4.2.7.2 To the north of the Suffolk Landfall is the town of Thorpeness and the Thorpeness headland. To the south of the Suffolk Landfall is Aldeburgh (Image 4.2.1). This stretch of coastline forms a shallow curve aligned north-south and is characterised by a wide shingle beach. The Thorpeness frontage is predominantly backed by soft cliffs made of sandy glacial till. The Aldeburgh frontage is backed by properties, at the northern end there is a small concrete back wall with a crest level approximately half a metre above the level of the shingle beach. Further south beyond the residential properties, the defence wall is slightly more substantial and set further back with a wave return crest incorporated into the concrete structure. This wall is situated at the back of the beach and at the time of inspection was largely buried by shingle (Ref 2.48).

4.2.7.3 At Aldeburgh, the short-term policy for the Thorpeness to Orford Ness section of coastline, as defined in the Suffolk Shoreline Management Plan (SMP2) (Sub-cell 3c, Policy Development Zone 5, is to maintain the existing defence and 'Hold the Line' for the medium and long-term plan (Ref 2.48).

4.2.7.4 Between Thorpeness and The Haven, a policy of managed realignment is recommended in the SMP for the short to long-term plan, to allow flooding at The Haven with a secondary defence to protect the road (Ref 2.48; Ref 2.10).

Image 4.2.1 Suffolk Landfall coastline, Thorpeness to Aldeburgh (Photo modified from Ref 2.48).

Suffolk Landfall Metocean Conditions

Water levels

4.2.7.5 Tides within the North Sea basin are generated by a tidal wave travelling from the north of Scotland coming from the Atlantic. The tidal wave travels down the Suffolk coast in a southerly direction.

4.2.7.6 The Thorpeness and Haven coastlines are exposed to a microtidal range (when the tidal range is lower than 2 metres) which results in wave energy being more focussed onto a narrower section of the beach (Ref 2.43). At Thorpeness this results in erosion of the soft cliffs and at The Haven, where the cable makes landfall, this causes erosion of the main shingle vegetated ridge.

4.2.7.7 Table 4.2.12 presents the water levels from the UKHO Admiralty tide tables (Ref 2.23) for Aldeburgh, just south of the Suffolk Landfall. The tidal range is much smaller in Suffolk compared to the Kent water levels (Table 4.2.14) and this is due to the Suffolk Landfall being closer to an amphidromic point (a point where the tidal range is almost zero) off the Suffolk coast near Lowestoft, approximately 40 km to the north.

Table 4.2.12. Aldeburgh tidal water levels (Ref 2.23)

Tide	Tidal Level (m above Chart Datum)
Highest Astronomical Tide (HAT)	3.4
Mean High Water Springs (MHWS)	2.7
Mean High Water Neaps (MHWN)	2.3
Mean Sea Level (MSL)	1.66
Mean Low Water Neaps (MLWN)	0.9
Mean Low Water Springs (MLWS)	0.3
Lowest Astronomical Tide (LAT)	-0.2

Suffolk nearshore currents

4.2.7.8 **Figure 4.2.1 Tidal excursion ellipses (mean tide), Suffolk Landfall** shows that the nearshore tidal ellipse near Aldeburgh is oriented northeast – southwest, with the major axis of the ellipse representing the tidal excursion distance of approximately 6 km in length. Further offshore, approximately 5 km from The Haven coastline (where the cable makes landfall), the major axis of the tidal ellipse is approximately 11km in length and is orientated approximately parallel to the coast. The flood tide flows southwards, and ebb tide flows to the north (Ref 2.43).

4.2.7.9 Based on the UK Renewables Atlas (Ref 2.26), the peak spring flow rate nearest The Haven coastline is between 0.84 – 1.04 m/s. The peak neap flow rate is between 0.5 – 0.62 m/s.

Surge effects

4.2.7.10 Storm surges are associated with a change in sea level caused by a storm, which can cause flooding across low-lying coastal areas. The east coast of the UK is historically affected by storm surges, with significant events having occurred in 1952 and 2013 (Ref 2.71).

Sea Temperature

4.2.7.11 The Channel Coastal Observatory provides average sea temperature for Lowestoft, Suffolk, which is the closest monitored point to the Suffolk Landfall. Average sea temperature data recorded for the years 2017-2023 are presented in Table 4.2.13.

Table 4.2.13. Average sea temperature at Lowestoft, Suffolk for the years 2017-2023

Month	Sea temperature (degrees C)
January	6.2
February	5.4
March	6.5
April	8.6
May	11.5
June	15.1
July	17.6
August	19.2
September	17.4
October	14
November	10.9
December	7.6

Source: Ref 2.49

Waves

4.2.7.12 Mott MacDonald (Ref 2.43) summarises previous wave studies carried out along the Suffolk coast, which show that Suffolk has a moderate wave climate. Offshore waves from the northeast and southeast are dominant; waves from the north-northeast sector tend to be larger, but less frequent.

4.2.7.13 Atkinson and Esteves (Ref 2.50) have analysed the wave climate near Thorpeness based on offshore data recorded by the West Gabbard buoy, located about 40km southeast of the study area. Atkinson and Esteves (Ref 2.50) explain that between June 2006 and March 2018, there was a strong bimodality in the direction of offshore waves, with the two dominant directions being from the north-northeast and south-southeast (Image 4.2.2). In most years (8 out of 11), waves from the south were more frequent than waves from the north.

4.2.7.14 Higher waves (significant wave height >2.5m) approached mainly from south-southwest (Ref 2.50) and north-northeast. While mean significant wave height is higher during the winter months, the highest waves (maximum significant wave heights) generally occur in autumn.

4.2.7.15 At Lowestoft the significant wave height (Hs) storm alert threshold for a 0.25-year return period is 3.11m Hs (Ref 2.49).

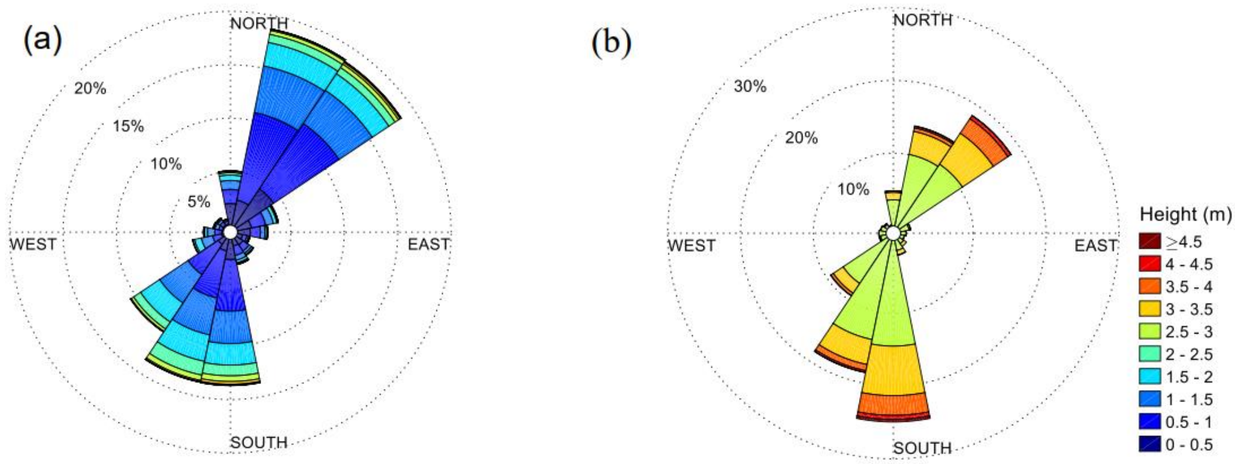


Image 4.2.2 From Atkinson and Esteves (Ref 2.50) – West Gabbard buoy wave roses for (a) all waves and (b) waves of Hs > 2.5 m, showing the percentage of waves of different heights (Hs) that approach from different directions in the period Jun-2006 to Mar-2018 (168685 records, 98% data coverage).

Suffolk Landfall and Nearshore Geology

4.2.7.16 Superficial deposits at the Suffolk Landfall comprise of Glacial Sand and Gravel (**Figure 4.2.2 Superficial geology at the Suffolk Landfall**). The MMT 2021 geophysical survey (Ref 2.69) shows that the Suffolk nearshore cable corridor (Block 01 Nearshore SW KP 5.624 to KP 8.563) is characterised by a clay substrate that continues through the section up to KP 6.237 where the substrate changes to sand, there are also several mounds of stiff clay present through the section (Ref 2.69).

4.2.7.17 Still within Block 01, but further offshore (Block 01 Offshore SW KP 0.000 TO KP 5.624), The MMT 2021 geophysical survey shows ripples and megaripples are present (Ref 2.69). Surficial sediments in this section consist of gravelly sand to sandy gravel and eroded depressions which give way to small, isolated patches of outcropping stiff clay. Between KP 2.2 to KP 4 surficial deposits consist of clay with eroded depressions which then transitions into a sandy substrate where the depressions terminate. At KP 5 sand transitions into silt until the beach landfall. Along this section, there are several mounds of outcropping stiff clay (Ref 2.69).

4.2.7.18 The bedrock geology at the Suffolk Landfall is part of the Coraline Crag Formation, comprising of calcarenite. The dominant bedrock types in the Offshore Scheme boundary are shown in **Figure 4.2.3 Bedrock geology at the Suffolk Landfall**.

Suffolk Geomorphology and Sediment Transport

Coralline crag ridges

4.2.7.19 The coastline between Thorpeness and Aldeburgh is largely controlled and stabilized by the hard geological control feature of the coralline crag formation, which outcrops offshore in the form of static ridges that extend north-eastwards away from Thorpeness (Image 4.2.3). The coralline crag ridges are composed of cemented Pliocene shelly sand which lie beneath the surficial marine sediments and sandwaves (cf. Ref 2.51; Ref 2.52).

4.2.7.20 The locally resistant geology of the coralline crag ridges helps to provide stability to the ness at Thorpeness and to the southern end of Sizewell Bank (further north). These features in turn influence the long-term stability of this section of the Suffolk coastline. For example, the ness slows sediment transport moving north to south helping to stabilise the position of the Sizewell shoreline.

4.2.7.21 The Sizewell Bank helps provide stability to the ness by sheltering it against direct wave impact (Ref 2.52). Further, the Sizewell Bank and Dunwich Bank both help stabilize the Dunwich, Sizewell and Thorpeness shorelines by locally affecting the tidal circulation patterns which flow clockwise around the banks (Ref 2.52).

4.2.7.22 The offshore coralline crag outcrop is interconnected with many of the physical processes that maintain the geomorphology of this stretch of Suffolk coastline. Any activity that adversely affects this feature may have implications for the stability and character of the coastline as far north as Dunwich to as far south as Orford Ness (Ref 2.52).

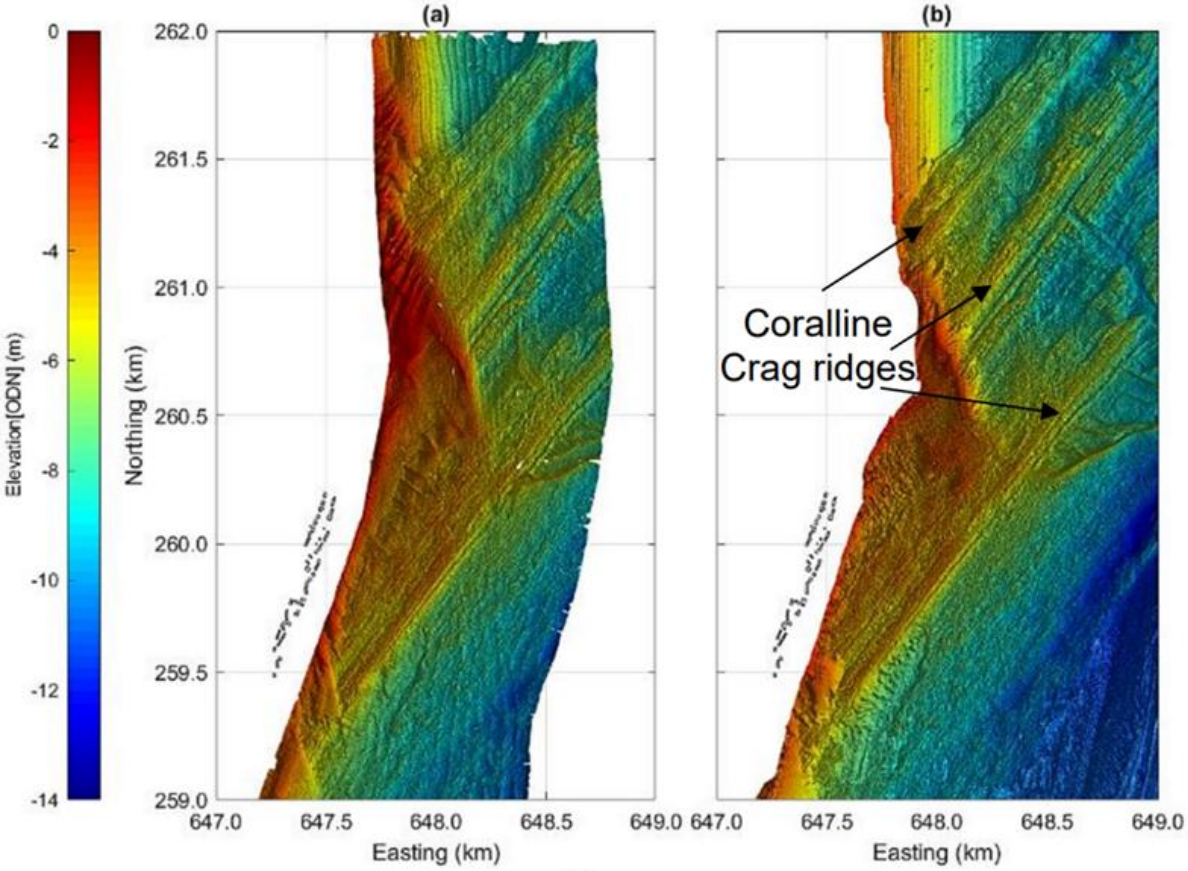


Image 4.2.3 Bathymetry obtained from two multibeam surveys undertaken by (A) the EA in June 2014 and (B) the Maritime Coastal Authority in January 2017. From Ref 2.52.

4.2.7.23 Between Dunwich and Aldeburgh longshore sediment transport is to the south. It is estimated that 40,000 m^3/year of sediment is eroded from the cliffs at Dunwich (Ref 2.48), however sediment transport beyond the prominent feature of Thorpe Ness is low as the ness acts as a barrier to sediment transport moving south. Further south at Orford Ness, the beach is characterized by nearly 100% shingle, with little sand component (Ref 2.48).

4.2.7.24 Storm surge events generate strong southerly sediment transport offshore and along the Suffolk coast, under these conditions, gross sediment transport is orders of magnitude higher than normal tidally driven bedload transport (Ref 2.71).

4.2.7.25 Image 4.2.4 shows the evolution of the Suffolk shoreline between 1992-2014, as analysed by Reeve *et al*. (2019) (Ref 2.53). Profile S040 (Ref 2.53) is located north of Aldeburgh at the Suffolk Landfall where the shoreline has been largely stable with a slight advancing trend. The Suffolk (SMP 7) Coastal Trends Report 2021 (Ref 2.41) reports that between Thorpeness and Aldeburgh there has been no significant change to the sediment budget, as losses and gains appear balanced between 2011 – 2019.

4.2.7.26 Future morphological change along the naturally stabilised bay between Thorpeness and Aldeburgh will be mostly driven by water level change (due to future sea level rise) relative to the profile of the beach, resulting in the shoreline moving inland (Ref 2.48).

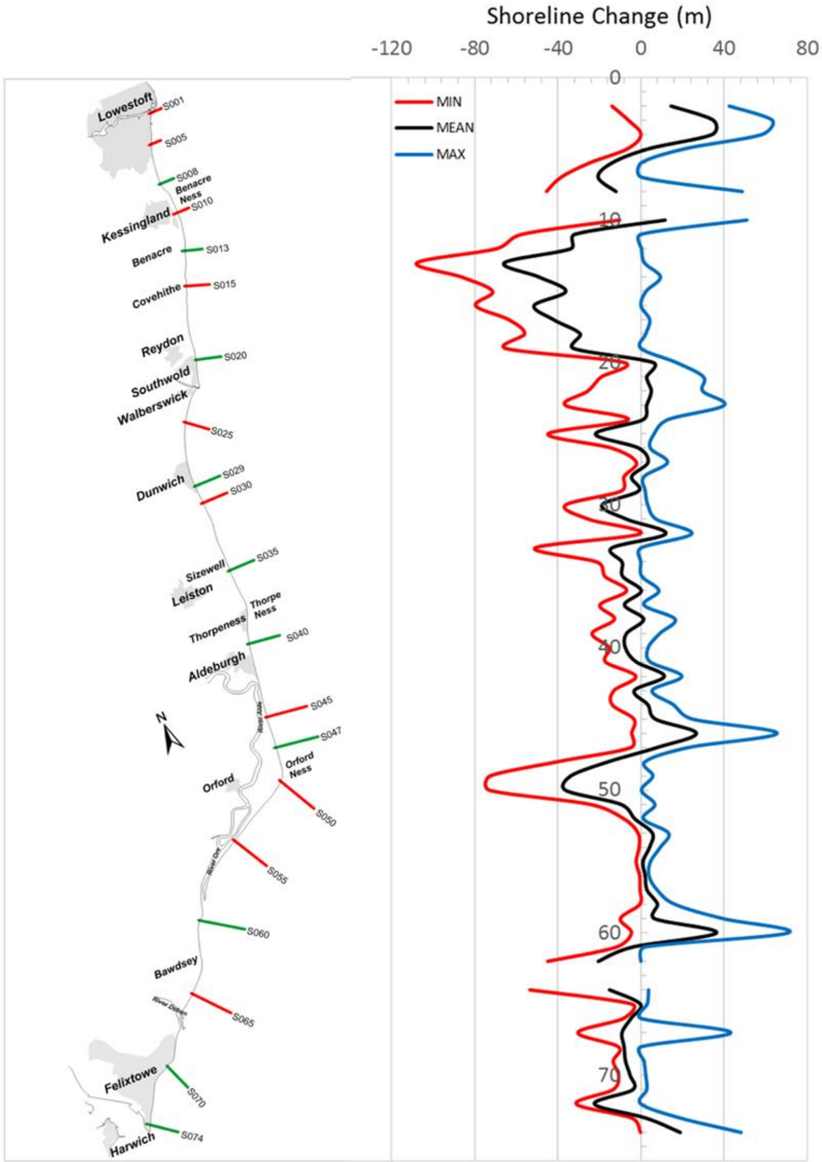


Image 4.2.4 Profile locations (left panel) and mean, maximum and minimum shoreline changes against the shoreline from August 1992 over 22 years for each profile along the Suffolk coast (right panel). From Ref 2.53.

Kent Landfall Coastal Environment

4.2.7.27 Pegwell Bay, where the cable makes landfall on the Kent coast, is a shallow inlet within the English Channel, southwest of Ramsgate, which spans across the estuary of the River Stour. The coastline from North Foreland to Ramsgate (West Cliff) is characterised by resistant Upper Cretaceous Chalk cliffs. West of Ramsgate (West Cliff) the chalk cliffs give way to a low-lying coastline made of superficial Pleistocene sand and gravel deposits that extend through Pegwell Bay, Sandwich, Deal and Kingsdown (Ref 2.9).

4.2.7.28 The shoreline of Pegwell Bay is orientated northeast – southwest and the bay is characterised by a sand beach stretching from Ramsgate in the north, to Pegwell Bay Nature Reserve in the south. The nature reserve features coastal habitats such as saltmarsh (Ref 2.72) and mudflats which make up part of the Sandwich Bay to Hacklinge Marshes SSSI.

4.2.7.29 Between Ramsgate Harbour and the north of the River Stour, the SMP recommends a 'Hold the Line' policy where there is an existing seawall and a 'No Active Intervention' policy where there are no existing defences and no risk of coastal erosion. This policy applies to the short to long term plan for the frontage (Ref 2.9).

4.2.7.30 The Pegwell Bay to Kingsdown Coastal Flood Risk Management Strategy, part of the Isle of Grain to South Foreland SMP, details that between Cliffs End and the Sandwich Bay Estate the plan is to promote, where possible, a natural functioning coastline. Predominantly this frontage is undefended except for the natural dune system which starts south of the River Stour and extends to Sandwich Bay Estate (north). A recommendation of the SMP is to monitor the dunes to ensure a suitable standard of flood protection is maintained. This 'no active intervention' policy is recommended for the short term – long term plan for the frontage (Ref 2.9).

Kent Metocean Conditions

Water levels

4.2.7.31 Table 4.2.14 presents the water levels from the UKHO Admiralty tide tables (Ref 2.23) for Ramsgate.

Table 4.2.14. Ramsgate tidal water levels (Ref 2.23)

Tide	Tidal Level (m above Chart Datum)
Highest Astronomical Tide (HAT)	5.7
Mean High Water Springs (MHWS)	5.2
Mean High Water Neaps (MHWN)	4.0
Mean Sea Level (MSL)	2.7
Mean Low Water Neaps (MLWN)	1.4
Mean Low Water Springs (MLWS)	0.6
Lowest Astronomical Tide (LAT)	-0.3

Kent nearshore currents

4.2.7.32 **Figure 4.2.4 Tidal excursion ellipse (mean tide), Kent Landfall (ABPmer, 2017)** shows that the nearshore tidal ellipse at the Kent landfall site is oriented northeast – southwest and the major axis is approximately 12.5 km in length.

4.2.7.33 Based on the UK Renewables Atlas (Ref 2.26), the peak spring flow rate nearest the Kent Landfall is between 0.58 – 0.79 m/s. The peak neap flow rate is between 0.33 and 0.52 m/s.

Waves

4.2.7.34 Wave and wind data have been extracted from the ABPmer SEASTATES database (Ref 2.38). The wave data provide a useful indication of average conditions likely to be encountered at the Kent Landfall. Image 4.2.5 shows that the dominant waves direction is from the north-east and south, southwest. This is in agreement with the Deal to Kingsdown Strategy 2010 Study (Ref 2.54) and the Sea Link Cable Burial Risk Assessment (Ref 2.71).

4.2.7.35 At Goodwin Sands, the significant wave height storm alert threshold for a 0.25-year return period is 2.54m (Ref 2.49).

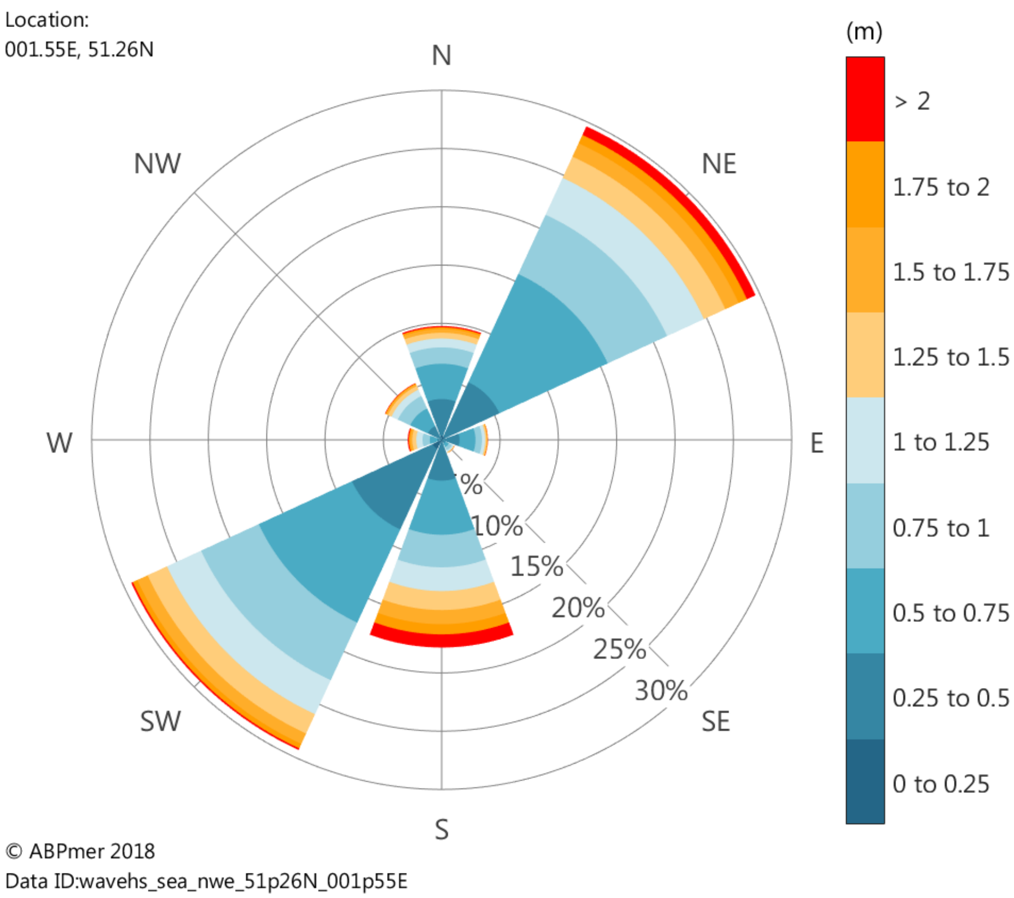


Image 4.2.5 Significant Wave Height (Ref 2.38).

Sea temperature

4.2.7.36 The Channel Coastal Observatory provides average sea temperatures for Goodwin Sands, the nearest monitoring point to Pegwell Bay. Average sea temperatures for the years 2017-2023 are provided in Table 4.2.15.

Table 4.2.15. Average sea temperature at Goodwin Sands for the years 2017-2023

Month	Sea temperature (degrees C)
January	8
February	7
March	7.5
April	9.2
May	11.8
June	14.8
July	17.2
August	18.2
September	17.6
October	15.5
November	12.8
December	9.6

Source: <Ref 2.49>

Kent Landfall and Nearshore Geology

4.2.7.37 The superficial geology at the Kent Landfall is shown in **Figure 4.2.5 Superficial geology at the Kent Landfall**. Pegwell Bay is characterised by clay, silts sand and gravel.

4.2.7.38 The MMT 2021 geophysical survey (Ref 2.69) shows that the Kent nearshore cable corridor (Block 05 Nearshore SWO KP 116.596 to KP 127.298) is characterised by gravelly sand to sandy gravel, which gradually transitions very coarse sediment which is dominant between KP 116.600 and KP 118.300. Areas of sand break up the very coarse sediment throughout the corridor.

4.2.7.39 Gravelly sand to Sandy gravel is present between KP 18.300 and 23.700, split by a 500 m stretch of very coarse sediment between KP 119.250 and KP 19.850. Stiff clay patches are present throughout the corridor at KP 123.700. This nearshore setting is also populated by megaripples which cross the corridor where the sediment is sandy and gravelly, they are predominantly oriented SW-NE. Sandwaves are also present at KP 120, oriented W-E. Bands of gravel and stiff clay are found at KP 124.110 and 124.175, followed by an extensive stretch of Gravelly sand to Sandy gravel (Ref 2.69).

4.2.7.40 The bedrock geology at the Kent Landfall comprises the Thanet Sand Formation, primarily composed of Thanet Sands along with Brickearth (silt superficial deposits). The dominant bedrock types in the Offshore Scheme boundary are shown in **Figure 4.2.6 Bedrock geology at the Kent Landfall**.

Kent Landfall Geomorphology and Sediment Transport

4.2.7.41 The region between North Foreland to South Foreland (including Pegwell Bay), is exposed to coastal processes operating within the southern North Sea and in the English Channel.

4.2.7.42 Between North Foreland and Cliffs End, net littoral transport is south, whereas, between Cliffs End and South Foreland the net littoral drift is north. This means that Pegwell Bay is a convergence site for sediment deposition in the region.

4.2.7.43 However, between North Foreland and Cliffs End, there is a lack of new sediment entering the system as the North Foreland headland acts as a barrier to sediment transport moving south (Ref 2.54; Ref 2.9). Further, there is limited erosion of the chalk cliffs between North Foreland and Ramsgate due to the toe protection measures, supplying only small amounts of flint-gravel which may only be transported westward into the bay and deposited onto shoreline during storm surge conditions (Ref 2.71), which are mainly south-easterly events (Ref 2.9).

4.2.7.44 The main sediment sources supplying Pegwell Bay are the offshore Goodwin sand banks and from the River Stour.

4.2.7.45 Extensive sand flats and mud flats are present within Pegwell Bay. Backscatter seabed surveys (carried out for the Channel Coastal Observatory, Ref 2.55) show a distinct zone of sand separating the nearshore mudflats and the mixed sediment found in the outer bay (Image 4.2.6). The mudflats of Sandwich Bay make up the Sandwich Bay to Hacklinge Marshes SSSI. This site includes the sand dune system, sandy coastal grassland and freshwater grazing marsh and scrub woodland. The sand dune system also acts as a natural coastal defence against flooding.

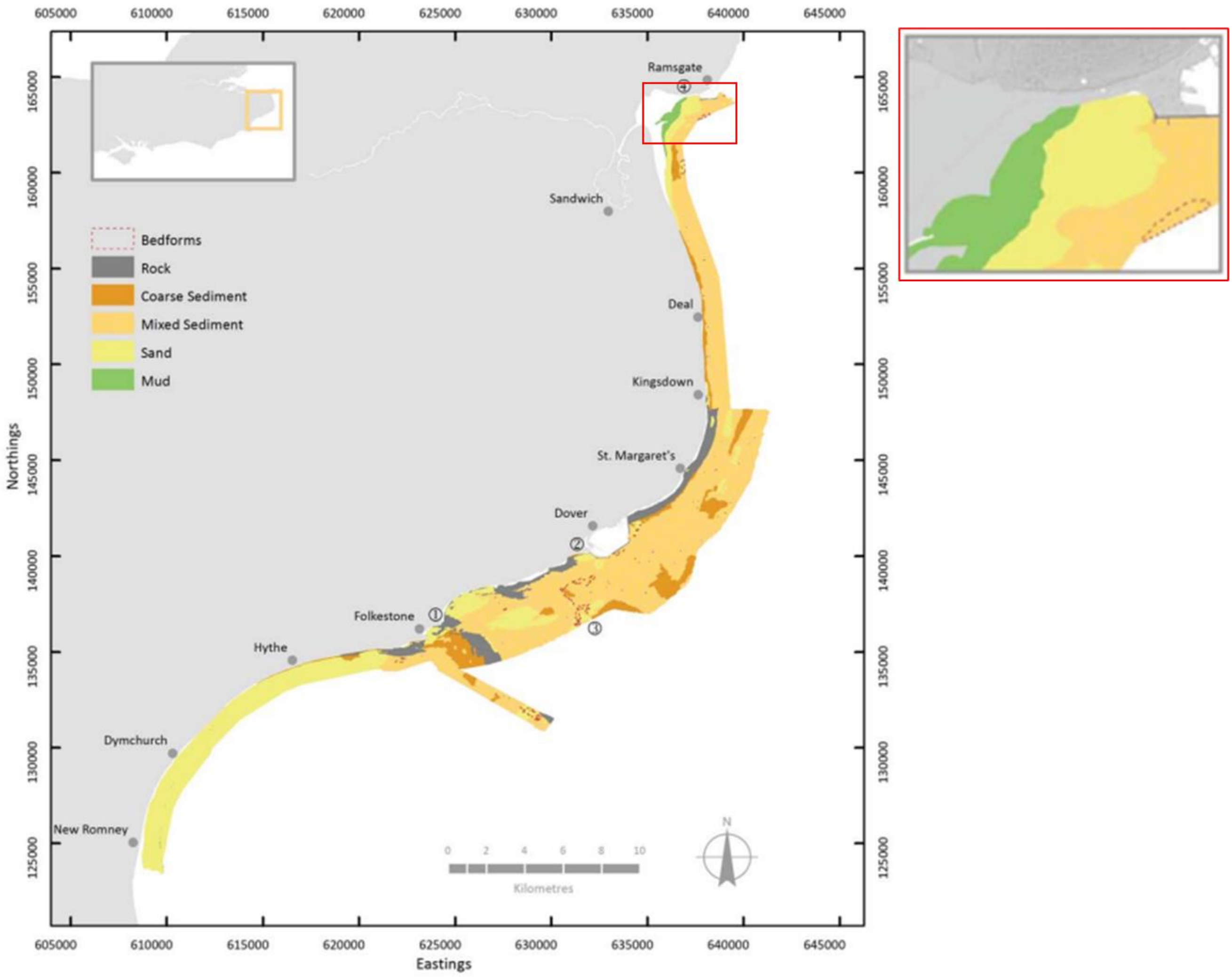


Image 4.2.6 Ramsgate to Dungeness substrate type (Adapted from: Ref 2.55)

4.2.7.46 The Southeast Regional Coastal Monitoring Programme (Ref 2.56) records beach profile change from North Foreland to Dover Harbour between 2003 – 2020. At Ramsgate Beach (in Pegwell Bay) there is a 'Hold the Line' policy in place and timber groynes are positioned at 50m intervals. The two beach profiles both show long-term erosive changes between 2003-2020, with a 12-26% beach slope reduction. Between 2019-2020 both profiles are erosive but the losses are of <5% and are considered negligible (Ref 2.56).

4.2.7.47 In Sandwich Bay the SMP policy is 'Do Minimum'. Here the beach profiles show an accretive trend of >30% between 2003-2020. Profiles nearest the mouth of the River Stour show the largest gains of 95-105% (Ref 2.56).

4.2.7.48 Goodwin Sands is a sand bank system situated 4-12km offshore of Deal, which is designated as a Marine Conservation Zone (MCZ). The Isle of Grain to South Foreland SMP Review (Ref 2.9) states that Goodwin Sands exerts a large-scale control over the development of Pegwell Bay by protecting the shoreline from direct incident wave attack (**Figure 4.2.7 EMODnet Bathymetry – mean depth. Depicting the Goodwin Sandbanks situated 4-12 km offshore of Deal**).

Suspended Sediment

4.2.7.49 The Cefas Climatology Report (Ref 2.27) provides the spatial distribution of average non-algal concentrations of Suspended Particulate Matter (SPM) between 1998 and 2015 for the majority of the UK continental shelf (Image 4.2.7). The largest plume concentrations are associated with large rivers such as the Humber Estuary, Thames Estuary, Severn Estuary and Liverpool Bay, where the mean values of SPM are above 30 mg/l. Based on the data from Cefas, the SPM concentration associated with the Offshore Scheme boundary has been estimated to be in the range 30-50 mg/l increasing to 40-50 mg/l at landfalls.

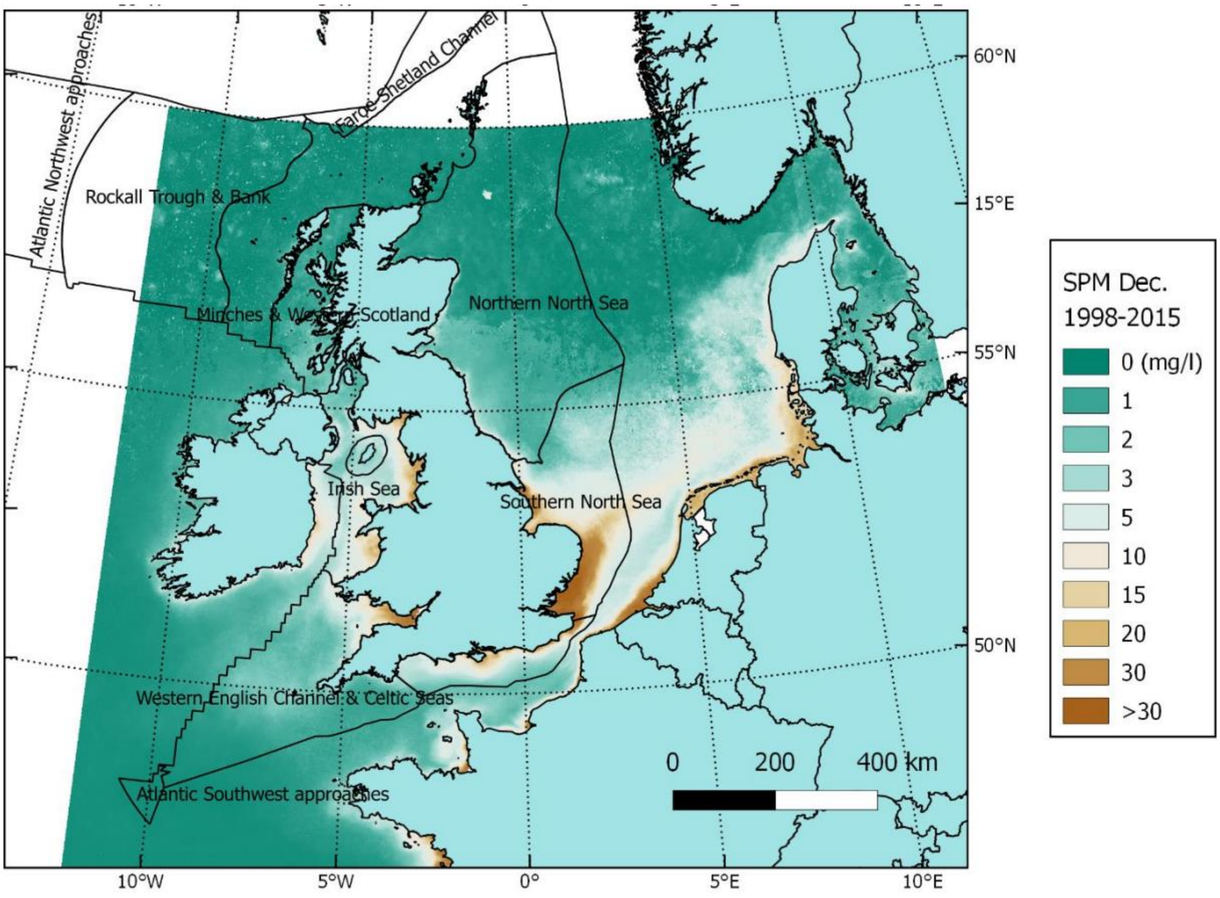


Image 4.2.7 Average Suspended Sediment around the UK (Ref 2.27)

Marine Sediment Quality

4.2.7.50 Marine sediment quality can be affected by the deposition and accumulation of substances on the seabed. The Offshore Scheme boundary is located in the Southern North Sea, adjacent to the Outer Thames Estuary. Historically the North Sea and its coastal zones have been heavily impacted by anthropogenic activities, which has resulted in significant chemical pollution (Ref 2.57) particularly relating to drilling fluids and produced waters discharged from oil and gas installations (Ref 2.58).

4.2.7.51 Additionally, the River Thames is a major input into the Southern North Sea, contributing industrial effluents and urban run-off for a large catchment (Ref 2.59).

4.2.7.52 As part of the geotechnical survey undertaken (Environmental Survey Report: Sea Link Marine Survey. September – October 2021 (Ref 2.64)), grab samples of seabed sediment were collected along the Offshore Scheme boundary for chemical analysis.

This chemical analysis included the determination of concentrations of metals, organics, Total Hydrocarbon Content (THC), and Polycyclic Aromatic Hydrocarbons (PAHs).

Heavy trace metals

4.2.7.53 Metals occur naturally in the marine environment and are widely distributed in both dissolved and sedimentary forms. Rivers, coastal discharges and the atmosphere are the principal modes of entry for metals into the marine environment, with anthropogenic inputs occurring as a result of industrial and municipal wastes. The metals most characteristic in offshore sediments include barium (Ba), chromium (Cr), lead (Pb) and zinc (Zn). Trace metal contaminants are most prone to various environmental interactions and transformations (physical, chemical and biological), potentially increasing their biological availability. Historically, within the Thames Estuary there has been increased sediment concentrations of copper (Cu), mercury (Hg), Pb, and Zn34, while in the North Sea increased concentrations of Nickel (Ni), Cu, Zn, Cadmium (Cd), and Hg have been common (Ref 2.58).

4.2.7.54 Sediment chemistry values were compared against a number of different criteria including Cefas Action Levels (Ref 2.60) and Canadian Council of Ministers of the Environment (CCME), Interim Sediment Quality Guidelines (ISQG), Canadian Council of Ministers of the Environment (CCME 2022, including probable effect levels (PEL)). These are not ‘pass/fail’ criteria but are indicative of the need for further assessment.

4.2.7.55 Chemical analysis of sediment quality showed that metal concentrations varied along the survey route. Arsenic (As) was often found in concentrations above threshold values. There were a small number of sample sites where, Cr, Cu, Pb, and Ni were above threshold values, as assessed using both Cefas and CCME guidelines (Ref 2.64).

Organics

4.2.7.56 Total Organic Carbon (TOC) is often used as a non-specific indicator of water quality. Furthermore, organic material in disturbed sediments can act as an energy source for marine microorganisms, reducing the dissolved oxygen availability in the water.

4.2.7.57 A benthic survey was undertaken by MMT specifically for the Project and the corresponding benthic report (Ref 2.64) explains that TOC and organic matter varied along the survey route, with an average content of 0.3% and 1.1%.

Total hydrocarbon content and polycyclic aromatic hydrocarbons

4.2.7.58 THC values are used to describe the quantity of hydrocarbon impurities present and are generally associated with compounds derived from crude oil, such as petrochemicals. PAHs are contaminants with moderate to low water solubility, generated from coal and oil combustion. They are also released during transportation or industrial use of petroleum; wastewater effluent discharge and sewer overflows; urban runoff; and natural seeps. Concentrations of THCs and PAHs are understood to be lower but still notable in the Southern North Sea, when compared the northern areas of the North Sea (Ref 2.60).

4.2.7.59 The MMT benthic report (Ref 2.64) explains that PAH concentrations varied along the survey route. Threshold values were found to be exceeded at several sites. No correlations were observed between PAHs and TOC, organic matter or sediment composition. The PAH levels were higher at the northern sites of the survey corridor compared to the central and southern sites.

Water Quality

4.2.7.60 This section provides a review of water quality with reference to the Water Framework Directive and the current status of the bathing waters near the two landfall sites. Additional detail on water quality is provided in Water Environment **Volume 1, Chapters 2.5 and 3.5** for the Suffolk and Kent landfalls, respectively.

Water Framework Directive

4.2.7.61 A programme of monitoring and water classification is undertaken by the Environment Agency, as part of the Water Framework Directive (WFD) requirements. The most recent classification data are available from the Environment Agency Catchment Data Explorer (Ref 2.62).

4.2.7.62 The Suffolk Water Body (Water Body ID: GB650503520002) within which the Suffolk Landfall is located is classified as Moderate Overall Status, with Moderate Ecological Status and Fail Chemical Status. The water body is failing to achieve good status because of high concentrations of dissolved mercury containing compounds, and Polybrominated diphenyl ethers (PBDE).

4.2.7.63 The Kent Landfall is located within the Stour (Kent) Water Body (Water Body ID: GB520704004700). This water body is classified as Moderate Overall Status, with Moderate Ecological Status and Fail Chemical Status. The water body is failing to achieve good status because of high concentrations of dissolved mercury and PBDE.

4.2.7.64 A WFD Screening Assessment will be undertaken and reported in the ES, and relevant stakeholders will be consulted on the findings.

Bathing water

4.2.7.65 Water quality at designated bathing water sites in England is assessed by the Environment Agency (Ref 2.63). The bathing water near the Kent Landfall is classified as ‘Good’. There is no designated bathing water at the Suffolk Landfall.

Offshore Physical Environment

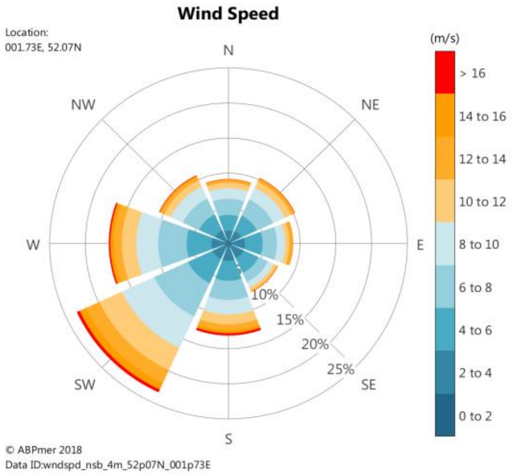
Offshore wave climate

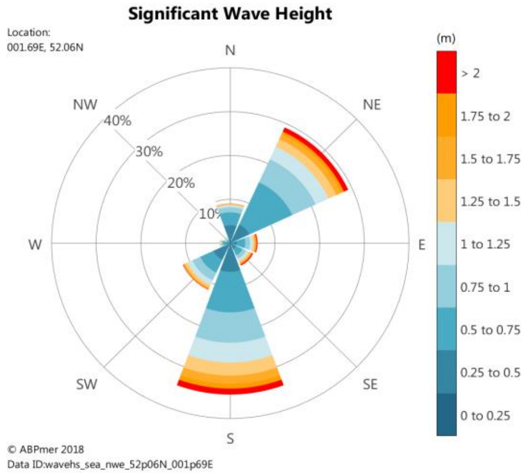
4.2.7.66 Table 4.2.16 displays rose diagrams of the wind speed and significant wave heights along the Offshore Scheme boundary (Ref 2.38), this is in agreement with the Sea Link Cable Burial Risk Assessment. The Kilometre Point (KP) values are based on the those used in the MMT benthic report (Ref 2.64) and MMT Geophysical Report (Ref 2.69).

4.2.7.67 Analysis of the wave climate carried out by Vattenfall Wind Power Ltd (Ref 2.44) shows that the dominant wave direction offshore of the Kent coast is from the north-east and that this is due to large fetch lengths from the north-east direction across the North Sea.

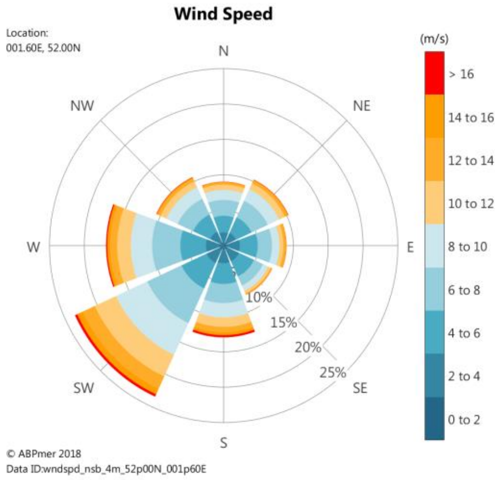
Table 4.2.16. Wind speed and Significant Wave Height along the Offshore Scheme (Ref 2.38). The KP numbers reference those used in the MMT benthic report (Ref 2.64).

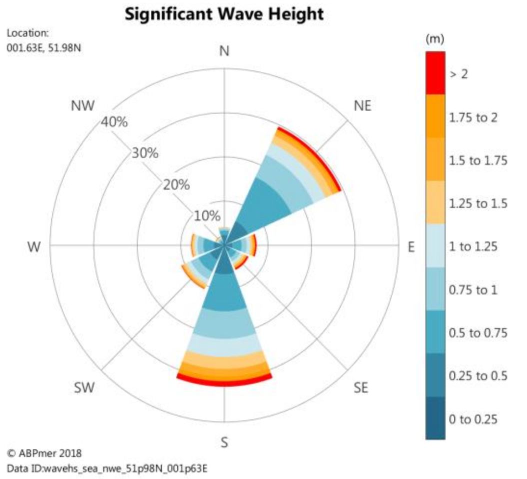
KP20 (Offshore Suffolk)



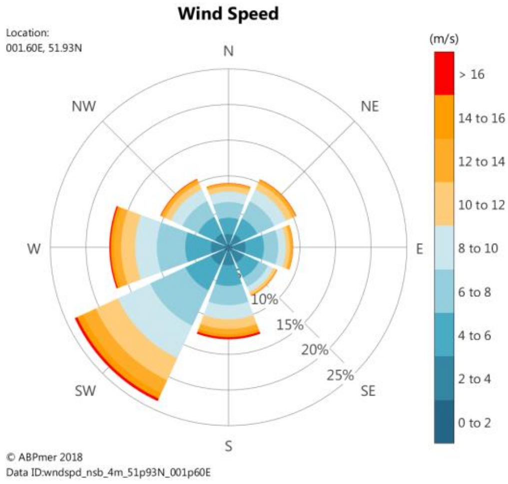


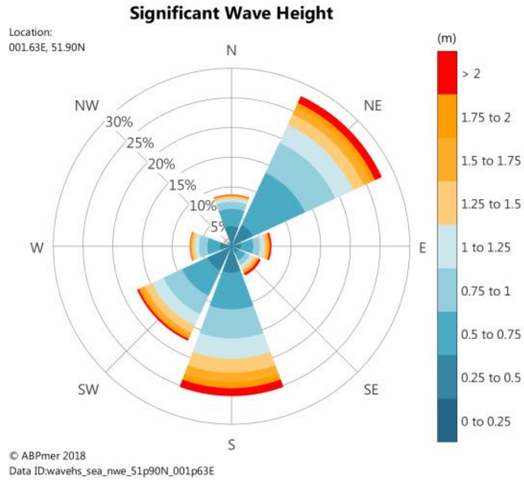
KP30



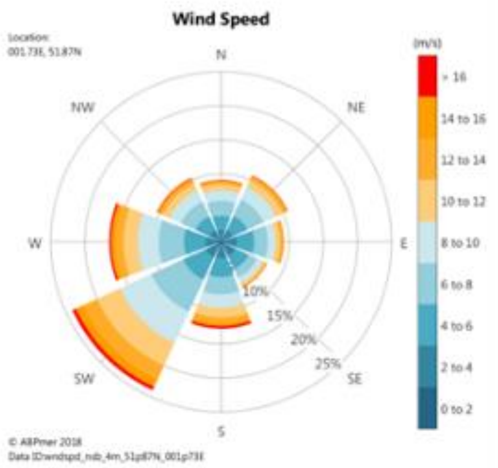


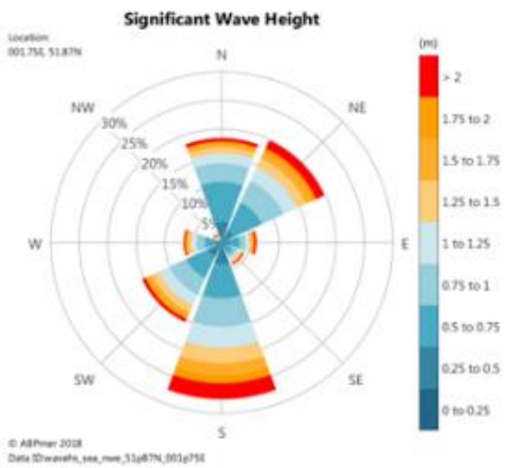
KP40



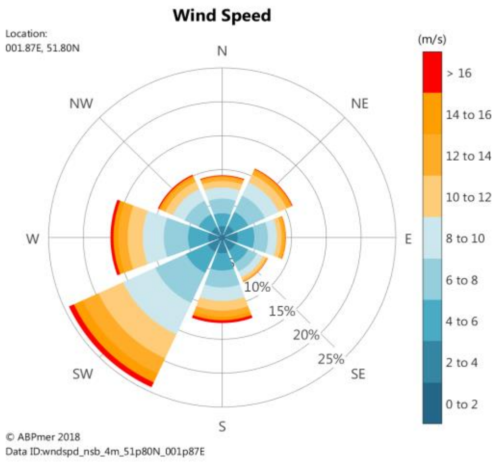


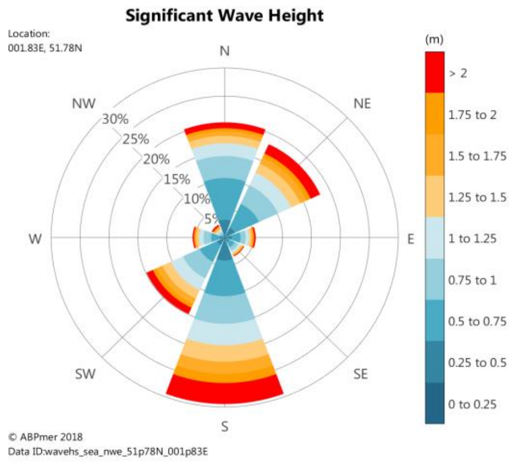
KP50



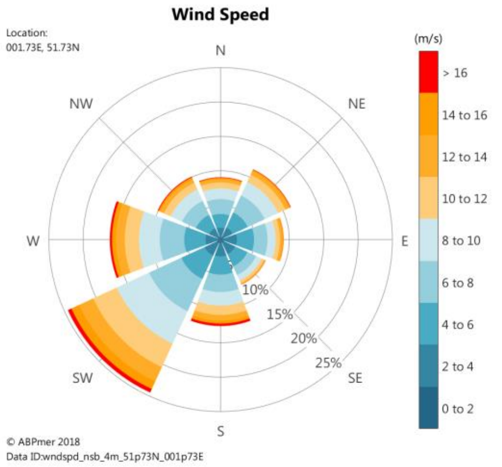


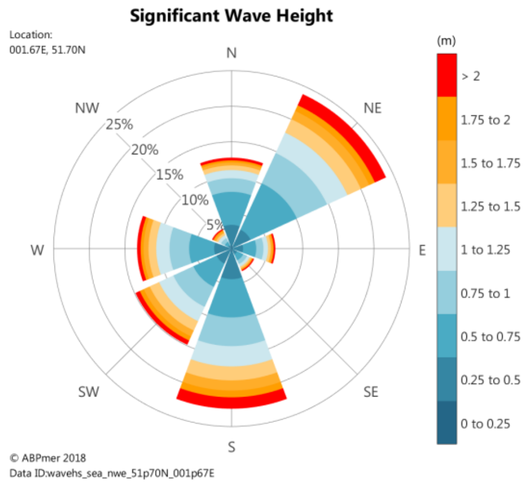
KP60



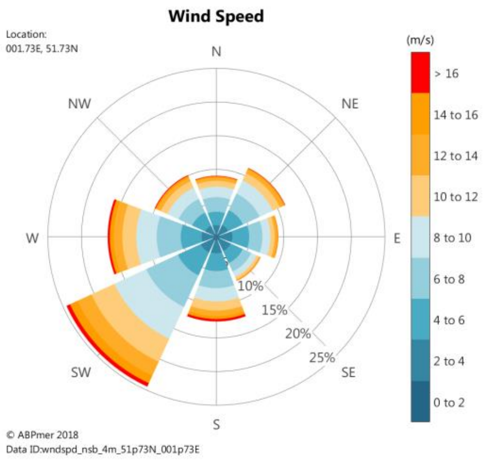


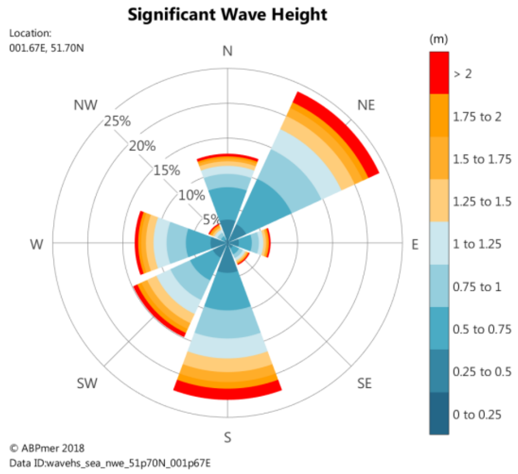
KP70



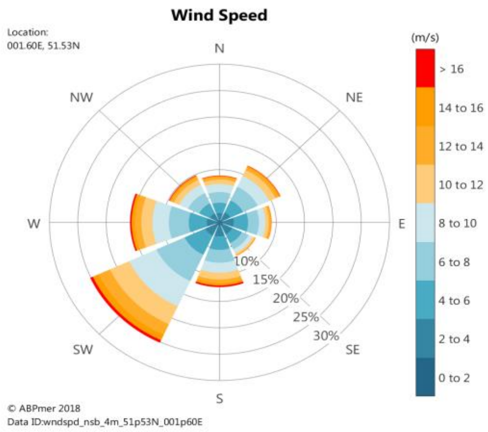


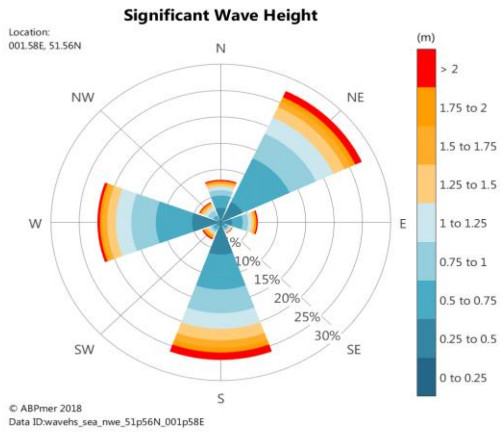
KP80



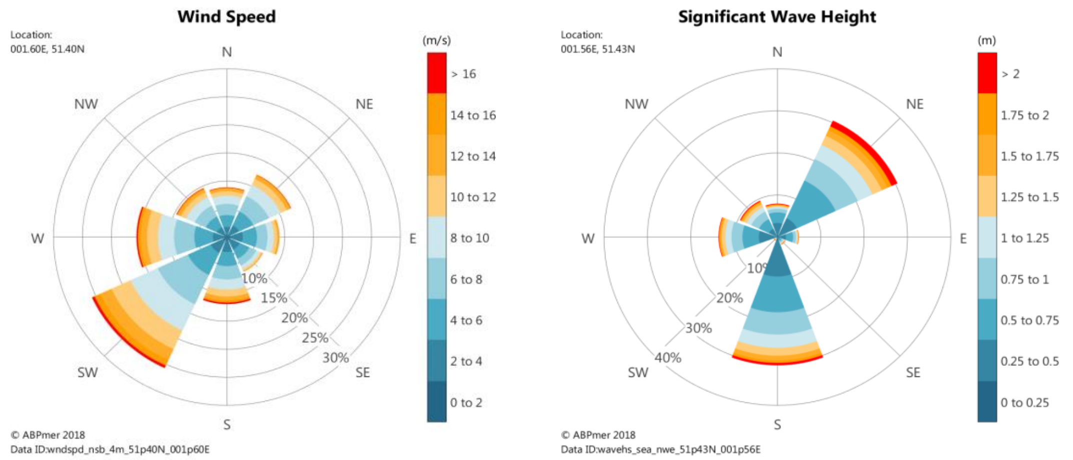


KP90

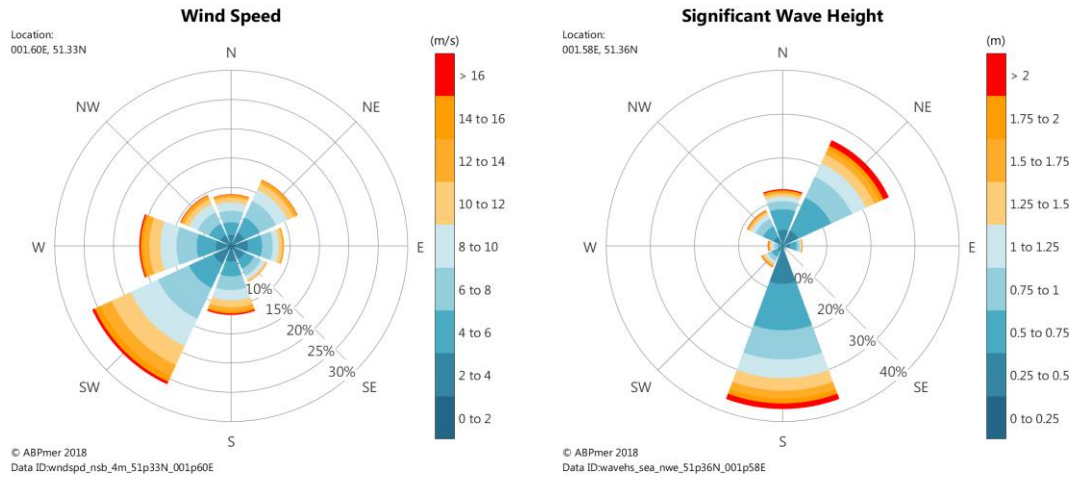




KP100



KP110 (Offshore Kent)



Offshore tide current patterns

4.2.7.68 HR Wallingford (2010) present typical predicted spring tide current patterns at peak flood and ebb within the Greater Thames Estuary (Ref 2.65). The maximum flow rate in the region is 1 m/s, with faster current speeds experienced during the peak flood.

Offshore seabed sediments and bathymetry

4.2.7.69 Seabed sediments across the Study Area are presented in **Figure 4.2.8 Seabed sediments across the study area**. which shows the seabed sediments along the cable corridor route and the wider study area. Between 5-10 km offshore of the Suffolk Landfall the seabed sediment is characterised by muddy sand and sand. Further south from KP15-K75 the cable passes through a region where the seabed sediment is mainly gravel. From KP75-KP90, the seabed is characterized by gravelly sand. Between KP90 and the Kent landfall site, the seabed sediment becomes more varied: the cable route passes through slightly gravelly muddy sand, muddy sand, sand, gravelly sand and sandy gravel.

4.2.7.70 The MMT 2021 geophysical survey (Ref 2.69) describes the offshore surficial seabed sediments in greater detail associated with different Blocks of the offshore cable corridor route (Image 4.2.8).

Block 02

4.2.7.71 Between KP 14.000 to KP 36.800 (Block 02) the seafloor remains relatively flat, starting at depth of 18.39 m and ending at a depth of 21.71 m. A minimum depth of 16.23 m and maximum depth of 24.66 m were measured within the block. Ripples and megaripples are present between KP 28.550 to KP 30.800 (Ref 2.69).

4.2.7.72 The northern section of Block 02 is mainly gravelly sand to sandy gravel, with a stretch of sand with megaripples and patches of very stiff clay. In the southern section of Block 02, gravelly sand to sandy gravel characterises the seafloor with continued patches of very stiff clay. At KP 28.526 there is a sharp transition to mottled clay then to a long stretch of sand containing megaripples (Ref 2.69).

Block 03

4.2.7.73 Block 03 (SWO KP 36.800 TO KP 68.000) starts at a depth of 21.67 m and remains relatively flat for the first 4 km (Ref 2.69). From KP 42.000 to KP 52.650 the depth increases to the deepest point along the cable corridor route (46.41 m). The seabed then rises to finish a depth of 19.96 m at KP 68.000. Throughout Block 03, there are areas of megaripples and ripples of varying sizes of different types of sediments – silt, sand and gravel, sandy gravel and gravelly sand (Ref 2.69). From KP 63.000 the seabed is characterised by large wave forms. Across Block 3, numerous linear scars and trawler marks were also recorded (Ref 2.69).

4.2.7.74 The northern section of Block 3 is characterised by sand which transitions to gravelly sand/Sandy Gravel which remains the most common sediment type throughout Block 3 (Ref 2.69). Very stiff clay intersected by an area of gravelly sand is the dominant sediment type between KP 48.282 and KP 53.334. A large area of sand stretches across the corridor between KP 54.617 and KP 57.346 (Ref 2.69).

Block 04

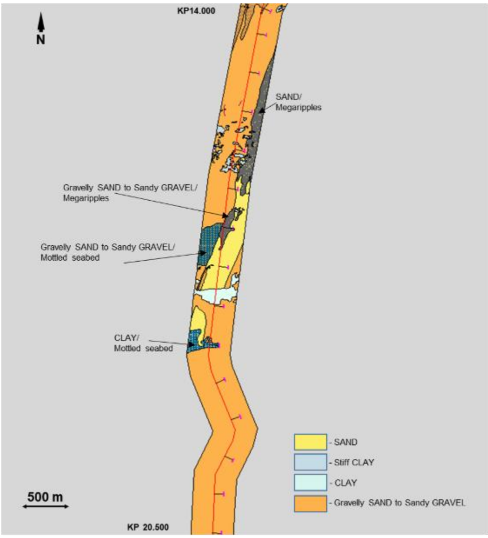
4.2.7.75 Block 4 (SWO KP 68.000 TO KP 110.399) starts at depth of 19.96 m and remains relatively flat throughout the block, gradually rising to 10.69 m at the end of the Block (Ref 2.69). A minimum depth of 10.52 m and maximum of 26.54 m was recorded. There are three intact wrecks and two wreck sites within Block 04, all within the survey corridor and all associated with scour (Ref 2.69).

4.2.7.76 Gravelly sand to Sandy gravel is the dominant sediment type to KP 86.760. Between KP 82.550 to KP 83.550 there are several elongated patches of sand. Between KP 85.000 and KP 86.800 the sediments vary between gravelly sand to sandy gravel, sand and clay (Ref 2.69). Sand then becomes the dominant sediment type for 15 km which transitions to gravelly sand to sandy gravel until the end of the Block. At KP 106.290 chalk outcrops at the edge of the corridor (Ref 2.69).

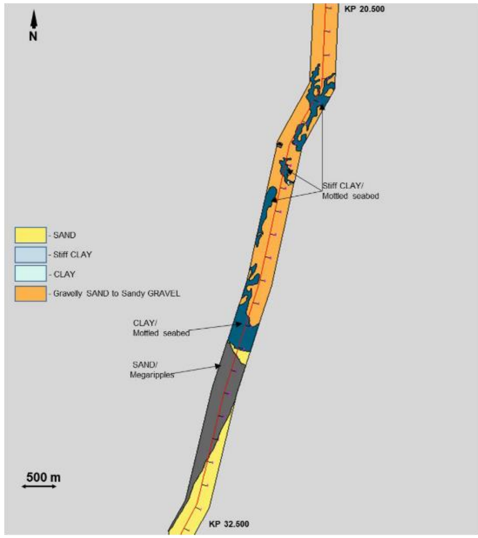
Block 05

4.2.7.77 Block 05 (SWO KP 110.399 TO KP 116.596) starts at a depth of 10.69 m and remains relatively flat. A minimum depth of 8.83 m and maximum depth of 13.43 m was recorded within Block 05 (Ref 2.69). The deepest section of Block 05 at KP 113.135 is found to be the site of large sandwaves.

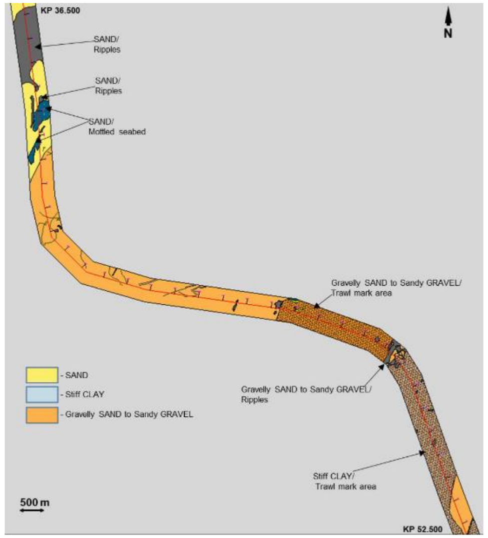
4.2.7.78 Sand is the dominant sediment up to KP 113.00 which transitions to gravelly sand to sandy gravel for the final 1 km of the Block. Ripples are present in patches through this section, their orientation gradually changes from North-South to West-East with increasing KP along the corridor (Ref 2.69).



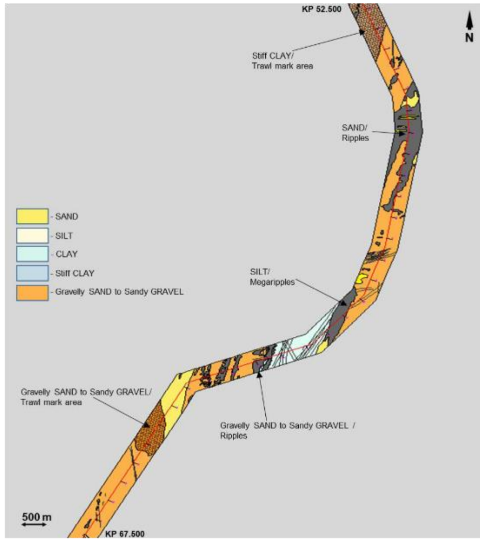
SWO KP 14.000 to KP 20.500



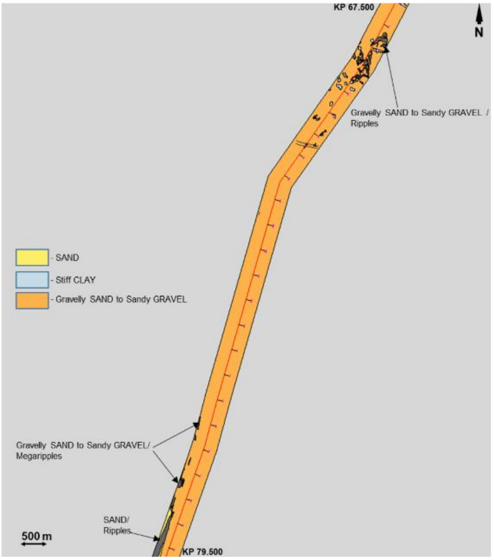
SWO KP 20.500 to KP 32.500



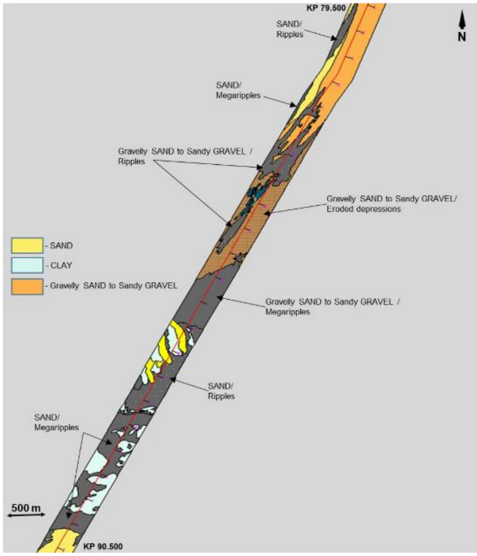
SWO KP 36.800 to KP 52.500



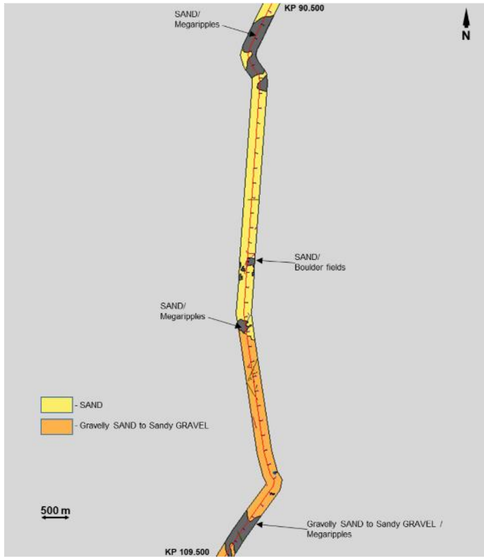
SWO KP 53.000 to KP 66.500



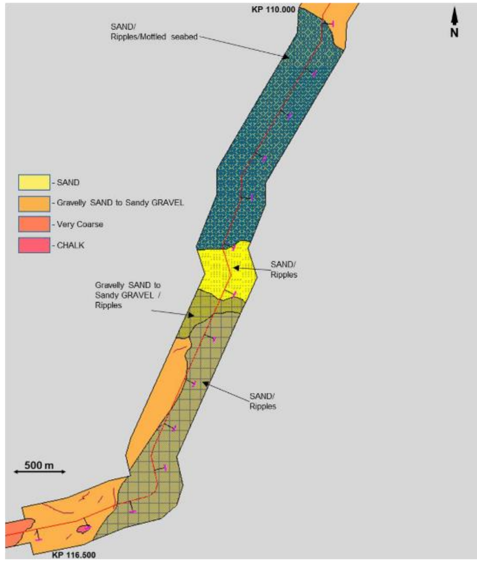
SWO KP 67.000 to KP 79.500



SWO KP 78.500 to KP 90.500



SWO KP 90.500 to KP 109.500



SWO KP 109.000 to KP 116.500

Image 4.2.8 Offshore seabed surficial geology interpretation for SWO KP 14.000 – KP 116.500 (Ref 2.69).

Offshore morphological features

4.2.7.79 The seabed of the Greater Thames Estuary/The Greater Thames Region covers an area of over 5000 km^2 occupying the Southwest corner of the North Sea. The region encompasses Aldeburgh (Suffolk), Southend-on-Sea (Essex) and Margate (Kent) (Image 4.2.9). It is characterized by large subtidal sandbanks and channels extending up to 80km in length and 7.5 km wide, aligned with the tidal streams (Ref 2.37).

4.2.7.80 The cable corridor passes near to the Greater Thames Estuary sandbanks and through the Aldeburgh Ridge (**Figure 4.2.9 Cable corridor route relative to the Greater Thames Estuary sandbanks** and Image 4.2.9).

4.2.7.81 Locally, there is great complexity in the multiple channels and banks within the greater Thames Estuary, which is due to lateral migration of the sandbanks and associated vertical change along the bank and channel boundaries (Ref 2.34). The local dynamic nature of the sand banks accounts for changes in depth in the order of 10 m (Ref 2.34). However, analysis of historical charts shows that the gross organisation of the morphology of the Thames seabed has remained very stable for over 180 years (Ref 2.64).

4.2.7.82 The Ridges associated with the Suffolk shoreline, including Cutler, Bawdsey Bank, Shipwash, and the Aldridge Ridge, through which the cable corridor passes, are much smaller features that exhibit smaller scale changes, such as subtle changes in their orientation relative to the shoreline (Ref 2.34).

4.2.7.83 Burningham, & French (2009) (Ref 2.44) show that sediment transport pathways across the Greater Thames Estuary are predominantly from northeast to southwest and become more southerly beyond the Isle of Thanet headland.

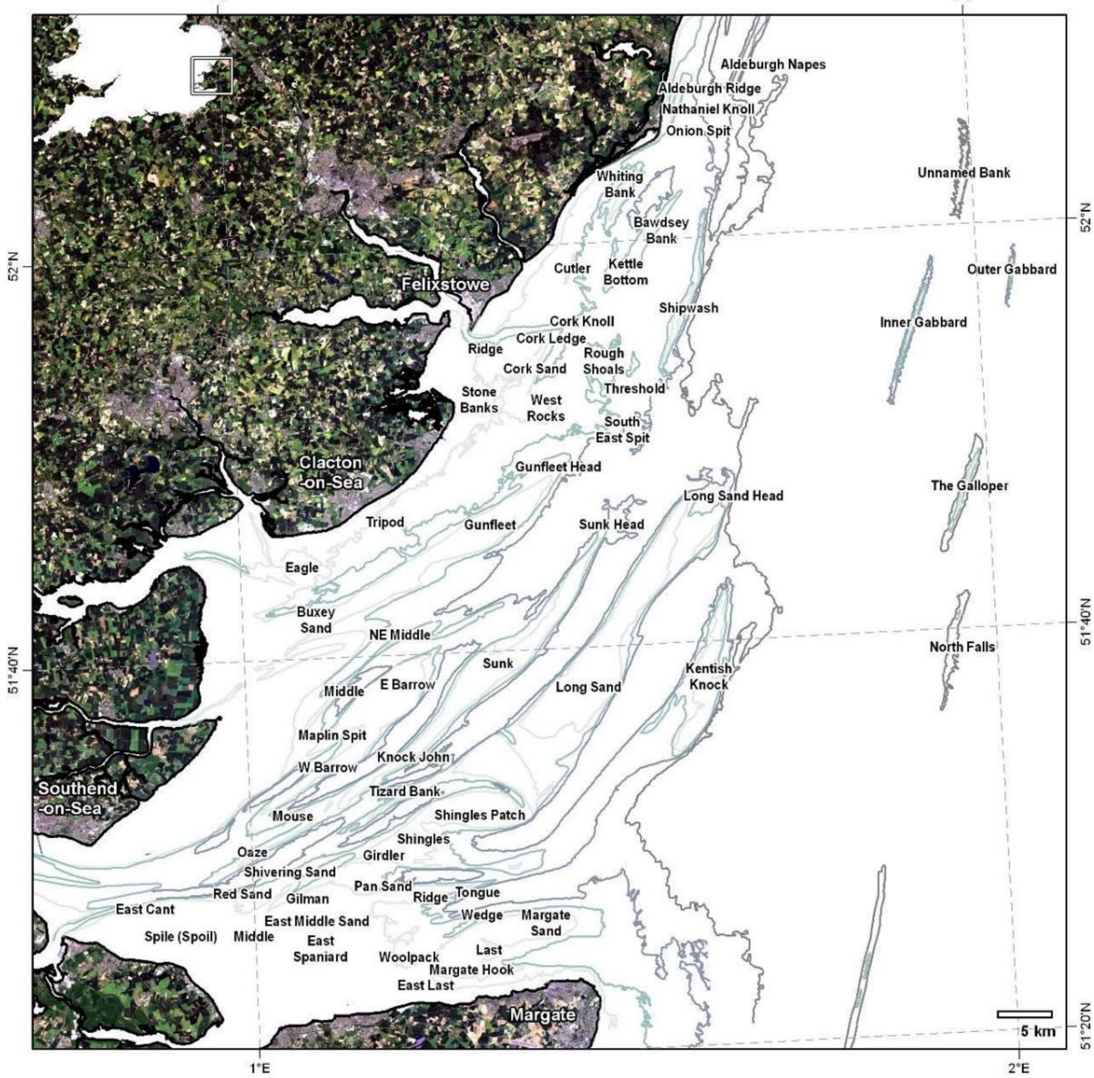


Image 4.2.9 The Greater Thames Estuary study area, showing the main bank features (Ref 2.34).

Future Baseline

4.2.7.84 For the assessment of the impact of climate change on the physical environment in the future, the UK guidance and projection of sea level rise and changing storm conditions are applied to the baseline.

4.2.7.85 Guidance on changes in future wind and wave conditions has been provided by the Environment Agency (Ref 2.66). The guidance states that wind speeds and wave height should be increased by 5% between 1990 and 2055, then by 10% for 2056 to 2115. UKCP18 (Ref 2.45), provides the most up-to-date assessment of climate change for the period up to 2100 and then beyond 2100. Sea level rise data have been sourced from the Met Office UKCP18 website. By 2050, sea level rise may rise by 0.25m above 2022 levels at the Kent and Suffolk landfall sites. This is estimated for a high emissions scenario (RCP 8.5) in the 95th percentile.

4.2.7.86 East Suffolk Council recognises that this dynamic coast has the ever-present threat of coastal erosion and coastal flooding. In response to future coastal change, East Suffolk Council deem it necessary to actively manage the coastal zone to ensure its resilience by incorporating the holistic principles of Integrated Coastal Zone Management into coastal policies (Ref 2.67). For the future baseline this may mean that in some situations it is not possible to continue to justify a 'hold the line' policy and a more adaptive management approach may be required. Climate change effects have an inherent level of uncertainty and policies may therefore change in response to future trends.

4.2.8 Mitigation

4.2.8.1 As set out in **Volume 1, Part 1, Chapter 5, PEIR Approach and Methodology**, mitigation measures typically fall into one of the three categories: embedded measures; control and management measures; and mitigation measures.

Embedded Measures

4.2.8.2 Embedded measures have been integral in reducing the potential for physical environmental effects of the Proposed Project. Measures that that have been incorporated are:

- Sensitive routeing and siting of infrastructure and temporary works;
- Commitments made within **Appendix 1.4.F Outline Schedule of Environmental Commitments**.

Control and Management Measures

4.2.8.3 The following measures have been included within **Volume 2, Appendix 1.4.A Outline Code of Construction Practice** relevant to the control and management of impacts that could affect marine physical environment receptors:

- GM01 – designated (and as minimal as possible) anchoring areas and protocols shall be employed during marine operations to minimise physical disturbance of the seabed;
- GM03 – an offshore Construction Environmental Management Plan (CEMP) including an Emergency Spill Response Plan and Waste Management Plan, Marine Pollution Contingency Plan (MPCP), Shipboard Oil Pollution Emergency Plan (SOPEP) and a dropped objects procedure, will be produced prior to installation;
- LVS01 – all project vessels shall adhere to the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention) (IMO, 2017);
- LVS02 – all project vessels must comply with the International Regulations for Preventing Collisions at Sea (1972) (IMO, 2019a), regulations relating to International Convention for the Prevention of Pollution from Ships (the MARPOL Convention 73/78) (IMO, 2019e) with the aim of preventing and minimising pollution from ships and the international Convention for the Safety of Life at Sea (SOLAS, 1974);
- LVS05 – drilling fluids required for trenchless operations will be carefully managed to minimise the risk of breakouts into the marine environment. Specific avoidance measures will include:

- the use of biodegradable drilling fluids (Pose Little or No Risk to the Environment (PLONOR)) where practicable,
- drilling fluids will be tested for contamination to determine possible reuse or disposal; and
- if disposal is required drilling fluids would be transported by a licensed courier to a licensed waste disposal site.

- MPE01 – during the course of cable route clearance, specific activities will be completed to remove items from the seabed. Out of Service cables will be removed as per industry guidelines, larger debris including lost fishing gear will be removed prior to cable installation and a pre-lay grapnel run will be completed to ensure smaller debris is removed. In the event that abandoned, lost or discarded fishing gear (ALDFG) is encountered, it may be necessary in certain circumstances to bring the ALDFG onto the vessel deck. In these instances, marked ALDFG will be returned to the local Marine Management (MMO)/ Inshore Fisheries and Conservation Authority (IFCA) office for onward retrieval by the owner of the marked gear, in line with existing best practice. Not all gear (particularly 'active' gear) is marked; if necessary to bring onto the vessel deck, unmarked gear will be disposed of via conventional onshore waste channels. Recovered objects identified as 'wreck' must be reported to the Receiver of Wreck within 28 days under the obligations of the Merchant Shipping Act 1995 and must be stored and maintained at the finder's expense until a decision is made on ownership. It is recommended that advice is sought from the marine archaeological consultant with regards survey campaigns and data assessments, to ensure, where possible, 'wreck' of possible or known archaeological interest can be avoided and left in situ;
- MPE02 – the minimum depth of lowing (DOL) to the top of the cable is 0.5 m (in areas of bedrock), with a target DOL for the Proposed Project approximately 1.5 m to 2.5 m, to be achieved where possible dependant on the seabed geology.
- MPE03 – cable protection features (e.g. rock placement, mattresses and grout bags) will be installed only where considered necessary for the safe operation of the Project. This includes the repair of cables due to accidental damage.

Mitigation Measures

4.2.8.4 Mitigation measures are additional topic and site-specific measures that have been applied to mitigate or offset any likely significant effects. Mitigation measures included that are relevant to physical environment receptors are:

- Where rock placement is required to protect an exposed or shallow buried cable, the height and width of these berms will be kept to a practical and safe minimum, typically a height of up to 1 m, with a width of up to 7 m for post-lay berms, and a height of 0.5 m, with a width of 4 m for pre-lay berms. Heights may increase to 1.5 m and widths to 10 m if both pre-and post-lay rock berms are used at any one location.
- Depth of Burial Monitoring surveys: Ideally the first monitoring survey should take place annually after the as-built survey until a trend is established (or no major changes observed) after which this interval may be relaxed to 2-5 years. It might be the case that only certain areas require more frequent assessment, but this

can only be determined after several surveys have been undertaken to establish any trends.

- At the Kent Landfall, the preferred installation method is a trenchless technique that will drill beneath the ground surface to avoid the need to trench the cables through the saltmarsh.
- The Suffolk Landfall is also expected to be installed by trenchless techniques.

4.2.9 Preliminary Assessment of Effects

4.2.9.1 The preliminary assessment of the effects of the Offshore Scheme described in this section considers the embedded, control and management, and mitigation measures described in section 4.2.8.

4.2.9.2 For the sensitivity test outlined in section 4.2.5, preliminary effects reported would not be any different if the works were to commence in any year up to year five.

4.2.9.3 The preliminary assessment of the effects of the Offshore Scheme on the physical environment is presented in Table 4.2.17.

4.2.9.4 The preliminary effects reported below are the same for the Proposed Project on its own, and the Proposed Project with co-location.

Table 4.2.17: Preliminary assessment of the physical environment effects.

	Preliminary assessment
Receptor	**Water column**
Potential Impact	Several activities during the construction phase will disturb the seabed and result in increased suspended sediment concentration (SSC) levels and water column turbidity above ambient levels. This includes the pre-lay grapnel run carried out prior to cable installation. At both landfall sites, trenchless techniques will be used to minimise the impact of sediment disturbance in the intertidal zone during cable installation. The excavation of the exit pits associated with trenchless installation techniques are estimated to disturb an area of up to approximately 7500 m^2 of the seabed for a Sea Link only design (**Volume 1, Chapter 4, Description of the Proposed Project)**. Footprints for coordination are to be refined for the ES. Offshore sand wave lowering, and trenching activities will result in temporary disturbance to the seabed and increased SSC. The estimated footprints of the methods considered for pre-installation and installation activities are presented in **Volume 1, Part 1, Chapter 4, Description of the Proposed Project.** Installation by jetting or mass flow excavation have the greatest potential to fluidise and eject material from the trench into suspension in the greatest quantities. SSC

	Preliminary assessment
	levels will be highest (potentially tens to hundreds of thousands of mg/l) at the point of sediment release during trenching activities at the seabed. Where the cable cannot be buried, cable protection measures such as rock berms may be used. These structures may act as an obstacle to the flow and can experience local scouring via the interaction of currents and waves with an obstacle on the mobile seabed. As a result, some sediment will be eroded from the seabed and suspended into the water column. Where cables are decommissioned by removal, they may need to be pulled or excavated from the seabed and pulled back through the trenchless solution conduit. The impact of the excavation process will be no greater than that for the construction phase.
Proposed Project phase	Construction, Operation & Decommissioning
Duration	Coarser sediment such as sand and gravel will be suspended temporarily – in the order of seconds to tens of seconds for sand or gravel before the material resettles onto the seabed. Fine sediments such as silts, fine sands and clays may be suspended for extended periods depending on current speeds and metocean conditions.
Mitigation	Embedded mitigation MPE02 Trenchless landfall construction
Preliminary sensitivity	In the nearshore setting, the use of trenchless techniques will greatly reduce the amount of sediment disturbed and suspended. However, some trenching would still likely be required. The sensitivity of the receiving shallow and deep-water environments to increased level of SSC is very low since water turbidity will return to baseline conditions quickly as coarser sediment settles out of suspension and finer sediments that remain in suspension are diluted by currents and wave action. Wood Environment & Infrastructure Solutions UK Limited (Ref 2.68) estimate that, medium to coarse sand and gravels are likely to result in a temporally and spatially limited plume affecting SSC levels and will settle out of suspension in close proximity to the trench. While SSC will locally increase the change will only occur for a very short time locally, in the order of seconds to tens of seconds for sand or gravel before the material resettles to the seabed.

	Preliminary assessment
	Wood Environment & Infrastructure Solutions UK Limited (Ref 2.68) further explain that depending on the height that the material is ejected from the seabed and the current speed at the time, measurable changes in SSC are likely to be spatially limited to within 20 m from the cable for gravel, and up to a few hundred metres for sand. The majority of the excavated material is expected to be coarse sediments, including sands and gravel which will settle back to the seabed relatively quickly and close to the point of disturbance. Finer sediment (silts, clays and drilling fluids) will be transported further by the prevailing tidal current and rapidly dispersed both upwards through the water column and laterally to near baseline levels (tens of mg/l) within hundreds to a few thousand metres of the point of sediment release. The drilling fluid has an overall density and viscosity similar to seawater and is therefore expected to efficiently mix and disperse the material in a similar manner (Ref 2.68) HR Wallingford (Ref 2.65) carried out field investigations into the dispersion of fine sediment plumes and sand dispersion caused by the release of sediment during dredging activities in the Greater Thames Estuary. This study can therefore provide an indication of the potential extent of the sediment dispersion footprint that may occur in association with cable installation activities and pre-sweeping. Plume concentrations reduced to 20 mg/l above background levels at approximately 300 m from the dredger. Background concentrations were achieved (to within a few mg/l) at a distance of 1500 m from the dredger. Information published as part of the Five Estuaries Offshore Windfarm array Stage 2 Consultation (Ref 2.32) described the possible extent of impact associated with local increases in SSC due to sediment disturbed during the installation of a single foundation of the Five Estuaries offshore windfarm situated within the Greater Thames Estuary. The extent of deposition of suspended sediment is based on the tidal excursion ellipse of 500m – this is established as a zone in which increased levels of SSC may be measured. Beyond this zone, there is no expected impact or measurable change to SSC levels.
Preliminary magnitude	The magnitude of the impact on the physical environment is considered to be small, as any measurable change in SSC will be temporary and localised, i.e., near the seabed. The finer fractions (including silts, clays and drilling fluid particulate matter) that are transported further will be quickly diluted to

	Preliminary assessment
	background levels in both the nearshore and offshore environments.
Preliminary likely significance of effect	Likely to be **Not Significant.**
Confidence in prediction	High confidence
Receptor	**Water quality**
Potential impact	Offshore and nearshore alteration of water quality through disturbance of potentially contaminated sediment. Sediment contamination is typically associated with finer materials (silt-clay sized particles) within disturbed sediments, adsorbed to the surface of organic matter, silt and clay particles. Dispersion of these fine materials and associated contaminants may occur during trenching and cable installation activities. Where cables are decommissioned by removal, they may need to be pulled or excavated from the seabed and pulled back through the landfall conduit. The impact of the excavation process will be no greater than that for the construction phase.
Proposed Project phase	Construction & Decommissioning.
Duration	Short-term
Mitigation	Embedded mitigation
Preliminary sensitivity	The concentrations of hydrocarbon and heavy metal encountered along the Offshore Scheme are not considered significant in the context of contaminants already present within the receiving environment (as outlined in section 4.2.6), therefore, the sensitivity of the receiving water environment is considered Low.
Preliminary magnitude	In the context of the receiving nearshore and offshore water environments, contaminants will be diluted by the tidal regime, currents, and waves hence the magnitude, as a combination of both concentration and area affected, will be low. Further, the construction and decommissioning activities are temporary and so will any associated reduction in water quality. Therefore, the magnitude of the impact is considered Low.
Preliminary likely significance of effect	Likely to be **Not Significant**
Confidence in prediction	High confidence
Receptor	**Seabed morphology, including seabed features such as bedforms and sandbanks**
Potential Impact	Changes to nearshore seabed morphology caused by trenchless installation techniques. At both landfall sites,

	Preliminary assessment
	trenchless techniques will be used to minimise the impact of sediment disturbance in the intertidal zone during cable installation. An area of pre-cut trenching will be required at the trenchless solution reception point. The area excavated is typically 15m^2 per bellmouth, with one bellmouth needed for each duct. This gives a total excavated area of approximately 60m^2 for four ducts (Sea Link only) and 150m^2 for 10 ducts (Coordination). Rock protection: up to 10 rock bags are required for each trenchless exit. This equates to 40 rock bags for Sea Link only (four ducts) and 100 rock bags for the Coordination option (up to 10 ducts) which would have a footprint slightly larger than the excavated areas provided above. Footprints for the Coordination option are to be refined for the ES. Offshore sand wave lowering and trenching activities will also result in temporary disturbance to the seabed. The estimated footprints of the methods considered for pre-installation and installation activities are presented in **Part 1, Chapter 4, Description of the Proposed Project.** During sandwave lowing and pre-sweeping activities (if required) smaller scale sandwaves (and smaller bedforms i.e., ripples and megaripples) may be destroyed by cable route clearance and trenching activities. Larger sandwaves (>10m in length) and sandwave fields are likely to only be partially disturbed. Where cables are decommissioned by removal, they may need to be pulled or excavated from the seabed and pulled back through the landfall conduit. The impact of the excavation process will be no greater than that for the construction phase.
Proposed Project phase	Construction & Decommissioning.
Duration	Short-term. The seabed and seabed features such as bedforms and sandbanks are expected to recover naturally once installation activities are complete.
Mitigation	Embedded mitigation MPE02 Trenchless landfall construction
Preliminary sensitivity	The sensitivity of the seabed in shallow water depths to sediment disturbance is considered Low due to its dynamic nature where sediment transport driven by natural wave and tidal action will evenly disperse and return the bed to equilibrium conditions.

	Preliminary assessment
	The sensitivity of sandwaves and sandwave fields (such as the Goodwin Sand Bank and Shipwash East Ridge) is considered Low as bedform recovery is expected via natural sediment transport processes once activities have stopped.
Preliminary magnitude	At both landfall sites the magnitude of the impact is considered Low as trenchless techniques will be used to minimise the impact of sediment and seabed disturbance in the intertidal zone during cable installation. Offshore, the magnitude of seabed disturbance is considered Low as the footprints of the installation activities are not likely to influence the overall form and function of the bedform or sandwave systems they disturb (including the Goodwin Sand Banks and the Shipwash sandbanks). Due to the continuous dynamic nature of the mobile seabed, sandwaves are unlikely to reform back to their original state following dredging of the crest. Sandwaves will continue to migrate in their new form, moving away from the newly levelled area. As the bedform develops and reforms, the crests are expected to recover to a naturally stable shape.
Preliminary likely significance of effect	Likely to be **Not Significant**
Confidence in prediction	High confidence
Receptor	**Suffolk and Kent coastline morphology, including Sandwich Bay to Hacklinge Marshes SSSI and The Haven SSSI**
Potential Impact	Changes to coastal morphology at landfalls due to installation of the cable. Potential changes to coastal morphology at the landfall are associated trenchless installation activities such as the excavation of the exit pits; trenchless drilling operations; and changes to the nearshore wave regime and sediment transport patterns due to the presence of nearshore cable protection measures. The excavation of the nearshore burial trenches and exit pits may bring about changes in the beach morphology as described below: - The trenches could interrupt longshore and cross-shore sediment transport and infill with sediment, which could theoretically cause a reduction in beach volume, however the impact and magnitude of this impact would be very low as once the trenches have been infilled by a combination of natural processes

	Preliminary assessment
	and reinstatement, natural sediment transport processes will be restored. - Side casting of the excavated trench material could locally increase the nearshore seabed elevation and act as a submerged groyne that might interrupt the nearshore wave regime by locally detracting and refracting the waves, or by causing wave shoaling, and trap sediment. This may result in accretion of sediment immediately updrift of the side-cast mound and erosion immediately down drift. Where cables are decommissioned by removal, they may need to be pulled or excavated from the seabed and pulled back through the landfall conduit. The impact of the excavation process will be no greater than that for the installation phase.
Proposed Project phase	Construction & Decommissioning.
Duration	Short term – Construction & Decommissioning activities are temporary.
Mitigation	Embedded mitigation MPE02 Trenchless landfall construction
Preliminary sensitivity	At the Suffolk Landfall site, the shoreline has been largely stable with a slightly advancing trend (Ref 2.53). The sensitivity of this coastline is considered Low. At the Kent Landfall, the Pegwell Bay beach profiles show long-term erosive changes between 2003-2020, with a 12-26% beach slope reduction. At Sandwich Bay (including Sandwich Bay to Hacklinge Marshes (SSSI) coastline), the beach profiles show an accretive trend of >30% between 2003-2020. Profiles nearest the mouth of the River Stour show the largest gains of 95-105% (Ref 2.56). The Sandwich and Pegwell Bay coastline experiences locational variability in beach accretion and beach material loss. Overall, the Sandwich and Pegwell Bay is assessed to have a Low-Medium sensitivity level.
Preliminary magnitude	The magnitude of change to coastal morphology caused by the excavation of the nearshore burial trench and exit pits is considered Low as any associated morphological change will be temporary and spatially limited – any accretion or erosion associated with the side-cast mound will be highly localised and temporary as the seabed sediment will be naturally re-distributed by currents and wave action. The preferred method for cable landfall is to bury the cables beneath the beach using a trenchless technique.

	Preliminary assessment
	This will avoid any disturbance to the existing coastline fabric or morphology, including the chalk cliffs, rocky shore, saltmarshes, and sand dunes of the Sandwich Bay to Hacklinge Marshes SSSI. Once buried, the cable will not interact with coastal processes, such as sediment transport patterns. Therefore, the magnitude of the impact on the coastline morphology is assessed to be Low.
Preliminary likely significance of effect	Likely to be **Not Significant**
Confidence in prediction	High confidence
Receptor	**Coraline Crag Ridges**
Potential Impact	The Coralline Crag is an exposed geological feature of the seabed that extends from onshore to offshore which underpins coastal processes along this section of the Suffolk coastline. The tidal excursion length in this region is 11 km, therefore, the Coraline Crag Ridges are close enough to the Offshore Scheme boundary to be affected by the fallout and deposition of sediment from suspension that is disturbed during trenching, cable installation and decommissioning activities. This may cause smothering of benthic habitats found on the Coraline Crag Ridges and surficial sediment character grain size change. Where cables are decommissioned by removal, they may need to be pulled or excavated from the seabed and pulled back through the landfall conduit. The impact of the excavation process will be no greater than that for the installation phase.
Proposed Project phase	Construction, Operation & Decommissioning.
Duration	Change to the surficial sediment composition of the Coraline Crag Ridges is likely to be temporary as the finer sediment is likely to be re-suspended under higher current speeds or storm wave activity. Some small, localized zones that are sheltered from current and wave action may experience permanent change to the sediment composition.
Mitigation	Embedded mitigation MPE02 Trenchless landfall construction
Preliminary sensitivity	To account for the fact that some small areas of Coraline Crag may experience the permanent addition of fine sediment in areas sheltered from current and wave action, the sensitivity has been assessed to be Medium – Low.

	Preliminary assessment
Preliminary magnitude	Change to the surficial sediment composition of the Coraline Crag Ridges is likely to be temporary as the finer sediment is likely to be re-suspended under higher currents speeds or storm conditions. Some localised zones that are sheltered from current and wave action may experience permanent change to the sediment composition, however, these deposits would be very thin (< 1 mm). Taking account of the spatial and temporal extents of increased suspended sediments, this is deemed to have a Low magnitude of impact on the sediment characterisation of the Coralline Crag Ridges.
Preliminary likely significance of effect	Likely to be **Not Significant**
Confidence in prediction	High confidence
Receptor	**Sizewell B and C power plant water intake**
Potential Impact	Changes to the water intake patterns and water quality in the vicinity of the Sizewell offshore intake sites caused by the Construction, Operation & Decommissioning activities carried out for the Sea Link project.
Proposed Project phase	Construction, Operation & Decommissioning
Duration	Lifetime of Project
Mitigation	Embedded mitigation MPE02
Preliminary sensitivity	The sensitivity of the Sizewell intake sites to changing water patterns and water quality is assessed to be High.
Preliminary magnitude	The Suffolk landfall is approximately 5 km to the south of the Sizewell sites. Storm surge conditions dominate sediment processes along the Suffolk coast resulting in southerly transport. Any construction or operational effects during these dominant conditions will not therefore affect water circulation patterns or water quality at the location of the offshore intake(s) at Sizewell. Storm conditions from the south are less significant in terms of sediment transport processes and any effects due to cable protection will in any case be highly localised with transport patterns re-established long before reaching Sizewell. Therefore, the magnitude of the impact is assessed to be Low.
Preliminary likely significance of effect	Likely to be **Not Significant**

	Preliminary assessment
Confidence in prediction	Moderate – this is an anthropogenic impact potentially caused by changes to the physical offshore environment.
Receptor	**Seabed Bathymetry**
Potential Impact	During the operational lifetime of the Project, there is potential for scouring of the seabed to occur which will locally lower the seabed levels. Local scouring occurs due to the interaction of currents and waves with an obstacle on a mobile seabed. This interaction causes locally enhanced turbulence and increased sediment transport rates around the obstacle leading to localised erosion of the seabed. Where the cable cannot be buried, cable protection measures such as rock berms will be used, these structures will act as an obstacle to the flow and can experience scouring around its periphery. Scouring also causes the removal of the finer sediment fraction from the seabed, therefore locally the seabed composition may become coarser. Approximately 13.2 km of planned post lay rock berm and areas of potential remedial rock berm is anticipated to be required for the protection of the bundled cables. Nearshore cable protection may be needed to mitigate the effects of mobile sediments, such as at exit points and to mitigate potential coastal erosion, thus creating the potential for localized scouring of the seabed.
Proposed Project phase	Operational
Duration	Initial changes to the seabed bathymetry are likely to take place within the first few weeks following installation after exposure to the stronger spring tidal currents. Storm conditions may result in a further during winter months before a new equilibrium state is established. Changes will also occur following decommissioning involving removal of the cable and any seabed protection but again the response can be expected to take place over a relatively short timescale.
Mitigation	MPE02, MPE03
Preliminary sensitivity	The sensitivity of the seabed in shallow and deep waters to sediment disturbance due to scour is considered Low due to the highly localised and short-duration nature of changes to the seabed its dynamic nature where sediment transport driven by natural wave and tidal action will evenly disperse and return the bed to equilibrium conditions once the obstacle is removed.
Preliminary magnitude	The magnitude of the impact of scour on the seabed is assessed to be Low, as any scour will be localised and

	Preliminary assessment
	eventually a state of equilibrium will be reached where the depth of scour stabilises and will have no further effect on the removal of sediment from the area or on local sediment transport.
Preliminary likely significance of effect	Likely to be **Not Significant**
Confidence in prediction	High confidence
Receptor	**Coraline Crag Ridges and associated role in the regional coastline morphology**
Potential Impact	Climate change that occurs over the operational lifetime of the Project may result in increased storminess and sea level rise that may cause erosion or damage to this geologically resistant feature. Morphological damage to the Coraline Crag Ridges as a result of the Offshore Scheme may have a knock-on effect by altering sediment transport patterns and therefore impact the region coastline geomorphology.
Proposed Project phase	Operational
Duration	Lifetime of the Project
Mitigation	-
Preliminary sensitivity	The offshore Coralline Crag outcrop is interconnected to many of the physical processes that maintain the geomorphology of this stretch of Suffolk coastline. Any activity that adversely affects this feature may have implications for the stability and character of the coastline as far north as Dunwich and as far south as Orford Ness (Ref 2.52). The Coraline Crag Ridges outcrop is a geologically resistant feature that has a Low sensitivity to erosion, however, its significance in determining the hydrodynamics, sediment transport patterns and coastal geomorphology in the region, incurs a higher level of sensitivity (Moderate – High) that reflects how even moderate alterations to the Ridges may then significantly impact the geomorphology of the coastline.
Preliminary magnitude	Over the lifetime of the Project, the magnitude of the impact of climate change on the landfall coastlines is likely to be Low-Medium. However, whilst the potential for any damage to the Coraline Crag feature could result in regional alterations to coastal processes and coastal geomorphology, the magnitude of the impact due to the Project is assessed as being Low, particularly in comparison to the potentially High impact as a result of climate change.

	Preliminary assessment
Preliminary likely significance of effect	Likely to be **Not Significant**
Confidence in prediction	Moderate – inherent uncertainty involved in the prediction of future climates and how coastal features might respond to the change.
Receptor	**Suffolk and Kent coastline morphology, including Sandwich Bay to Hacklinge Marshes (SSSI) and The Haven SSSI**
Potential Impact	During the operational lifetime of the cable, cable protection measures at the landfalls could cause modification of the local nearshore wave regime and associated patterns of sediment transport, which in turn may alter coastal morphology by acting as a barrier to sediment transport processes. A potential secondary impact on the coastline morphology of both landfall sites stems from increased storminess and sea level rise driven by climate change over the operational lifetime of the Project. This is likely to result in increased erosion and subsequent coastal morphological change, including potentially effecting the chalk cliffs, rocky shores, shingle, sand and mudflats, saltmarsh and sand dunes of the Sandwich Bay to Hacklinge Marshes (SSSI).
Proposed Project phase	Operational
Duration	Lifetime of the Project
Mitigation	Cable protection at the landfalls will be constructed so they are sufficiently low with shallow side slopes to minimise the likelihood of turbulent conditions resulting from the interaction between currents and waves and the resulting effect on sediment transport.
Preliminary sensitivity	The sensitivity of both landfall coastlines (including the Sandwich Bay to Hacklinge Marshes SSSI) to the effects of the nearshore cable protection measures, is considered Low -Medium, as these receptors will likely tolerate small alterations to their morphologies and still be able to recover once the cable protection measures are removed. Both the Suffolk and Kent landfall coastlines are considered to have High sensitivities to the effects of climate change. The Kent coastline is at risk from both increased storminess and sea level rise, while Royal Haskoning (Ref 2.48) explain that future morphological change along the naturally stabilised bay between Thorpeness and Aldeburgh will be mostly driven by water level change relative to the profile of the beach resulting in the shoreline moving inland.

	Preliminary assessment
Preliminary magnitude	The magnitude of change as a result of the presence of nearshore cable protection is considered Low as any coastal morphological change will be temporary, low magnitude and highly localised. The magnitude of change as a result of the effects of climate change are considered High (for more information see **Volume 1, Part 5, Chapter 1, Climate Change**).
Preliminary likely significance of effect	Likely to be **Not Significant** – in relation to the presence of nearshore cable protection measures.
Confidence in prediction	Moderate
Receptor	**Seabed**
Potential Impact	Localized scour of the seabed may occur about the cable as a result of the cable becoming exposed over time having been left in-situ for decommissioning. This may also be the case for rock berms left in-situ at cable crossing points that are still active at the time of decommissioning. Scouring occurs via the interaction of currents and waves with an obstacle on a mobile seabed. This interaction causes locally enhanced turbulence and increased sediment transport rates about the obstacle leading to leading to localised erosion or the seabed. Scouring also causes the removal of the finer sediment fraction from the seabed, therefore locally the seabed composition may become coarser.
Proposed Project phase	Decommissioning associated with the abandonment of cable in the seabed
Duration	For as long as the cable protection/obstruction remains on the seabed
Mitigation	-
Preliminary sensitivity	Due to the dynamic nature of the seabed driven by natural wave and tidal action and associated sediment transport processes, we can expect the seabed to establish new equilibrium conditions even if an obstruction, such as exposed sections of the cable remain on the seabed. Therefore, the sensitivity of the seabed to sediment disturbance due to scour is considered Low.
Preliminary magnitude	The magnitude of the impact of scour on the seabed is assessed to be Low, as any scour will be localised and eventually a state of equilibrium will be reached where the depth of scour stabilises and will have no further effect on the removal of sediment from the area of on local sediment transport. Further, over time the rock berms or exposed sections of cable may become buried

	Preliminary assessment
	by the eventual a build-up of sediment or migration of bedforms, thus re-establishing direct sediment pathways over the obstacle.
Preliminary likely significance of effect	Likely to be **Not Significant**
Confidence in prediction	Moderate confidence

4.2.10 Transboundary Effects

4.2.10.1 A transboundary effect is any significant adverse effect on the environment resulting from human activity, the physical origin of which is situated wholly or in part within an area under the jurisdiction of another State.

4.2.10.2 All works associated with the Proposed Project fall within the UK jurisdiction (12 NM). Given the distance of the Proposed Project from French waters (approximately 25 km), no significant transboundary effects have been identified. Predicted disturbance from the Proposed Project is short term and local and are therefore not anticipated to be sufficient to influence physical environmental receptors outside UK waters, and subsequently cause transboundary effects.

4.2.10.3 Furthermore, the PEIR has concluded no significant effects for physical environmental receptors in UK waters.

4.2.11 Summary

4.2.11.1 In Summary:

- in Suffolk, the cable makes landfall at a stretch of coast known as The Haven, a SSSI;
- at the Suffolk landfall, the short-term policy is to maintain the existing defence and ‘Hold the Line’ for the medium- and long-term plan (Ref 2.48);
- between Thorpeness and The Haven a policy of managed realignment is recommended in the SMP for the short – long term plan (Ref 2.48; Ref 2.67);
- the offshore Coralline Crag outcrop near the Suffolk landfall site is interconnected to many of the physical processes that maintain the geomorphology of this stretch of Suffolk coastline;
- at the Kent landfall in Pegwell Bay, there is a nature reserve to the south which features coastal habitats such as saltmarsh and mudflats which makeup part of the Sandwich Bay to Hacklinge Marshes SSSI. The main sediment sources supplying Pegwell Bay are from the offshore Goodwin Sands sandbanks and from the River Stour;
- between Ramsgate Harbour and to the north of the River Stour, the SMP recommends a ‘Hold the Line’ policy where there is an existing seawall, and a ‘No Active Intervention’ policy where there are no existing defences and no risk of coastal erosion;

- the Pegwell Bay to Kingsdown Coastal Flood Risk Management Strategy, is to promote a natural functioning coastline, including the natural dune flood defence.
- the Offshore Scheme spans the Greater Thames Estuary, characterised by large subtidal sandbanks and channels that are aligned with the tidal stream. The cable corridor passes near to the Greater Thames Estuary sandbanks and through the Aldeburgh Ridge;
- the preliminary assessment of effects indicates that there are no likely significant effects from Project activities on the physical environment associated with the Offshore Scheme.
- over the lifetime of the Project, the magnitude of the impact of climate change and sea level rise on the landfall coastlines is likely to be Low-Medium; and
- there is potential that damage to the Coraline Crags caused by climate change and associated increased storminess, may result in regional alterations to coastal processes and coastal geomorphology due to the importance of this feature to physical processes in the region.

4.2.12 References

Ref 2.1 HM Government (2009). Marine and Coastal Access Act (MCAA) 2009.

Ref 2.2 European Commission (2000). European Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy – commonly referred to as the Water Framework Directive.

Ref 2.3 European Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of environmental policy (MSFD).

Ref 2.4 Department of Energy and Climate Change (2011). Overarching National Policy Statement for Energy (EN-1). London: The Stationery Office.

Ref 2.5 Department of Energy and Climate Change (2011). National Policy Statement for Electricity Networks Infrastructure (EN-5). London: The Stationery Office.

Ref 2.6 HM Government (2011). UK Marine Policy Statement.

Ref 2.7 HM Government (2014). East Inshore and East Offshore Marine Plans.

Ref 2.8 HM Government (2021). South East Inshore Marine Plan.

Ref 2.9 Halcrow Group Limited (2010). Isle of Grain to South Foreland SMP Review 2010.

Ref 2.10 East Suffolk Council supported by the Client Steering Group (2010). SMP 7 – Lowestoft and Felixstowe.

Ref 2.11 National Grid (2022). Sea Link: Environmental Impact Assessment Scoping Report. [online] Available at: https://infrastructure.planninginspectorate.gov.uk/projects/south-east/sea-link/ [Accessed 16/05/2023].

Ref 2.12 The Planning Inspectorate (2022). Scoping Opinion: Proposed Sea Link. Case Reference: EN020026. [online] Available at: https://infrastructure.planninginspectorate.gov.uk/projects/south-east/sea-link/ [Accessed 16/05/2023].

Ref 2.13 RenewableUK (2013). Cumulative Impacts Assessment Guidelines: Guiding Principles for Cumulative Impacts Assessment in Offshore Wind Farms. Report by RenewableUK.

Ref 2.14 Cefas (2012). Guidelines for data acquisition to support marine environmental assessments for offshore renewable energy projects.

Ref 2.15 British Standards Institute (2015). Environmental impact assessment for offshore renewable energy projects. Guide.

Ref 2.16 Office of the Department of the Prime Minister (2001). Guidance on Environmental Impact Assessment in Relation to Dredging.

Ref 2.17 Natural Resources Wales (2018). Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to Inform EIA of Major Development Projects. Report No 243.

Ref 2.18 Cefas (2004). Offshore Wind Farms:Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA Requirements.

Ref 2.19 Defra (2005). Nature Conservation Guidance on Offshore Windfarm Development A guidance note on the implications of the EC Wild Birds and Habitats Directives for developers undertaking offshore windfarm developments.

Ref 2.20 Marine Management Organisation (2014). Marine Licensing: Sediment Analysis and Sample Plans. Details of sediment and sample analysis for marine licence applications.

Ref 2.21 Marine Management Organisation (2015). High Level Review of Current UK Action Level Guidance: MMO Project No. 1053.

Ref 2.22 Cefas (2018). Review of Action Levels used for assessing dredging and disposal marine licences – ME5226. [Online] Available at: http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=20243&FromSearch=Y&Publisher=1&SearchText=ME5226&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description.

Ref 2.23 UK Hydrographic Office (2021). Admiralty Tide Tables: UKHO.

Ref 2.24 Environment Agency (2017). Anglian Coastal Monitoring Programme: 2016 – 2017 Survey Report.

Ref 2.25 Natural England (2020). Assessment of Coastal Access Proposals between Aldeburgh and Sizewell on sites and features of nature conservation concern.

Ref 2.26 ABPmer, 2017. *Atlas of UK marine renewable energy resources.* [Online] Available at: https://www.abpmer.co.uk/experience/atlas-of-uk-marine-renewable-energy-resources/.

Ref 2.27 Cefas (2016). Suspended Sediment Climatologies around the UK. Report for the UK Department for Business, Energy & Industrial Strategy offshore energy Strategic Environmental Assessment programme. [online] Available at:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584621/CEFAS_2016_Suspended_Sediment_Climatologies_around_the_UK.pdf.

Ref 2.28 Environment Agency (2018). Coastal Flood Boundary Dataset (CFBD). [Online] Available at: https://data.gov.uk/dataset/73834283-7dc4-488a-9583-a920072d9a9d/coastal-design-sea-levels-coastal-flood-boundary-extreme-sea-levels-2018.

Ref 2.29 Environment Agency (2011). Coastal Morphology Report, Thorpeness (Phase 1).

Ref 2.30 Environment Agency (2016). Flood Risk Assessments: Climate Change Allowances, When and how local planning authorities, developers and their agents should use climate change allowances in flood risk assessments.

Ref 2.31 Scottish Power Renewables (2019). East Anglia ONE North Offshore Windfarm, Appendix 4.6 Coastal Processes and landfall Site Selection, Environmental Statement, Volume 3.

Ref 2.32 GoBe Consultants Ltd (2023). Five Estuaries Offshore Windfarm array. Stage 2 Consultation. [online] Available at: https://fiveestuaries.co.uk/document-library-stage-2/

Ref 2.33 British Geological Survey (2022). GeoIndex Offshore. [Online] Available at: https://mapapps2.bgs.ac.uk/geoindex_offshore/home.html.

Ref 2.34 Burningham, & French (2009). Seabed mobility in the greater Thames estuary. The Crown Estate.

Ref 2.35 NNRCMP (2021). National Network of Regional Coastal Monitoring Programmes. [Online] Available at: https://coastalmonitoring.org/.

Ref 2.36 NNRCMP (2019). Coastal Wave Network Annual Report.

Ref 2.37 Burningham and French (2011). Seabed dynamics in a large coastal embayment: 180 years of morphological change in the outer Thames estuary. *Hydrobiologia.* 672:105–119, DOI 10.1007/s10750-011-0760-y.

Ref 2.38 ABPmer, 2018. Data Explorer, SEASTATES. [Online] Available at: https://www.seastates.net/explore-data/.

Ref 2.39 Burninghan and French (2016). 'Shoreline – Shoreface Dynamics on the Suffolk Coast' The Crown Estate, 117 pages. ISBN: 978-1- 906410-76-6.

Ref 2.40 Channel Coastal Observatory (2020). Annual Survey Report, 2020, North Foreland to Dover Harbour. Southeast Regional Coastal Monitoring Programme.

Ref 2.41 Anglian Regional Coastal Monitoring Programme (2022). Suffolk (SMP 7) Coastal Trends Report 2021 Lowestoft Ness to Landguard Point. Environment Agency.

Ref 2.42 BEEMS Technical Report TR311 (2020). The Sizewell C, Volume 2 Main Development Site Chapter 20 Coastal Geomorphology and Hydrodynamics, Appendix 20A Coastal Geomorphology and Hydrodynamics: Synthesis for Environmental Impact Assessment.

Ref 2.43 Mott MacDonald (2014). Thorpeness Coastal Erosion Appraisal.

Ref 2.44 Vattenfall Wind Power Ltd (2018). Thanet Extension Offshore Wind Farm, Environmental Statement Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes.

Ref 2.45 Met Office (2022). UK Climate Projections (UKCP18) Science Overview Executive Summary. [Online] Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-overview-summary.pdf.

Ref 2.46 ABPmer (2017). UK Renewables Atlas. [Online] Available at: https://www.renewables-atlas.info/.

Ref 2.47 Natural England (2020). Assessment of Coastal Access Proposals between Aldeburgh and Sizewell on sites and features of nature conservation concern.

Ref 2.48 Royal Haskoning (2010). Suffolk SMP2 Sub-cell 3c Policy Development Zone 5 – Thorpeness to Orford Ness.

Ref 2.49 NNRCMP (2023). Channel Coastal Observatory. [Online] Available at: National Coastal Monitoring – Welcome.

Ref 2.50 Atkinson and Esteves (2019). Understanding Coastal and Nearshore Changes in the Area of Thorpeness (Suffolk, UK). Bournemouth University. [online] Available at: https://www.coasteast.org.uk/assets/img/1415072.pdf.

Ref 2.51 Bamber and Moore (1995). “Porcupine Newsletter.” *Porcupine Newsletter 5* (10): 1–28.

Ref 2.52 Royal Haskoning DHV (2019). East Anglia ONE North Offshore Windfarm, Appendix 4.6 Coastal Processes and landfall Site Selection, Environmental Statement, Volume 3.

Ref 2.53 Reeve, Horrillo-Caraballo, Karunarathna and Pan (2019). A new perspective on meso-scale shoreline dynamics through data-driven analysis. *Geomorphology*. 341, 169–191.

Ref 2.54 South East Coastal Group (2011). South East Strategic Regional Coastal Monitoring Programme, Beach Management Plan Report, Deal & Kingsdown, 2010.

Ref 2.55 Channel Coastal Observatory (2011). Seabed Mapping Ramsgate to Dungeness: Summary Report, Southeast Strategic Regional Coastal Monitoring Programme.

Ref 2.56 Walker (2021). Southeast Regional Coastal Monitoring Programme, Annual survey report 2020, North Foreland to Dover Harbour.

Ref 2.57 Logemann, A., Reininghaus, M., Schmidt, M., Ebeling, A., Zimmermann, T., Wolschke, H., Friedrich, J., Brockmeyer, B., Pröfrock, D. and Witt, G. (2022). Assessing the chemical anthropocene–development of the legacy pollution fingerprint in the North Sea during the last century. Environmental Pollution, 302, pp.119040.

Ref 2.58 Cefas (2001). Contaminant Status of The North Sea: Technical Report Produced for Strategic Environmental Assessment – SEA2. Technical Report TR_004. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/197352/TR_SEA2_Contamination.pdf

Ref 2.59 Pope, N. and Langston, W. (2011). Sources, distribution and temporal variability of trace metals in the Thames Estuary. Hydrobiologia, 672(1), pp. 49-68.

Ref 2.60 Cefas (2022). Use of Action Levels in Dredged Material Assessments. [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/573075/Appendix_B_Action_Levels.pdf.

Ref 2.61 Rijksinstituut Voor Volksgezondheid En Milieu (RIVM) (2001). Technical evaluation of the Intervention Values for Soil/sediment and Groundwater: Human and ecotoxicological risk assessment and derivation of risk limits for soil, aquatic sediment and groundwater. [online] Available at: https://www.rivm.nl/bibliotheek/rapporten/711701023.pdf.

Ref 2.62 Environment Agency (2021). Explore catchment data. [online] Available at: https://environment.data.gov.uk/catchment-planning/.

Ref 2.63 Environment Agency (2021). Bathing Water Quality. [online] Available at: https://environment.data.gov.uk/bwq/profiles/.

Ref 2.64 MMT (2022) South East Anglia Link Marine Survey, Geophysical & Environmental Survey England – SE coast September - October 2021.

Ref 2.65 HR Wallingford (2010). Thames Estuary Dredging Association, MAREA: Tidal Flows and Sediment Transport Study. Technical Note.

Ref 2.66 Environment Agency (2021). Flood Risk Assessments: Climate Change Allowances. [Online] Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

Ref 2.67 East Suffolk Council (2020). Suffolk Coastal Local Plan, 2020.

Ref 2.68 Wood Environment & Infrastructure Solutions UK Limited (2020).

Ref 2.69 MMT (2022). National Grid, South East Anglia Link Marine Survey, Geotechnical Survey England–SE Coast, August - September 2021.

Ref 2.70 Red Penguin Marine (2022). Sea Link Cable Burial Assessment Study, Version 1.

Ref 2.71 Red Penguin Marine (2022). Sea Link Cable Burial Risk Assessment, Version 1.

Ref 2.72 Riggall & Associates (2022). Technical Note reviewing potential HDD Landfall locations for Sea Link.

Ref 2.73 Department for Energy Security & Net Zero (2023). National Policy Statement for Renewable Energy Infrastructure (EN-3). Crown copyright 2022.

Ref 2.74 CIRIA, CUR, CETMEF (2007). The Rock Manual. The use of rock in hydraulic engineering (2nd edition). C683, CIRIA, London

Ref 2.75 DNV. GL (2019) Recommended Practice, Electrical power cables in subsea applications.

Ref 2.76 DNV. GL (2016) Recommended Practice, Subsea power cables in shallow water.

Page intentionally blank

National Grid plc
National Grid House,
Warwick Technology Park,
Gallows Hill, Warwick.
CV34 6DA United Kingdom

Registered in England and Wales
No. 4031152
nationalgrid.com