The Great Grid Upgrade

Sea Link

Sea Link

Volume 6: Environmental Statement

Document: 6.2.4.1
Part 4 Marine
Chapter 1
Physical Environment

Planning Inspectorate Reference: EN020026

Version: H~~G~~
April 2026

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(a)

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Version History

Date	Issue	Status	Description / Changes
March 2025	A	Final	For DCO submission
September 2025	B	Final	Update to reflect S89(3) Procedural Decision from the Examining Authority
November 2025	C	Final	Submission for Deadline 1
January 2026	D	Final	Submission for Deadline 3
February 2026	E	Final	Submission for Deadline 4
March 2026	F	Final	Submission for Deadline 5
April 2026	G	Final	Submission for Deadline 6
April 2026	H	Final	Submission for Deadline 7

1. Physical Environment

1.1 Introduction

1.1.1 This chapter of the Environmental Statement (ES) presents information about the environmental assessment of the potential significant Physical Environment effects that could result from the Proposed Project (as described in **Application Document 6.2.1.4 (C) Part 1 Introduction Chapter 4 Description of the Proposed Project [AS-093]**).

1.1.2 This chapter describes the methodology used, the datasets that have informed the environmental assessment, baseline conditions, mitigation measures and Physical Environment residual significant effects that could result from the Proposed Project.

1.1.3 The Order Limits, which illustrate the boundary of the Proposed Project, are illustrated on **Application Document 2.2.1 Overall Location Plan**.

1.1.4 This chapter should be read in conjunction with:

- **Application Document 2.2.1 Overall Location Plan**;
- **Application Document 5.1 Consultation Report [APP-301]**;
- **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project**;
- **Application Document 6.2.1.5 Part 1 Introduction Chapter 5 EIA Approach and Methodology**;
- **Application Document 6.2.1.6 Part 1 Introduction Chapter 6 Scoping Opinion and EIA Consultation**;
- **Application Document 6.2.5.1 Part 5 Project Wide Effects Climate Change**;
- **Application Document 7.5.2 Offshore Construction Environmental Management Plan**;
- **Application Document 9.84 Register of Environmental Actions and Commitments (REAC)**;
- **Application Document 9.92 Outline Cable Specification and Installation Plan;**
- **Application Document 6.2.2.4 Part 2 Suffolk Chapter 4 Water Environment**;
- **Application Document 6.2.3.4 Part 3 Kent Chapter 4 Water Environment**;
- **Application Document 6.2.4.2 Part 4 Marine Chapter 2 Benthic Ecology**;
- **Application Document 6.2.4.3 Part 4 Marine Chapter 3 Fish and Shellfish**;
- **Application Document 6.6 (E) Habitats Regulations Assessment Report**;
- **Application Document 6.11 Marine Conservation Zone Assessment**;
- **Application Document 6.3.4.2.A ES Appendix 4.2.A Benthic Characterisation Report (Original Report)**;

- **Application Document 6.3.4.2.B Appendix 4.2.B Geophysical Survey Interpretation (Additional Survey)**;
- **Application Document 6.3.4.2.D Appendix 4.2.D Interim Subtidal Survey Report (Additional Surveys)**;
- **Application Document 9.13 Pegwell Bay Construction Method Technical Note**; and
- **Application Document 9.113 (A) The Coralline Crag Technical Note [REP4-102]**, ~~submitted at Deadline 4~~.

1.1.5 This chapter is supported by the following figures:

- **Application Document 6.4.4.1 ES Figures Marine Physical Environment**.

1.1.6 This chapter is supported by the following appendices:

- **Application Document 6.3.4.1.A Suspended Sediment Modelling**.
- **Application Document 9.144: Additional Sediment Dispersion Modelling - Technical Note**.

1.2 Regulatory and Planning Context

1.2.1 This section sets out the legislation and planning policy that is relevant to the Physical Environment assessment. A full review of compliance with relevant national and local planning policy is provided within the Planning Statement submitted as part of the application for Development Consent.

1.2.1 Policy generally seeks to minimise effects from development and to avoid significant adverse effects. This applies particularly to coastline geomorphology and sediment transport patterns, designated sites and features of geomorphological and geological scientific interest.

Legislation

European Legislation

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

1.2.2 Commonly referred to as the Water Framework Directive (WFD), 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 a European Union (EU) directive which commits EU member states to achieve good qualitative and quantitative status of all water bodies. Since leaving the EU, the 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.

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

1.2.3 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”. This directive sets out a framework within which EU Member States must take the necessary measures to achieve or maintain Good Environmental Status (GES) in the marine environment. Such status should have been achieved by 2020. Since leaving the EU, the existing UK-wide framework has been maintained to allow for consistent marine environmental monitoring and standards across the UK.

UK National Legislation

Marine and Coastal Access Act 2009

1.2.4 The Marine and Coastal Access Act 2009 (HM Government, 2009) 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.

1.2.5 The Marine and Coastal Access Act comprises of the following key elements that are relevant to the Proposed Project:

- Creation of Marine Management Organisation (MMO) – to operate as the marine planning authority on behalf of UK Government in English territorial waters and UK offshore waters.
- A Strategic Marine Planning System – To agree future marine objectives and priorities that encourage and facilitate a more efficient, sustainable use and protection of marine resources. Marine planning is one of the major functions of the MMO and the UK Marine Policy Statement (MPS) was issued in March 2011.
- Marine Licencing system – a more streamlined system that simplifies the licence application procedure, so that only one licence is required for the lifetime of a project.
- Marine Nature Conservation – The Act enables the designation of Marine Conservation Zones (MCZs) in the territorial waters adjacent to England and Wales and UK offshore waters.
- Coastal Access – The Act enables the creation of a continuous signed and managed route around the English and Welsh coastline.
- Coastal and Estuarine Management – Integrated Coastal Zone Management (ICZM) links existing sectoral policies and bylaws associated with the coastal and estuarine environment to minimise conflict and promote its sustainable use.

The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

1.2.6 The WFD Regulations seek to achieve an integrated approach to the use of the water environment in a sustainable and protective way. The WFD Regulations are the main mechanism for assessing and maintaining the water environment in the UK. Under these regulations, WFD waterbodies in the UK (including transitional and coastal (TraC) waterbodies) are monitored and assigned targets. Managing waters under the WFD requires a holistic approach, focusing on the wider ecosystem and hydrological cycle.

The Marine Strategy Regulations 2010

1.2.7 These regulations establish a framework for community action in the field of marine environmental policy. The objective of these regulations reflects the UK's vision of having "clean, healthy, safe, productive and biologically diverse oceans and seas". Essentially these regulations ensure that human activities within the marine environment remain compatible with achieving or maintaining GES.

The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019

1.2.8 These regulations set out:

"*a framework for the protection of inland surface waters (rivers and lakes), transitional waters, coastal waters and groundwater, to prevent and reduce pollution, promote sustainable water use, protect the aquatic environment, improve the status of aquatic ecosystems and mitigate the effects of floods and droughts.*"

National Policy

National Policy Statements

1.2.9 National Policy Statements (NPS) set out the primary policy tests against which the application for a Development Consent Order (DCO) for the Proposed Project would be considered. Table 1-1~~Table 1.1~~, Table 1-2~~Table 1.2~~ and Table 1-3~~Table 1.3~~ below provides details of the elements of NPS for Energy (EN-1) (DECC, 2023), NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2023b) and NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2023c) that are relevant to this chapter.

Table 1-1 NPS EN-1 requirements relevant to Physical Environment

NPS EN-1 section	Where this is covered in the ES
4.5.7…"*Applicants are encouraged to approach the marine licensing regulator (MMO in England and Natural Resources Wales in Wales) in pre-application, to ensure that they are aware of any needs for additional marine licenses alongside their Development Consent Order application*".	Consultation with the statutory consultees, including the Marine Management Organisation (MMO) and Natural England, was undertaken during the scoping stage and during the Preliminary Environmental Impact Report (PEIR) stage. Relevant comments are provided in Section 1.3.
4.5.8…"*Applicants for a Development Consent Order must take account of any relevant Marine Plans and are expected to complete a Marine Plan assessment as part of their project development,*	Relevant Marine Plans are identified in Section 1.2.

NPS EN-1 section	Where this is covered in the ES
using this information to support an application for development consent".	
4.5.9…"*Applicants are encouraged to refer to Marine Plans at an early stage, such as in pre-application, to inform project planning, for example to avoid less favourable locations as a result of other uses or environmental constraints".*	Relevant Marine Plans are identified in Section 1.2.
5.4.17*…"Where the development is subject to Environmental Impact Assessment (EIA), the applicant should ensure that the ES clearly sets out any effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance (including those outside England), on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity, including irreplaceable habitats".*	Details of designated sites of principal importance are provided in Section 1.7. Any potential impacts on these sites are considered in Section 1.9. An assessment of impacts on designated sites is available in the Habitant Regulations Assessment (HRA) and MCZ Assessment (**Application Document 6.6 Habitats Regulations Assessment Report**; **Application Document 6.11 Marine Conservation Zone Assessment**).
5.4.18*…"The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the Secretary of State consider thoroughly the potential effects of a proposed project".*	Section 1.8 provides relevant baseline environmental information on Physical Environment.
5.4.19*…"The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests".*	The Proposed Project will adopt a range of measures to conserve the physical environment and associated Physical Environment, as detailed in Section 1.7.
5.4.35…"*Applicants should include appropriate avoidance, mitigation, compensation and enhancement measures as an integral part of the proposed development*".	Relevant mitigation measures identified are provided in Section 1.8.
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."*	A sediment transport model has been developed to assess sediment dispersion distances associated with different types of cable burial techniques and assess the depth of sediment deposition on the seafloor (**Application Document 6.3.4.1.A Suspended Sediment Modelling [APP-195]**).
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*	Section 1.7 evaluates coastal processes at both regional and local scales in relation to the two proposed landfall sites. The assessment draws upon

NPS EN-1 section	Where this is covered in the ES
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 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."	sediment transport studies, recent erosion analyses, beach and seabed profile and elevation data, as well as information from relevant Shoreline Management Plans. This analysis informs the evaluation of the Proposed Project's potential to influence coastal and nearshore morphological change and associated coastal processes, as detailed in Section 1.9. Section 1.7 also establishes the future baseline conditions to account for the effects of climate change. The impact of the effects of climate change are assessed in Section 1.9).
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."*	Consultation with statutory consultees, including the Marine Management Organisation (MMO) and Natural England, was conducted during both the scoping phase and the preparation of the Preliminary Environmental Impact Report (PEIR). Feedback received from these consultees is summarised in Section 1.3. A sediment transport model has been developed to evaluate the dispersion of sediment resulting from various cable burial techniques, as well as to determine the extent of sediment deposition on the seabed (refer to **Application Document 6.3.4.1.A Suspended Sediment Modelling [APP-195]**). The potential impacts of increased turbidity and elevated suspended sediment concentrations are assessed in Section 1.7.
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*	Details of designated sites of principal importance are provided in Section 1.7. Any potential impacts on these sites are considered in Section 1.9. An assessment of impacts on designated sites is available in the HRA and MCZ Assessment (**Application Document 6.6 Habitats Regulations**

NPS EN-1 section	Where this is covered in the ES
potential SCIs and Sites of Special Scientific Interest.”	**Assessment Report**~~;~~ and **Application Document 6.11 Marine Conservation Zone Assessment**).
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.”*	Consultation with the statutory consultees, including the MMO, Natural England and the Environment Agency (EA) as undertaken during the scoping stage and during the PEIR stage. Relevant comments are provided in Section 1.3. Relevant mitigation measures identified are provided in Section 1.8.
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.”	The potential impact on the Physical Environment, including sediment transport regimes and hydrodynamics are assessed in Section 1.9.

Table 1-2~~1.2~~ NPS EN-3 requirements relevant to Physical Environment

NPS EN-3 section	Where this is covered in the ES
2.8.101 *”Applicants must undertake a detailed assessment of the offshore ecological, biodiversity and physical impacts of their proposed development, for all phases of the lifespan of that development, in accordance with the appropriate policy for offshore wind farm EIAs, HRAs and MCZ assessments”*	An EIA for Physical Environment has been undertaken and is provided in Section 1.9. An assessment of impacts on designated sites is available in the HRA and MCZ Assessment (**Application Document 6.6 Habitats Regulations Assessment Report**~~;~~ and **Application Document 6.11 Marine Conservation Zone Assessment**).

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

NPS EN-3 section	Where this is covered in the ES
2.8.104…"Applicants should consult at an early stage of pre-application with relevant statutory consultees and energy not-for profit organisations/non governmental organisations as appropriate, on the assessment methodologies, baseline data collection, and potential avoidance, mitigation and compensation options which should be undertaken".	Consultation with the statutory consultees, including the MMO, Natural England and the Environment Agency (EA), was undertaken during the scoping stage and during the PEIR stage. Relevant comments are provided in Section 1.3.
2.8.119…"Applicant assessment of the effects of installing offshore transmission infrastructure across the intertidal/coastal zone should demonstrate compliance with mitigation measures in any relevant plan-level HRA including those prepared by The Crown Estate as part of its leasing round, and include information, where relevant, about: • any alternative landfall sites that have been considered by the applicant during the design phase and an explanation for the final choice; • any alternative cable installation methods that have been considered by the applicant during the design phase and an explanation for the final choice; • potential loss of habitat; • disturbance during cable installation, maintenance/repairs and removal (decommissioning); • increased suspended sediment loads in the intertidal zone during installation and maintenance/repairs; • potential risk from invasive and non-native species; • predicted rates at which the intertidal zone might recover from temporary effects, based on existing monitoring data; and • protected sites".	A baseline assessment on Physical Environment is provided in Section 1.7 and the impact assessment can be found in Section 1.9. Further detail on the routing is considered in **Application Document 6.2.1.3 Part 1 Introduction Chapter 3 Main Alternatives Considered**. An assessment of impacts on designated sites is available in the HRA and MCZ Assessment (**Application Document 6.6 Habitats Regulations Assessment Report**~~;~~ and **Application Document 6.11 Marine Conservation Zone Assessment**). Further assessment of ecological impacts relating to the Proposed Development can be found in: **Application Document 6.2.4.2 Part 4 Chapter 2 Benthic Ecology** and **Application Document 6.2.4.3 Part 4 Chapter 3 Fish and Shellfish**. A sediment transport model has been developed to assess sediment dispersion distances associated with different types of cable burial techniques and assess the depth of sediment deposition on the seafloor (**Application Document 6.3.4.1.A Suspended Sediment Modelling [APP-195]**). The impact of increased turbidity and increases suspended sediment is assessed in Section 1.7.
2.8.112… "Applicant assessments are expected to include predictions of the physical effects arising from modifications to hydrodynamics (waves and tides), sediments and sediment transport, and	The impact of the Proposed Project on Physical Environment, including changes to hydrodynamics, metocean conditions, sediment transport regimes

NPS EN-3 section	Where this is covered in the ES
seabed morphology that will result from the construction, operation and decommissioning of the required infrastructure."	and morphology is provided in Section 1.9.
2.8.113… "Assessments should also include effects such as the scouring that may result from the proposed development…"	The potential impact of scour of the seabed is assessed in Section 1.9.
2.8.114… "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 been carried out along the Offshore Scheme Boundary in 2021 and 2024. Results are presented in **Application Document 6.3.4.2.A ES Appendix 4.2.A Benthic Characterisation Report (Original Report) [APP-196]**; and **Application Document 6.3.4.2.B Appendix 4.2.B Geophysical Survey Interpretation (Additional Surveys) [APP-197]**. The results have been used to develop the baseline (Section 1.7) and to support out the impact assessment (Section 1.9).

Table 1-3~~1.3~~ NPS EN-5 requirements relevant to Physical Environment

NPS EN-5 section	Where this is covered in the ES
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 …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 Proposed Project undertook a detailed routeing and siting study in **Application Document 6.2.1.3 Part 1 Introduction Chapter 3 Main Alternatives Considered [APP-044]**, which considered a wide range of environmental factors including features of special interest. Relevant mitigation measures identified are provided in Section 1.8.
2.13.21 *"…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*	The Proposed Project undertook a detailed routeing and siting study in **Application Document 6.2.1.3 Part 1 Introduction Chapter 3 Main**

NPS EN-5 section	Where this is covered in the ES
considered in the identification onshore connection points."	**Alternatives Considered** [APP-044], which considered a wide range of environmental factors including features of special interest. Section 1.9 assesses how the Physical Environment influence the wider coastline.
2.14.2...(Part) "*In the assessments of their designs, applicants should demonstrate how environmental, community and other impacts have been considered and how adverse impacts have followed the mitigation hierarchy i.e. avoidance, reduction and mitigation of adverse impacts through good design; how the mitigation hierarchy has been followed, in particular to avoid the need for compensatory measures for coastal, inshore and offshore developments affecting SACs SPAs, and Ramsar sites".*	The Proposed Project undertook a detailed routeing and siting study in **Application Document 6.2.1.3 Part 1 Introduction Chapter 3 Main Alternatives Considered** [APP-044], which considered a wide range of environmental factors including features of special interest. Relevant mitigation measures identified are provided in Section 1.8. Details of designated sites of principal importance are provided in Section 1.7. Any potential impacts on these sites are considered in Section 1.9. An assessment of impacts on designated sites is available in the HRA and MCZ Assessment (**Application Document 6.6 Habitats Regulations Assessment Report** and~~;~~ **Application Document 6.11 Marine Conservation Zone Assessment**).

National Planning Policy Framework

1.2.10 The National Planning Policy Framework (NPPF), as revised in December 2024, (Ministry for Levelling Up, Housing and Communities, 2024) sets out national planning policies that reflect priorities of the UK Government for operation of the planning system and the economic, social, and environmental aspects of the development and use of land. The NPPF has a strong emphasis on sustainable development, with a presumption in favour of such development. The NPPF may be considered both important and relevant to the Secretary of State's (SoS) assessment of the Proposed Project.

1.2.11 ~~Table 1-4~~Table 1.4 below provides details of the elements of the NPPF that are relevant to this chapter, and how and where they are covered in the ES.

Table 1-41.4 NPPF requirements relevant to Physical Environment

NPPF section	Where this is covered in the ES
Paragraph 187 "*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 unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability*".	Details of designated sites of principal importance are provided in Section 1.7. Any potential impacts on these sites are considered in Section 1.9. An assessment of impacts on designated sites is available in the HRA and MCZ Assessment (**Application Document 6.6 Habitats Regulations Assessment Report** and; **Application Document 6.11 Marine Conservation Zone Assessment**).

National Planning Practice Guidance

1.2.12 Marine planning in England is the national approach to managing the seas and coasts around England. The UK MPS (HM Government , 2011) provides the policy framework for the national marine planning system.

1.2.13 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

1.2.14 The following marine plans are relevant to Physical Environment and have informed the assessment of preliminary effects in this chapter:

- The UK MPS, which was adopted in 2011, provides the policy framework for the preparation of marine plans and establishes how decisions affecting the marine area should be made (HM Government , 2011);
- East Inshore and East Offshore Marine Plan (HM Government, 2014); and
- Southeast Inshore Marine Plan (HM Government, 2021).

Table 1-51.5 Marine Planning Policies relevant to Physical Environment

Marine Plan	Where this is covered in the ES
The UK MPS ensures that marine resources are used in a sustainable way by ensuring biodiversity is protected and conserved by using the precautionary principle and relying on sound evidence.	In alignment with the policy objectives outlined in the Marine Policy Statement (MPS), this chapter considers measures to avoid adverse impacts on the physical environment. Where feasible, efforts have been made to conserve and minimise alterations to hydrodynamic and sediment transport regimes that could result in geomorphological changes. These considerations have informed decisions regarding routeing, installation and engineering techniques, mitigation measures, and the evaluation of reasonable alternatives. Potential adverse effects to designated sites and protected features have been avoided where possible. Details of protected and designated sites and are provided in Section 1.7. Relevant mitigation is detailed in Section 1.8
East Inshore and East Offshore Marine Plan 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. Policy SOC3 Proposals that may affect the terrestrial and marine character of an area should demonstrate: • That they will not adversely impact the terrestrial and marine character of an area; • How, if there are adverse impacts on the terrestrial and marine character of an area, they will minimise them; • How, where these adverse impacts on the terrestrial and marine character of an area cannot be minimised they will be mitigated against; and • **The case for proceeding with the proposal if it is not**	Routing of the Proposed Project has been selected to avoid sensitive seabed features and habitats (**Application Document 6.2.1.4 (D) Part 1 Introduction Chapter 4 Description of the Proposed Project [REP1A-003]**). An ecosystems-based approach has been adopted and cumulative impacts have been considered to ensure the Proposed Project does not adversely impact Physical Environment that then may have the potential to effect biodiversity within the Offshore Scheme. Section 1.7 details the baseline physical environment conditions, including protected and designated sites. Section 1.9. considers how the Proposed Project might impact Physical Environment and the likely significance of the effect, including the geologically significant and/or sensitive features associated with the Offshore Scheme. Section 1.101.9 suggests additional mitigation measures where significant adverse effects are

Marine Plan	Where this is covered in the ES
possible to minimise or mitigate the adverse impacts	identified. Section 1.11 describes the potential residual effects.
Policy ECO1: • Cumulative impacts affecting the ecosystem of the East marine plans and adjacent areas (marine, terrestrial) should be addressed in decision-making and plan implementation. Policy BIO2: • Where appropriate, proposals for development should incorporate features that enhance biodiversity and geological interests. Policy MPA1: • Any impacts on the overall Marine Protected Area network must be taken account of in strategic level. Policy CC1: • Proposals should take account of how they may be impacted upon by, and respond to, climate change over their lifetime. • Where detrimental impacts on climate change adaptation measures are identified, evidence should be provided as to how the proposal will reduce such impacts.	The future baseline in Section 1.7 accounts for how the effects of climate change and the associated effects of sea level rise and increased storminess may alter the landfall sites. Further information can be found in **Application Document 6.2.5.1 Part 5 Project Wide Effects Climate Change [APP-085]**.
The Southeast Inshore Marine Plan area stretches from Felixstowe in Suffolk to near Folkestone in Kent, covering approximately 1,400 km 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. • SE-CO-1: "*Proposals that optimise the use of space and incorporate opportunities for co-*	

Marine Plan	Where this is covered in the ES
existence and cooperation with existing activities will be supported." • S-CAB-1: "*Preference should be given to proposals for cable installation where the method of installation is burial. Where burial is not achievable, decisions should take account of protection measures for the cable that may be proposed by the applicant. Where burial or protection measures are not appropriate, proposals should state the case for proceeding without those measures."* • SE-CAB-2: "*Proposals demonstrating compatibility with existing landfall sites and incorporating measures to enable development of future landfall opportunities should be supported. Where this is not possible proposals will, in order of preference: a) avoid b) minimise c) mitigate - adverse impacts on existing and potential future landfall sites so they are no longer significant. If it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding."* • S-CAB-2: "*Where seeking to locate close to existing subsea cables, proposals should demonstrate compatibility with ongoing function, maintenance and decommissioning activities relating to the cable."*	

Local Planning Policy

1.2.15 The intertidal area of the Offshore Scheme lies within the jurisdiction of the MMO and local planning authorities which include, Suffolk County Council, East Suffolk Council, Kent County Council and Thanet District Council. Table 1-6~~Table 1.6~~ lists the relevant plans associated with these jurisdictions:

Table 1-61.6 Local planning relevant to Physical Environment

<table>
<tr><th>Local Plan</th><th>Where is this covered in the ES</th></tr>
<tr><td>Suffolk Coastal Local Plan (East Suffolk Council, 2020)
Policy SCLP9.3: Coastal Change Management Area.
Policy SCLP9.4: Coastal Change Rollback or Relocation.
Policy SCLP9.5: Flood Risk.
Policy SCLP10.1: Biodiversity and Geodiversity.
Policy SCLP10.3: Environmental Quality.</td><td rowspan="3">Section 1.7 details the baseline physical environment conditions, including the processes specific to coastal management units, the existing and planned management techniques along the frontage, coastal erosion and morphological change, regional geology, and consideration of protected and designated sites.

The future baseline in Section 1.7 accounts for how the effects of climate change and the associated effects of sea level rise and increased storminess may alter the landfall sites. Further information can be found in Application Document 6.2.5.1 Part 5 Project Wide Effects Climate Change.

An assessment of impacts on designated sites is available in the Habitant Regulations Assessment (HRA) and MCZ Assessment (Application Document 6.6 Habitats Regulations Assessment Report; and Application Document 6.11 Marine Conservation Zone Assessment).

Section 1.9 considers how the Proposed Project might impact Physical Environment at the landfall sites and the likely significance of the effect, including the geologically significant and/or sensitive features associated with the Offshore Scheme.</td></tr>
<tr><td>Dover District Local Plan (Dover District Council, 2024)

New Local Plan to 2040 is currently in development. The plan sets out a vision and objectives for the development of the district over the period to 2040. It provides the planning policy framework to guide the future development of infrastructure, conserving and enhancing the natural environment and mitigating and responding to climate change.</td></tr>
<tr><td>Thanet District Council Local Plan (Thanet District Council, 2020)
Policy GI01- Protection of Nationally Designated Sites and MCZs.
Policy GI02 - Locally Designated Wildlife Sites.
Policy GI03 - Regionally Important Geological Sites (RIGS).
Policy CC01 - Fluvial and Tidal Flooding.
Policy CC03 - Coastal Development.
Policy CC04 - Renewable Energy.</td></tr>
</table>

Local Plan	Where is this covered in the ES
• Policy SE01 - Potentially Polluting Development.	

1.3 Scoping Opinion and Consultation

Scoping

1.3.1 A Scoping Report (National Grid, 2022) for the Proposed Project was issued to the Planning Inspectorate (PINS) on 24 October 2022 and a Scoping Opinion (PINS, 2022) was received from the Secretary of State (SoS) on 01 December 2022 (**Application Document 6.2.1.6 Scoping Opinion and Consultation**). Table 1-7~~Table 1.7~~ sets out the relevant comments raised in the Scoping Opinion and how these have been responded to in this Chapter. The Scoping Opinion takes account of responses from prescribed consultees as appropriate.

Table 1-7~~1.7~~ Comments raised in the Scoping Opinion relevant to Physical Environment

ID	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 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.	Following consultation at PEIR, the impact on water quality has been scoped back into the assessment (Section 2.8). As part of the baseline assessment the most up-to-date water quality status at the landfall sites are described in Section 1.7. Section 1.7 also provides information on marine sediment quality. The potential impact on the water column should contaminants from the seabed be released are assessed in Section 1.9.
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	The potential impacts of changes to nearshore hydrodynamic and sediment transport regimes, along with any resulting modifications to the nearshore seabed and coastal geomorphology, are assessed in Section 1.9.

ID	Inspectorate's comments	Response
	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.	
5.1.3	[*Impact of climate change*] The Applicant has not provided a rationale for scoping this matter out. However, the Inspectorate 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.	The future baseline in Section 1.7 accounts for how the effects of climate change and the associated effects of sea level rise and increased storminess may alter the landfall sites. The impact on coastal erosion has been scoped back into the assessment (Section 1.9).
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.	The potential impact of changes to the hydrodynamic and sediment transport regimes, and any associated changes to seabed morphology including sand waves, and coastal geomorphology are all scoped in and assessed in Section 1.9.
5.1.5	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	Section 2.6 Designated Sites includes a list and accompanying description of the designated sites associated with the Proposed Project, including the Sandwich Bay to Hacklinge Marshes Site of Special Scientific Interest (SSSI).

ID	Inspectorate's comments	Response
	assessment where likely significant effects could occur.	Section 1.9 considered the potential impacts on these sensitive designated features.

Statutory Consultation

1.3.2 Statutory consultation for the Proposed Project took place between 24 October and 18 December 2023. A further targeted consultation exercise on the main changes to the Proposed Project introduced after the 2023 statutory consultation, was undertaken between 08 July and 11 August 2024. A summary of relevant feedback received during statutory consultation relating to Physical Environment is provided below. Further details on how consultation responses have informed the assessment can be found in **Application Document 5.1 Consultation Report**.

Statutory consultees who provided feedback relevant to the physical environment included the Marine Management Organisation (MMO), Natural England, the Environment Agency (EA), and East Suffolk Council. The key themes arising from the consultation are summarised below, along with details of how each has been addressed within this assessment

- Develop the detail included in the baseline characterisation relating to rates and extent of erosion and coastal geomorphological change at both landfall sites.
  - Recent erosion studies, beach and seabed profile and elevation data are incorporated into the baseline assessment. This analysis is used to establish the potential impacts and magnitude of the impact of the Proposed Project to morphological change at the coast.
- Develop understanding of wider sediment transport patterns across the Proposed Project site and the complex interrelationship between adjacent coastlines.
  - The assessment includes a study of the coastal geomorphology and geology and regional sediment transport patterns for both the Kent and Suffolk landfall sites.
  - This analysis supports the impact assessment on the how the Proposed Project might alter hydrodynamic and sediment transport regimes and the wider coastal morphology.
- Include an assessment on suspended sediment dispersion quantities and distance associated with Construction activities.
  - A study has been conducted to estimate the sediment release rates and volumes of sediment that may be released into the water column during different cable burial techniques during the construction phase.
  - A sediment transport model has been developed to assess sediment dispersion distances associated with different types of cable burial techniques and the depth of sediment deposition on the seafloor (**Application Document 6.2.4.1.A Suspended Sediment Modelling**).
- Identify sensitive features and designated sites in the vicinity of the Proposed Project and incorporate them into the impact assessment.

  - The baseline assessment includes a list and accompanying description of the designated sites associated with the Proposed Project, including the Sandwich Bay to Hacklinge Marshes SSSI, The Coralline Crag Ridges, the Thanet Coast Special Areas of Conservation SAC, the Sandwich Bay SAC, the Thanet Coast MCZ and the Goodwin Sands MCZ.
  - Section 2.9 considered the potential impacts on these sensitive and designated features.
- Assess the potential impact on nearshore and offshore bedforms and sand waves in the vicinity of the Offshore Scheme.
  - The sensitivities of and potential changes to bedforms sand waves, sandbanks, including Aldeburgh Napes and the Goodwin Sands (MCZ) system are assessed.
  - Since PEIR, the Offshore Scheme has been re-routed to avoid direct interaction with the Goodwin Sands (MCZ).
- A map showing peak spring tidal flow speeds along the length of the Offshore Scheme route and across the wider Study Area should be provided.
  - Maps showing the tidal current speeds and directions along the Offshore Scheme Boundary route have been produced as part of the modelling assessment carried out for the sediment dispersion model.
- Include to what extent is it anticipated the Coralline Crag Ridges at the Suffolk landfall will be impacted by the Proposed Project.
  - The baseline assesses the sensitivities of the Coralline Crag Ridges and its important role in stabilising the regional coastal morphology. This includes reference to the recent assessment carried out by ABPmer (2024a) on the landfall site at Aldeburgh.
  - The impact assessment considers how any alterations to the Coralline Crag Ridges may impact the wider Suffolk coastline, including altering the stability and character of the coastline as far north as Dunwich and as far south as Orford Ness.

Further Engagement

1.3.3 No further engagement specific to Physical Environment was conducted.

Summary of Scope of Assessment

1.3.4 Following the PEIR and stakeholder consultations, a summary of the considerations included in this assessment are summarised below:

- changes to seabed bathymetry and morphology;
- changes to local and regional beach and coastal morphology;
- changes to coastal morphology as a result of climate change;
- changes to sediment transport regimes and patterns;
- changes to hydrodynamic regimes and patterns;
- the impact of the Proposed Project on sand waves and bedforms;

- the impact of the Proposed Project on designated sites within the marine and coastal environments;
- changes to suspended sediment concentration of the water column and the extent and impact of subsequent deposition of sediment onto the seabed; and
- changes to marine water quality from accidental leaks and spills from vessels, including loss of fuel oils and the release of contaminants from the seabed.

1.4 Approach and Methodology

1.4.1 **Application Document 6.2.1.5 Part 1 Introduction Chapter 5 EIA Approach and Methodology** outlines the overarching framework adopted for the environmental assessment. This section details the technical methodologies used to establish baseline conditions, evaluate receptor sensitivity, and determine the magnitude of potential effects. It also defines the significance criteria applied specifically to the assessment of the physical environment.

Guidance Specific to the Physical Environment Assessment

1.4.2 The following has been used to inform this appraisal of potential effects on Physical Environment, insofar as applicable to the Proposed Project:

- The Rock Manual. The use of rock in hydraulic engineering. CIRIA Report C683 (CIRIA, CUR, CETMEF, 2007).
- Cumulative Impact Assessment Guidelines – Guiding Principles for Cumulative Impact Assessment in Offshore Wind Farms (RenewableUK, 2013);
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Cefas, 2012);
- Environmental Impact Assessment for offshore renewable energy projects (British Standards Institute, 2015);
- Guidance on Environmental Impact Assessment in Relation to Dredging Applications (Office of the Department of the Prime Minister, 2001);
- Guidance on Best Practice for Marine and Coastal Physical Environment Baseline Survey and Monitoring Requirements to Inform EIA of Major Development Projects. (Natural Resources Wales , 2018);
- 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 (Cefas, 2004);
- Nature Conservation Guidance on Offshore Wind Farm Development (DEFRA, 2005);
- Marine Licensing: Sediment Analysis and Sample Plans (Marine Management Organisation, 2014);
- High Level Review of Current UK Action Level Guidance: MMO Project No. 1053 (Marine Management Organisation, 2015);
- ME5226 C7590: Review of Action Levels used for assessing Dredging and Disposal Marine Licences (Cefas, 2018);

- DNV-RP-F401 Electrical power cables in subsea applications (DNV. GL, 2019); and
- DNV-RP-0360 Subsea power cables in shallow water (DNV. GL , 2016)

Baseline Data Gathering and Forecasting Methods

1.4.3 The Physical Environment baseline conditions have been established by undertaking a combination of desktop review of published information and the collection of project-specific survey data. The baseline provides a robust and up-to-date characterisation of Physical Environment within the Study Area.

1.4.4 A substantial body of publicly available data exists concerning the physical environment within the Study Area. Much of this information has been generated in connection with both current and historical offshore developments, including offshore wind farms and subsea cable projects, which have been subject to statutory or non-statutory Environmental Impact Assessments (EIAs).

Desk study

1.4.5 Where relevant, this information has been used to help inform the baseline characterisation for the Offshore Scheme. In addition, a range of other data sources have been used to inform the baseline description and appraisal including:

- Admiralty Tide Tables (UK Hydrographic Office, 2021);
- Anglian Coastal Monitoring Programme: 2016 - 2017 Survey Report (Environment Agency , 2017);
- Assessment of Coastal Access Proposals between Aldeburgh and Sizewell on sites and features of nature conservation concern (Natural England, 2020);
- Atlas of UK marine renewables resources: modelled wave, wind and tidal current (ABPmer , 2017);
- Cefas Climatology Report (2016) Waters Suspended sediment concentrations (SSC) (Cefas, 2016);
- Coastal Flood Boundary Dataset (CFB) (Environment Agency, 2018);
- Coastal Morphology Report, Thorpeness (Phase 1) (Environment Agency, 2011);
- EA ‘Flood Risk Assessments: Climate Change Allowances; EA ‘Flood Risk Assessments: Climate Change Allowances (Environment Agency, 2016);
- East Anglia ONE North Offshore Windfarm, Appendix 4.6 Coastal Processes and landfall Site Selection, Environmental Statement (Scottish Power Renewables, 2019);
- East Inshore and East Offshore Marine Plans (HM Government, 2014);
- Five Estuaries Offshore Windfarm Array (GoBe Consultants Ltd, 2023);
- GeoIndex Offshore (British Geological Survey, 2022);
- Isle of Grain to South Foreland SMP (Halcrow Group Limited, 2010);
- Lowestoft to Felixstowe SMP (East Suffolk Council, 2010);
- Landfall Assessment at Aldeburgh, Landfall Sediment Modelling (ABPmer, 2024a);

- Landfall Assessment at Pegwell Bay, Landfall Sediment Modelling (ABPmer, 2024b);
- Marine Estate Research Report – Seabed mobility in the greater Thames estuary (Burningham; French, 2009);
- National Network of Regional Coastal Monitoring Programmes of England, Meteorological Station Network Annual Report (NNRCMP, 2021);
- Coastal Wave Network Annual Report (NNRCMP , 2019);
- Seabed dynamics in a large coastal embayment: 180 years of morphological change in the Outer Thames Estuary (Burningham & French, 2011);
- SEASTATES Associated British Ports Marine Environmental Research (ABPmer, 2018a);
- Shoreline – Shoreface Dynamics on the Suffolk Coast, Marine Research Report (Burninghan & French, 2016);
- Southeast Regional Coastal Monitoring Programme – North Foreland to Dover Harbour (Channel Coastal Observatory , 2020)
- Suffolk (SMP 7) Coastal Trends Report 2021, Lowestoft Ness to Landguard Point (Anglian Regional Coastal Monitoring Programme, 2022);
- 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 (BEEMS Technical Report TR311, 2020);
- Thorpeness Coastal Erosion Appraisal, Final Report (Mott MacDonald, 2014);
- Thanet Extension Offshore Wind Farm, Environmental Statement Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Environment (Vattenfall Wind Power Ltd , 2018); and
- UK Climate Projections (UKCP): sea level rise (Met Office, 2022).

Intertidal Characterisation Survey 2023

1.4.6 An intertidal survey at the Kent landfall, was conducted on the 13 and 14 June 2023, followed by an intertidal survey at the Suffolk landfall on the 11 and 12 September 2023 (**Application Document 6.3.4.2.C Appendix 4.2.C Intertidal Survey Report**).

1.4.7 At each location, three transects were placed at intervals along the shore. Along each transect, three sediment core samples (0.01 m^2) were collected at different shore heights (upper, mid, and low shore). The sediment core samples were collected for macrofaunal analysis and particle size analysis (PSA). Quadrat sampling was required at upper and mid shore sampling points in Suffolk due to pebbles and cobbles preventing sampling with core samplers. At these stations, a 0.25 m^2 quadrat was used.

Subtidal Characterisation Survey 2021

1.4.8 A dedicated subtidal benthic survey was carried out between 08 September and 06 October 2021 to characterise benthic ecological conditions and map the distribution and extent of habitats along the subtidal Offshore Scheme. Detailed information related to the benthic surveys undertaken and the findings are provided in **Application**

Document 6.3.4.2.A Appendix 4.2.A Benthic Characterisation Report (Original Report), with a summary of the methods provided below.

1.4.9 The two key objectives of the subtidal surveys were to:

- Collect video/stills footage and grab samples from pre-defined stations positioned along the Offshore Scheme, in order to characterise seabed sediments and associated benthic communities within this area.
- Collect additional video/stills at proposed ground truthing stations along the Proposed Project route, particularly where features of interest were observed (e.g., mottled seabed indicative of possible reef habitats etc.) to allow for high confidence mapping of any habitats of conservation importance.

1.4.10 Sample stations were selected by reviewing remote sensing data provided by side scan sonar (SSS) and multi beam echo sounder (MBES) from a preliminary geophysical survey. The number and location of sample stations were determined based on depth variation, sediment, and habitat changes to provide benthic data for all habitat types interpreted across the survey route. As a result, the sampling effort was concentrated in areas of heterogeneous seabed. This resulted in the selection of 37 subtidal sampling stations, 21 of which are within the current Offshore Scheme Boundary positioned to reflect the diversity of habitats identified in the geophysical survey data.

1.4.11 Grab sampling was carried out at each of the survey stations for quantitative macrofaunal, particle size analysis (PSA), and sediment chemical analysis. The primary grab sampler utilized was a dual van Veen (2 x 0.1 m^2) and the secondary a Hamon grab (0.1 m^2).

1.4.12 In areas with hard bottom substrates or sensitive areas that could not be sampled with grab samplers, grab sampling was not attempted, and an extended drop-down video (DDV) transect was performed to identify epifauna and habitat transitions. The survey line was planned over the area of interest, and still images were collected along the entire DDV transect. Five DDV transects were performed in total, three of which are within the Offshore Scheme Boundary.

Geophysical and Environmental Survey 2024

Geophysical

1.4.13 Following consultation and a minor route change, where the Offshore Scheme Boundary deviates from the Benthic Characterisation Report 2021 survey area (**Application Document 6.3.4.2.A Appendix 4.2.A Benthic Characterisation Report (Original Report)**), a geophysical survey (**Application Document 6.3.4.2.B Appendix 4.2.B Geophysical Survey Interpretation (Additional Surveys)**) was commissioned to understand seabed morphology, shallow sediment structure, and to provide benthic characterisation at these locations. This survey was undertaken in 2024, and covered following sections of the Offshore Scheme Boundary:

- KP1.0 - KP3.2, nearshore of the Suffolk Landfall;
- KP17.7 - KP32.3;
- KP33.8 - KP42.0;
- KP99.0 - KP103.2, north of Goodwin Sands Marine Conservation Zone (MCZ); and

- KP104.7 - KP114.5, west of Goodwin Sands MCZ.

1.4.14 The initial interpretations of the seabed sediments are based on SSS and MBES data, with further analysis anticipated.

Environmental

1.4.15 For the pre-sweeping interval (KP96.32–KP113.883), the baseline incorporates MMO-validated 2024 vibrocore data from 16 pre-sweep locations (MMO Site A to MMO Site O) (Next Geosolutions & Benthic Solutions Ltd. , 2025). Samples were analysed in an MMO-validated laboratory for contaminants (trace metals including arsenic, PAHs, organic matter) and Particle Size Analysis (PSA) in line with the agreed MMO sampling plan. These data have been integrated with the 2024 geophysical datasets to characterise sediment type, thickness and quality prior to sand-wave clearance.

1.4.16 The findings of the MMT 2021 survey align closely with the results of the new 2024 environmental survey, with both datasets showing similar sediment compositions, naturally elevated arsenic levels, and consistently low PAH concentrations across the southern North Sea corridor (Next Geosolutions & Benthic Solutions Ltd. , 2025).

Assessment Criteria

1.4.17 When defining sensitivity, the criteria levels set out in **Application Document 6.2.1.5 Part 1 Introduction Chapter 5 EIA 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 1-8~~Table 1.8~~.

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

Sensitivity of Physical Environment receptors

1.4.19 When defining sensitivity, reference has been made to the criteria levels set out in **Application Document 6.2.1.5 Part 1 Introduction Chapter 5 EIA Approach and Methodology**: very high, high, medium, low and negligible. To determine sensitivity of the receptor, the vulnerability of the receptor to the specific impact and its ability to recover and adapt were also considered. The importance, or value, of the receptor on an international, national, and local scale has also been considered in assessing sensitivity.

Table 1-8~~1.8~~ 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 Proposed Project life (10 + years), e.g., low tolerance to change

Sensitivity criteria	Definition
	and low recoverability, such as features formed over geological timescales; or • 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., within >5 or 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 sand waves; 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 of Physical Environment effects

1.4.20 The magnitude of impact will be considered in terms of the spatial extent over which the impact is likely to occur, the duration and frequency of the impact, and timing of the potential impact. When defining the magnitude of the impact, criteria detailed in **Application Document 6.2.1.5 Part 1 Introduction Chapter 5 EIA Approach and Methodology** has been followed: large, medium, small, and negligible.

1.4.21 A summary of the magnitude criteria is detailed in Table 1-9~~Table 1.9~~.

Table 1-9~~1.9~~ 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

Magnitude	General criteria
	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 Physical Environment effects

1.4.22 The methodology for establishing the significance of an impact is as is set out in the **Application Document 6.2.1.5 Part 1 Introduction Chapter 5 EIA Approach and Methodology**.

1.4.23 When determining whether an effect is significant, the magnitude of impact and sensitivity of the receptor are accounted for. Professional judgement has also been applied to allow for consideration of previous project knowledge. Additionally, a precautionary approach has been taken with the worst-case scenario assessed for each impact, in order to account for any uncertainty or lack of baseline survey data in the assessment.

Assumptions and Limitations

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

- Data relevant to Physical Environment have been obtained from publicly available data sources, supplemented with information from the baseline surveys. No site-specific field measurements of waves, currents, or sediment concentrations have been collected along the Offshore Scheme. Reference is made to previous studies and use made of modelled and empirical datasets from available sources to inform the appraisal and provide a robust, evidence-based approach consistent with other regional developments.

- 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.

1.5 Basis of Assessment

1.5.1 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 assessment to changes in the construction commencement year.

1.5.2 Details of the available flexibility and assessment scenarios are presented in **Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project** and **Application Document 6.2.1.5 Part 1 Introduction Chapter 5 EIA Approach and Methodology**.

Flexibility Assumptions

1.5.3 The environmental assessments have been undertaken based on the description of the Proposed Project provided in **Application Document 6.2.1.4 Part 1 Introduction 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 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 Order Limits.

1.5.4 The assumptions made regarding the use of flexibility for the main assessment, and any alternatives assumptions are set out in Table 1-10~~Table 1.10~~ below.

Table 1-10~~1.10~~ Flexibility assumptions

Element of flexibility	How it has been considered within the assessment?
Cable burial techniques	Where different cable burial techniques may be used, the impact assessment is based on the worst-case scenario.

Sensitivity Test

1.5.5 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 potential 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 1.9.

1.6 Study Area

1.6.1 The Offshore Scheme Boundary runs from mean high-water springs (MHWS) at the landfall in Aldeburgh, Suffolk, to MHWS at the landfall in Pegwell Bay, Kent, crossing the outer Thames Estuary in the southern North Sea.

1.6.2 The Offshore Scheme is situated entirely within UK territorial waters and is up to 122 km in length (**Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project**). The Offshore Scheme Boundary is 500 m wide for the majority of the Offshore Scheme representing a typical offshore working corridor within which the cable can be laid.

1.6.3 The Offshore Scheme will use a trenchless solution, such as horizontal directional drilling (HDD), at both landfall locations.

1.6.4 It is noted that the MMO defines the inshore and offshore as 12 nm and > 12 nm from land respectively. However, for the purposes of describing Physical Environment in the marine environment this chapter defines the 'nearshore environment' based on water depth as it better relates to the Physical Environment discussed within the assessment. Where water depth is less than 15 m and the 'offshore environment' where water depths are greater than 15 m. This aligns approximately with KP 10, near Suffolk and KP 110 near Pegwell Bay.

1.7 Baseline Conditions

Overview of the Suffolk Landfall Coastal Environment

1.7.1 The Suffolk landfall is located on a stretch of coast known as The Haven (Local Nature Reserve & SSSI) (Plate 1-1~~Plate 1.1~~). The Haven is a shingle beach and is characterised by a main shingle vegetated ridge that hosts rare and protected plants (Natural England, 2020), (Riggall & Associates, 2022). The intertidal zone abuts the main ridge with a sharp shingle cliff, which in places experiences erosion resulting in root exposure (Natural England, 2020).

1.7.2 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. 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.

Shoreline management policy

1.7.3 The Suffolk landfall location lies within the coastline covered by the Lowestoft to Felixstowe shoreline management plan (SMP) 7 which is split into 7 areas (Royal Haskoning, 2010). The landfall location is situated within the Thorpeness to Orford Ness 5 area, which is further split it into management units. The landfall location aligns with management unit ALB14.2.

1.7.4 The management approach of ALB14.2 in the short term (0 to 20 years, 2005 to 2025), medium term (20 to 50 years, 2025 to 2055) and the long term (50 to 100 years, 2055 to 2105) is managed realignment.

1.7.5 At present, the shingle bank along the Haven Beach acts as flood defence to the lower lying land behind it, including to the Meare and to the rear of Aldeburgh. In future, the overtopping risk is likely to increase (Royal Haskoning, 2010). To mitigate this risk, the advised management approach is to develop a secondary defence set back from the shingle ridge to protect properties around the Meare and in Aldeburgh. The defence should allow the natural roll-back of the shingle beach and inundation of the low-lying land. There is potential for the creation of new habitat in the area immediately behind the shingle ridge. The Thorpe Road should also be protected (Halcrow Group Limited, 2010).

1.7.6 Following an update to the Thorpeness Shoreline Management Plan 7 (2015), the policy towards Thorpeness and at Thorpeness Haven (ALB14.1), adopts a managed realignment approach over the long term, allowing the coastline to respond naturally to changing conditions while managing risks. In Epochs 1 (2005–2025) and 2 (2025–2055), the policy (MR2) focuses on slowing erosion where possible, permitting limited measures to reduce the rate of cliff retreat or erosion of back-shore features without attempting to halt natural processes. By Epoch 3 (2055–2105), the policy shifts to MR3, where existing defences are removed to enable natural erosion and flooding to higher ground, supporting long-term coastal adaptation and the creation of more sustainable shoreline conditions.~~which includes the location of the landfall site, is for managed realignment with the current alignment maintained at existing defences for epoch 1 (until 2025) and epoch 2 (2025 – 2055), then managed realignment alone in epoch 3 (2055-2105).~~

Plate 1-11.1 Suffolk landfall coastline, Thorpeness to Aldeburgh (Photo modified from (Royal Haskoning, 2010). Suffolk Landfall Metocean Conditions

Water levels

1.7.7 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.

1.7.8 The Thorpeness and Haven coastlines are exposed to a microtidal range (i.e. a tidal range of less than 2 metres) which results in a more focused/narrower section of the beach being more frequently interacting with the sea and exposed to wave action (Mott MacDonald, 2014; Red Penguin Marine, 2022; ABPmer, 2024a). At Thorpeness this results in erosion of the soft cliffs and at The Haven, where the Offshore Scheme makes landfall, this causes erosion of the main shingle vegetated ridge. Beach geomorphological change is assessed in section: Suffolk landfall geomorphology and sediment transport.

1.7.9 Table 1-11~~Table 1.11~~ presents the water levels from the UKHO Admiralty Tide Tables (UK Hydrographic Office, 2021) for Aldeburgh, approximately 2 km south of the Suffolk landfall. The tidal range is much smaller in Suffolk due to the Suffolk landfall being located 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 1-11~~1.11~~ Aldeburgh tidal water levels (UK Hydrographic Office, 2021)

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

Waves

1.7.10 Mott MacDonald (Mott MacDonald, 2014) 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.

1.7.11 Atkinson and Esteves (Atkinson & Esteves, 2019) have analysed the wave climate near Thorpeness based on offshore data recorded by the West Gabbard buoy, located about 40 km southeast of the landfall site. Atkinson and Esteves (Atkinson & Esteves, 2019) 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 (Plate 1-2~~Plate 1.2~~ Plate 1-2~~Plate 1.2~~). In most years (8 out of 11), waves from the south were more frequent than waves from the north. Overall, the nearshore wave climate along the Suffolk coast correlates well with the offshore wave directions (Red Penguin Marine , 2022).

1.7.12 Higher waves (significant wave height >2.5 m) approached mainly from south-southwest (Atkinson & Esteves, 2019) 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. At Lowestoft the significant wave height (Hs) storm alert threshold for a 0.25-year return period is 3.11 m (NNRCMP, 2021).

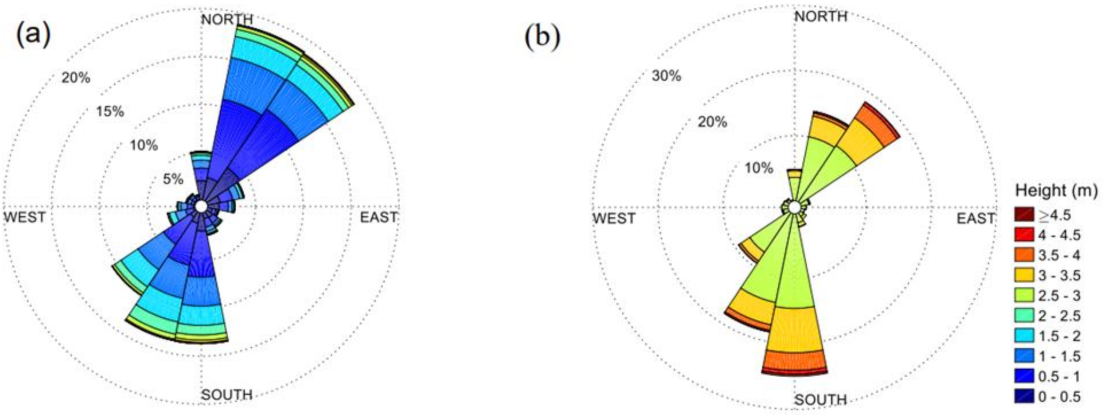

Plate 1-21.2 From Atkinson and Esteves (Atkinson & Esteves, 2019) – West Gabbard buoy wave roses for (a) all waves and (b) waves of Hs > 2.5 m, showing the percentage of waves of different heights (Hs) that approach from different directions in the period June 2006 to March 2018 (168685 records, 98% data coverage).

Extreme wave conditions

1.7.13 ABPmer (2024a) used wave data from SEASTATES to assess the extreme wave conditions at KP 3 and are therefore representative of wave conditions on the approach to the Suffolk landfall.

1.7.14 Table 1-12Table 1.12 shows wave parameter data for 5 different return periods, including wave height (Hs) and wave period (Tp) for all wave directions (ABPmer, 2024a).

1.7.15 Plate 1-3Plate 1.3 plots the directional extreme wave heights for a 1:50 year return period. The most extreme wave heights are from the south-southeast (2.9 m), followed by waves from the east at 2.6 m and east-southeast at 2.4 m.

Table 1-121.12 Omnidirectional extreme wave results at KP3 for five different return periods (ABPmer, 2024a)

Wave parameter	Return Period				
	1:1	1:5	1:10	1:50	1:100
Hs (m)	2.4	2.7	2.7	2.9	2.9
Tp (s)	7.5	7.9	8.1	8.2	8.3

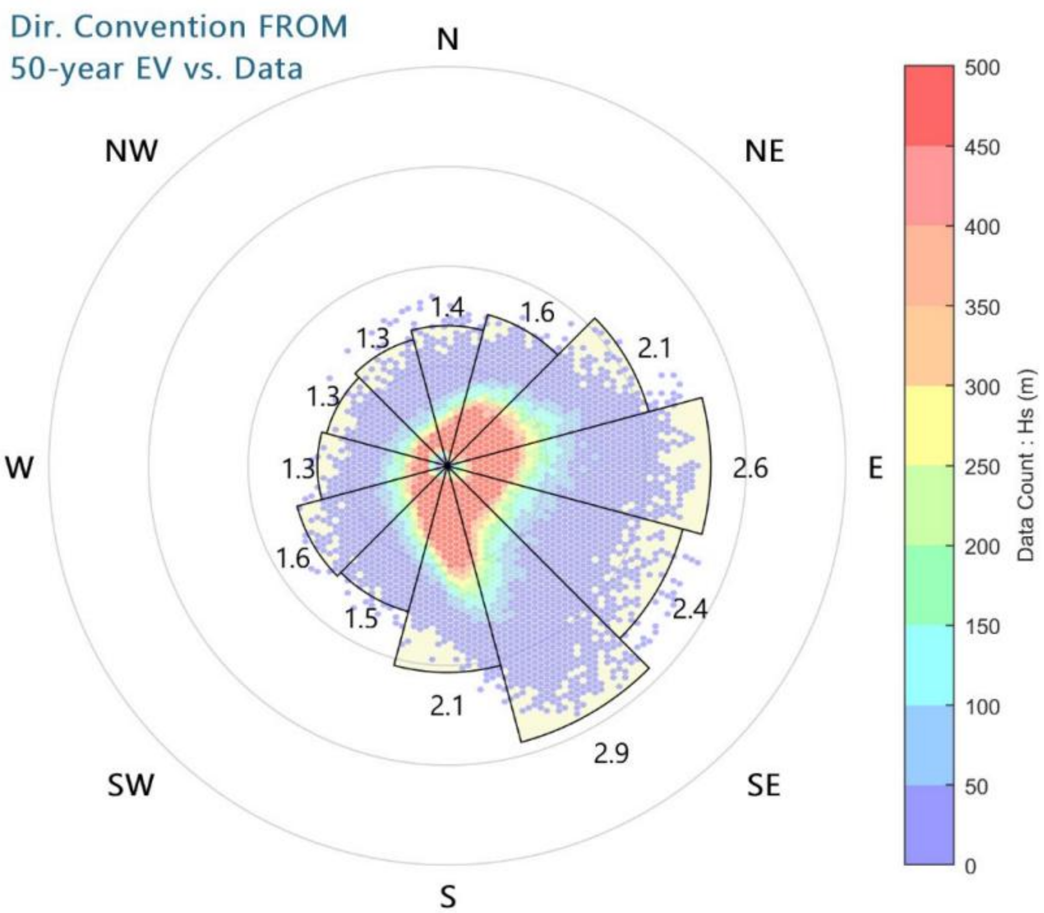

Plate 1-31.3 Wave rose of extreme wave heights at 1:50 return period for KP3, showing the amount of wave height data per sector and in black the extreme wave height per direction sector (ABPmer, 2024a).

Sea temperature

1.7.16 The Channel Coastal Observatory provides average sea temperature for Lowestoft, Suffolk, situated approximately 30 km north of the Suffolk landfall site. Average sea temperature data recorded for the years 2017-2023 are presented in Table 1-13Table 1.13 (Channel Coastal Observatory , 2020).

Table 1-131.13 Average sea temperature at Lowestoft, Suffolk for the years 2017-2023 (Channel Coastal Observatory, 2020)

Month	Sea temperature (degrees C)
January	6.2
February	5.4
March	6.5

Month	Sea temperature (degrees C)
April	8.6
May	11.5
June	15.1
July	17.6
August	19.2
September	17.4
October	14.0
November	10.9
December	7.6

Suffolk Landfall Geomorphology and Sediment Transport

Suffolk coastal geomorphology and geology and regional sediment transport

1.7.17 The Suffolk coastline is characterised by relatively young and soft geology with sedimentary formations largely comprising sands, muds and shingle, which are all readily eroded by the sea. As a result, the Suffolk coastline is morphologically dynamic as its soft sediments are continually re-worked, experiencing coastline advance and erosion over thousands of years (Alison Farmer Associates, 2018). The underlying bedrock geology comprises of the Chalk Group, the London Clay Formation and the Crag Group, whose deposits are made of the accumulation of estuarine or marine shelly sands (The British Geological Survey, 2024). At Thorpeness, the Crag formation outcrops as the Coralline Crag sub-unit.

1.7.18 The Suffolk coastline features multiple headlands, known as nesses including, Lowestoft, Benacre, Thorpeness, Orford, and at Shingle Street. These features protrude from the coastline forming shallow bays and moderately protected havens along the coast. The Thorpe Ness is formed by the underlying hard geology of the Coralline Crags, while other nesses, such as the Orford Ness, Lowestoft Ness and Benacre Ness are formed by the deposition of sediment and sustained longshore transport (HR Wallingford, 2002).

1.7.19 Erosion of the cliffs across the region provides the main source of sediment supply to beaches, the offshore sandbanks and nearshore bars. The net direction of sediment transport along the Suffolk coast is to the south (Plate 1-4~~Plate 1.4~~). Generally speaking, the northern Suffolk coastline may be considered erosive, while the southern Suffolk coastline shows long term accretional trends (Reeve, Horrillo-Caraballo, Karunarathna, & Pan, 2019; Mott MacDonald, 2014; BEEMS Technical Report TR311). However, this is a large-scale and long-term trend that does not account for localised erosion and accretion rates and patterns that affect the Suffolk coastline associated with the landfall site. This is further assessed in the beach morphology and erosion section below.

1.7.20 Further offshore, bedform migration suggests sediment transport is generally northwards (Royal Haskoning, 2009).

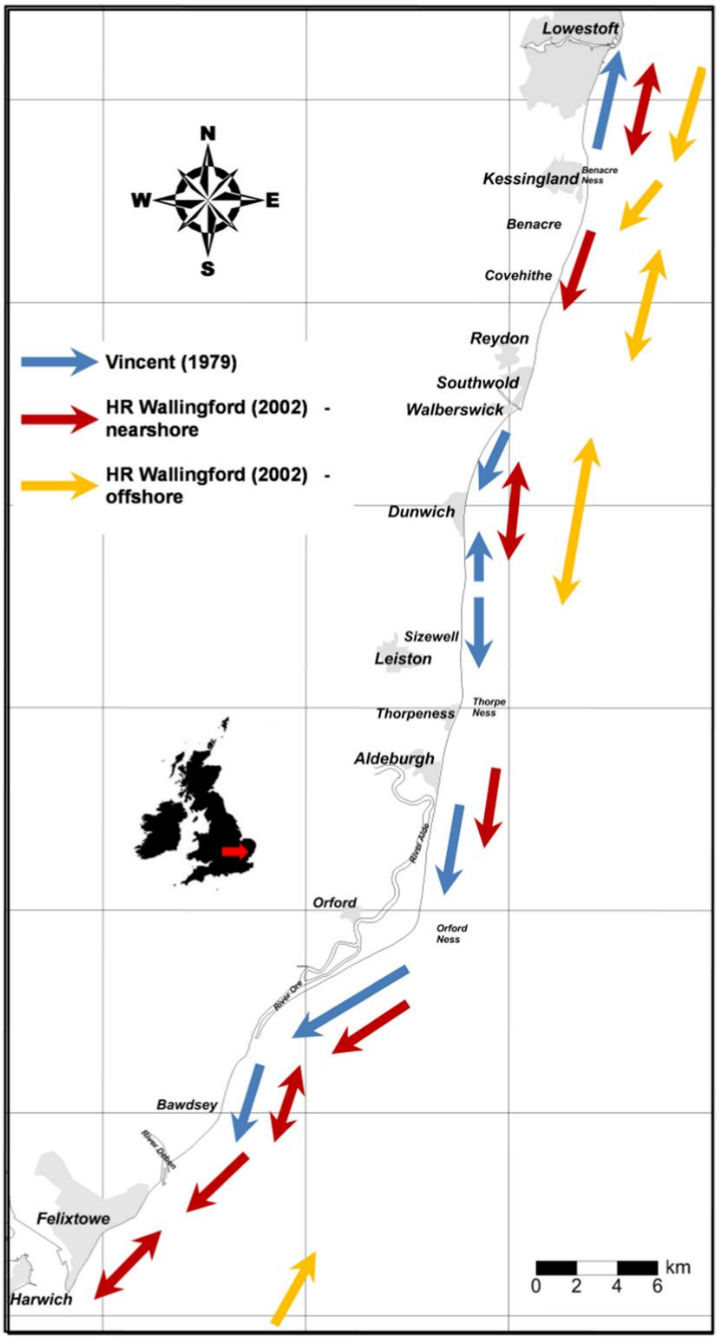

Plate 1-41.4 Potential littoral transport as estimated by (Vincent, 1979) and schematic sediment transport pathways (HR Wallingford, 2002)

Coralline crag ridges

1.7.21 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 (extending approximately 3 km) in the form of static ridges that extend north-eastwards away from Thorpeness (Plate 1-5Plate 1.5). The coralline crag ridges are composed of cemented Pliocene shelly sand which lie beneath the surficial marine sediments and sand waves (Bamber & Moore, 1995) (Royal Haskoning DHV, 2019)

(Red Penguin Marine, 2022). Further information on the Coralline Crag is included in **Application Document 9.113 (A) The Coralline Crag Technical Note [~~rep~~REP4-102]**.

1.7.22 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 stabilize the position of the Sizewell shoreline.

1.7.23 The Coralline Crag outcrop within the inshore area is interconnected with many of the Physical Environment processes that maintain the geomorphology of this stretch of Suffolk coastline (Royal Haskoning DHV, 2019).

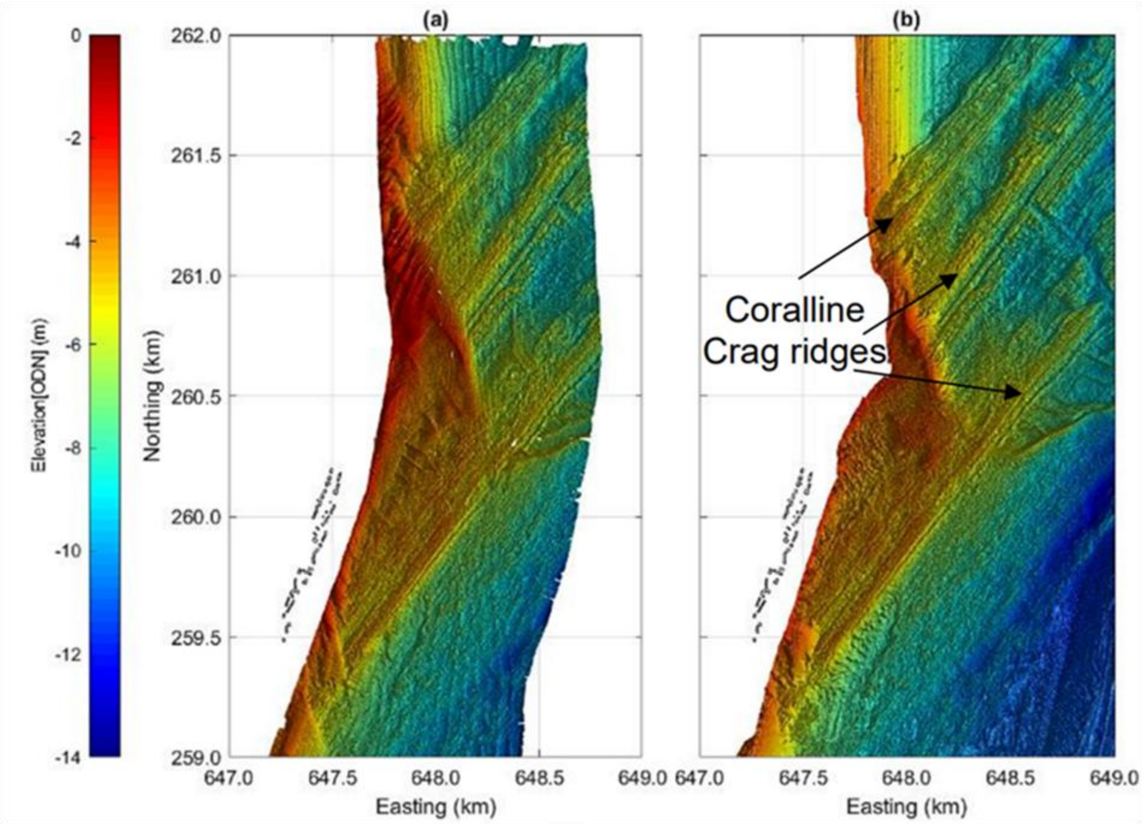

Plate 1-5~~1.5~~ Bathymetry obtained from two multibeam surveys undertaken by (A) the EA in June 2014 and (B) the Maritime Coastal Authority in January 2017. From (Royal Haskoning DHV, 2019).

Seabed features

Sizewell-Dunwich Bank complex (SDBC)

1.7.24 The Sizewell – Dunwich Bank Complex (SDBC) is a sedimentary feature made up of two parts, the Sizewell bank (-3 to -5 m elevation) to the south, and the Dunwich bank (-to -5 m elevation) to the north (BEEMS Technical Report TR311). The SDBC is approximately 11 km in length, 1 km wide, with a 1:60 slope on the western flank and a 1:200 slope on the eastern flank (Mott MacDonald, 2014; Red Penguin Marine , 2022). The BEEMS Technical Report TR311 explains that the infrequent surveying of the

SDBC suggests this feature remains relatively stationary for several years. Historical records show that the northern and central sections of the bank complex tend to migrate towards the land at an average rate of 6 m to 7 m/year. However, records show that over the last decade, the southern section has remained relatively stationary in location (BEEMS Technical Report TR311).

1.7.25 It is thought that the reason for the stability of the Sizewell bank is related to the Coralline Crag ridges. The Coralline Crags outcropping ridges extend seawards towards the Sizewell Bank. As described above, the erosion resistant Coralline Crag formation at Thorpeness fixes the location of the Thorpe Ness, this subsequently locally affects the tidal circulation patterns, which flow clockwise around the banks, which in turn maintain the position of the Sizewell bank. It is possible that the Coralline Crag Ridges that extend beneath the bank, may also be associated with its development and contribute to its positional stability (BEEMS Technical Report TR311).

1.7.26 The SDBC is also thought to help provide stability to the Thorpe Ness by sheltering it against direct wave impact (Royal Haskoning DHV, 2019).

1.7.27 Numerical modelling of the Greater Sizewell Bay (BEEMS Technical Report TR357) indicated that some of the sediment being transported south along a nearshore pathway is diverted offshore as the Coralline Crag Ridges funnel and direct the flow offshore, creating a recirculation sediment transport pattern around the SDBC (Plate 1-6~~Plate 1.6~~).

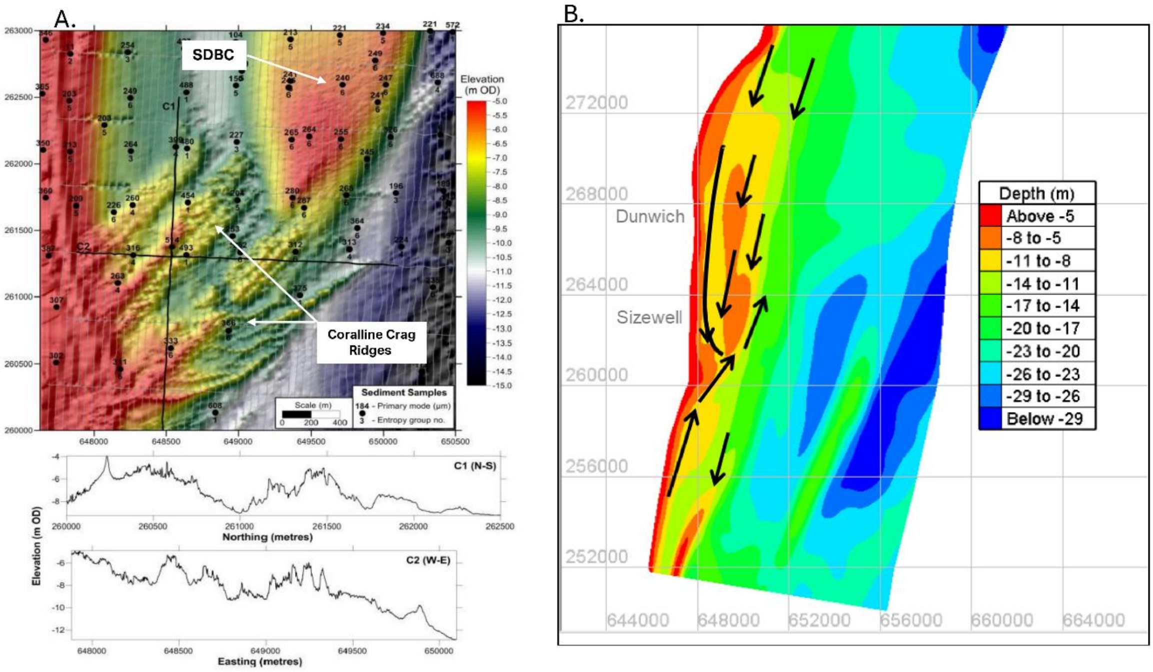

Plate 1-6~~1.6~~ Bathymetry of the southern end of the trough showing ridges of Coralline Crag extending north eastwards from Thorpeness under the southern end of the SDBC. Image modified from (Mott MacDonald, 2014). B: Schematic subtidal sand transport pathways deduced from numerical modelling (BEEMS Technical Report TR357).

Aldeburgh Napes and Aldeburgh Ridge

1.7.28 The Aldeburgh Napes (or Knapes) is a sand bank that lies about 10 km east of Aldeburgh (Plate 1-7~~Plate 1.7~~). The Aldeburgh Napes is thought to be a relic equivalent to the present-day Aldeburgh Ridge that formed in association with a historic and more seaward shoreline (HR Wallingford, 2002; Burningham & French , 2008; Red Penguin Marine, 2022). The bank is oriented northeast to southwest. This feature may offer some protection to the Aldeburgh and Thorpeness coastlines by providing a degree of shelter from wave impact. However, this may vary over time depending on the erosional and depositional patterns and cycles associated with the bank, and the wave approach direction (Mott MacDonald, 2014). Since 1800 the minimum water depths over the Aldeburgh Napes have progressively increased at a rate of 40 mm/yr (Burningham & French , 2008) i.e. the Napes have experienced a reduction in height. At present, there is insufficient data available to better define the extent of protection the Aldeburgh Napes offers the Suffolk coastline.

1.7.29 The Aldeburgh Ridge has also experienced a -decrease in height at a rate of approximately11 mm/yr between 1860s -1960s. Since this period, the Aldeburgh Ridge has experienced a dramatic change in trend, experiencing vertical accretion of over 72 mm/yr (Burningham & French , 2008).

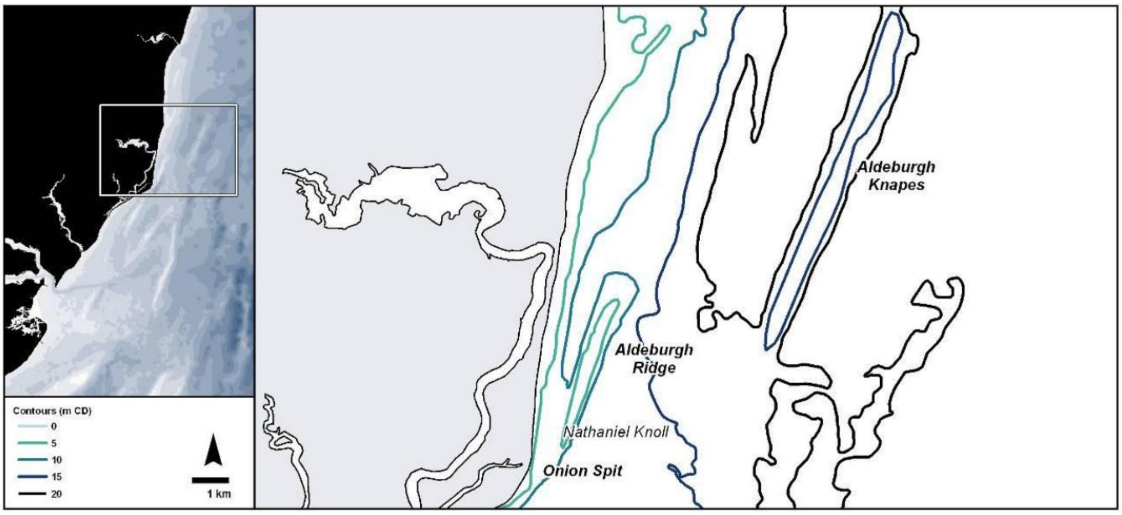

Plate 1-7~~1.7~~ Thames Estuary bedforms near the Suffolk Coastline, including the Aldeburgh Napes and Aldeburgh Ridge (Burningham & French, 2008).

Beach morphology and erosion

1.7.30 At the Suffolk landfall site, the intertidal area comprises a mixture of sand and shingle that shelves steeply down to approximately -4 m AOD. With increasing depth, the gradient of the seabed decreases and becomes virtually flat approximately 700 m from the MHWS mark (Red Penguin Marine, 2022).

1.7.31 The Anglian Coastal Monitoring Programme (ACMP) has been surveying the Suffolk coastline, from Lowestoft Ness to Landguard Point in Felixstowe, since the early 1990s (see Plate 1-8~~Plate 1.8~~). The coastline between Lowestoft and Orford Ness is predominantly oriented north–south. Net sediment transport along this stretch is generally southward; however, due to the bi-directional nature of the wave climate, northward sediment movement also occurs.

Plate 1-81.8 The Anglian Coastal Monitoring Programme, monitoring cells.

Thorpeness (Cell 3cSU10TN)

1.7.32 The cell extends from north of the Thorpe Ness to south of the village Thorpeness (Plate 1-9Plate 1.9). The Anglian Regional Coastal Monitoring Programme (ACMP) (Anglian Regional Coastal Monitoring Programme, 2022) explain that properties along the Thorpeness frontage have been protected by gabion baskets since 1970 and geotextile bags since 2010. However, recent monitoring by the ACMP has found that the defences have been progressively weakened due to beach drawdown and wave action. In response, repair works were carried out and a rock revetment was installed at the North End Avenue frontage in 2021.

1.7.33 Between Transects S037 and S038 are the Coralline Crags, identifiable in where the water depth is shallower (-2.5 to - 4.5 m).

1.7.34 Plate 1.10 shows the LiDAR elevation difference between 2011/12 – 2020/21. It shows that just north of Thorpeness, there is an erosion hot-spot associated with cliff recession of up to 10 m.

1.7.35 To the north of the Thorpe Ness, sediment has built up between 2011 and 2021, while to the south of the ness, beach material has been lost (Anglian Regional Coastal Monitoring Programme, 2022) (Plate 1-10~~Plate 1.10~~).

1.7.36 Following storms in Winter 2013, Transects S037 and S039 recorded the narrowest and lowest beach levels. It took 2 years to recover to pre-storm conditions (Anglian Regional Coastal Monitoring Programme, 2022). Further south at Transect S039, the lowest and narrowest beach was measured in Summer 2011, which recovered to its former level by the following Winter (Anglian Regional Coastal Monitoring Programme, 2022).

1.7.37 The ACMP (2022) has calculated mean rates of change from Transects S037, S038 and S039 to show erosional trends since 1991 (Plate 1-11~~Plate 1.11~~). Each transect within the Thorpeness monitoring cell shows a long-term erosional trend:

- Transect S037 shows a notable acceleration in erosion from -0.2 m/yr, to -4.6 m/yr since 2016.
- Transect S038 has experienced a tripling of erosion rate from -0.6 m/yr to -2.8 m/yr between 2016-2021 in association with the more vulnerable northern end of Thorpeness.
- Transect S039 has experienced a doubling in the mean rate of shoreline retreat from -0.9 m/yr to -2.0 m/yr between 2016-2021.

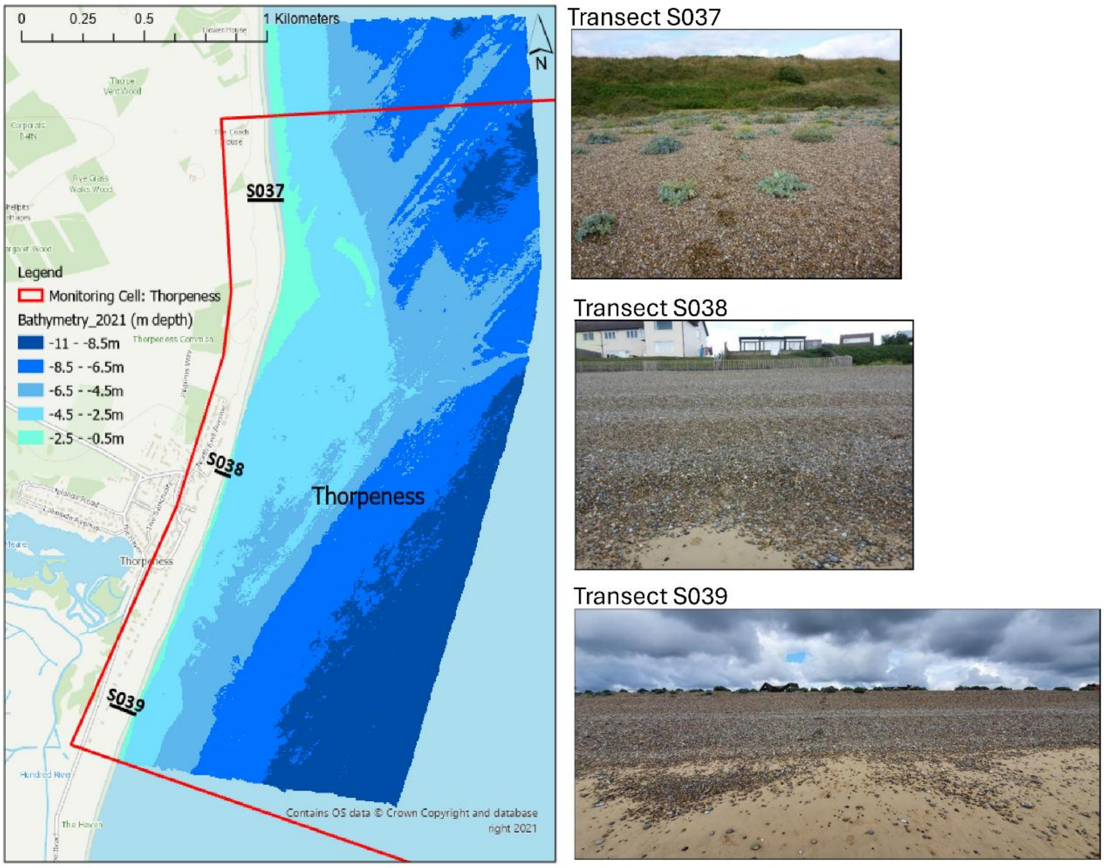

Plate 1-9~~1.9~~ Geographical extent of the Thorpeness monitoring cell, and the location and reference of strategic transects within it (Anglian Regional Coastal Monitoring Programme, 2022).

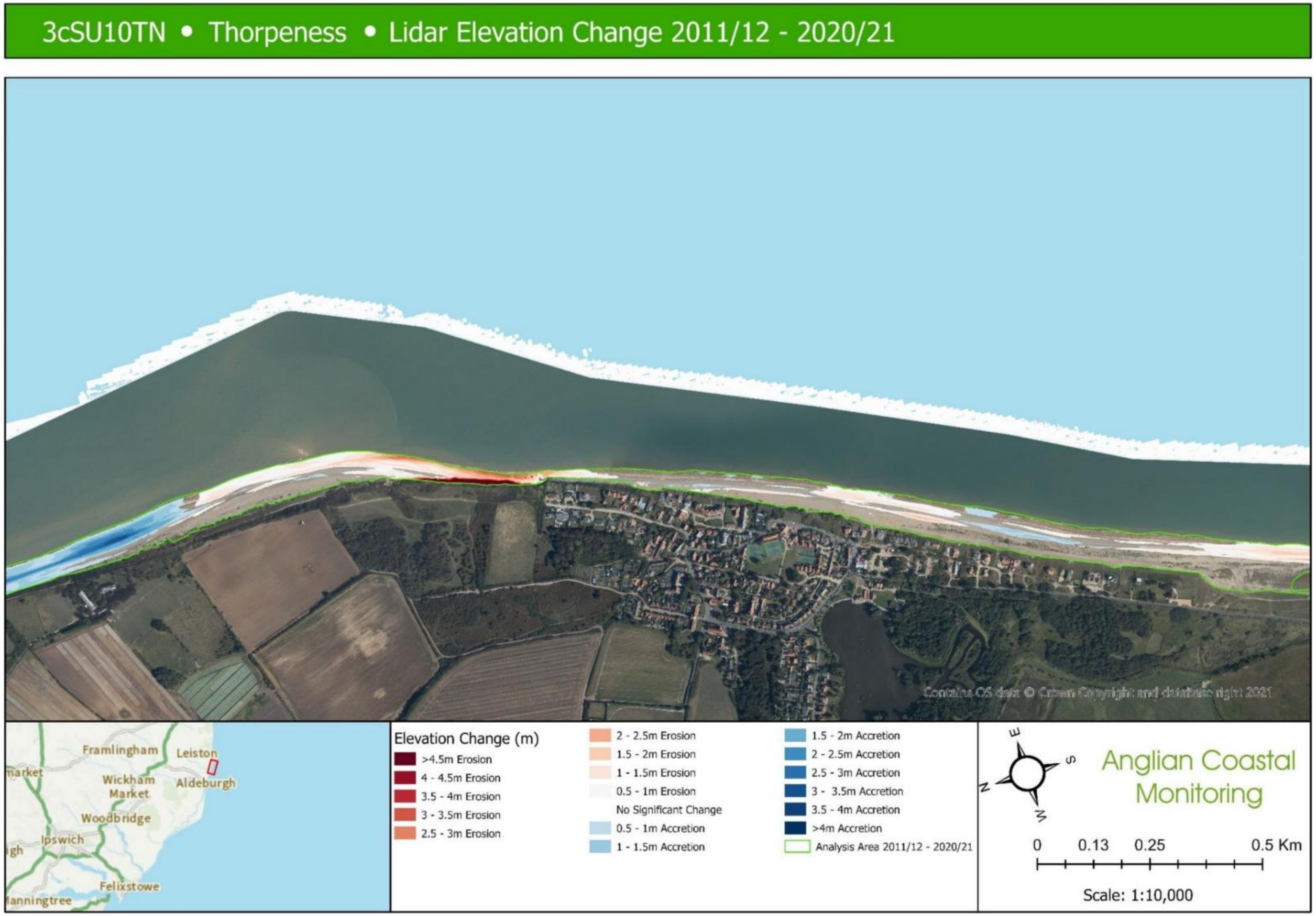

Plate 1-101.10 The difference in elevation from the first LiDAR survey in 2011 and the most recent survey in 2021 for the Thorpeness monitoring cell (Anglian Regional Coastal Monitoring Programme, 2022).

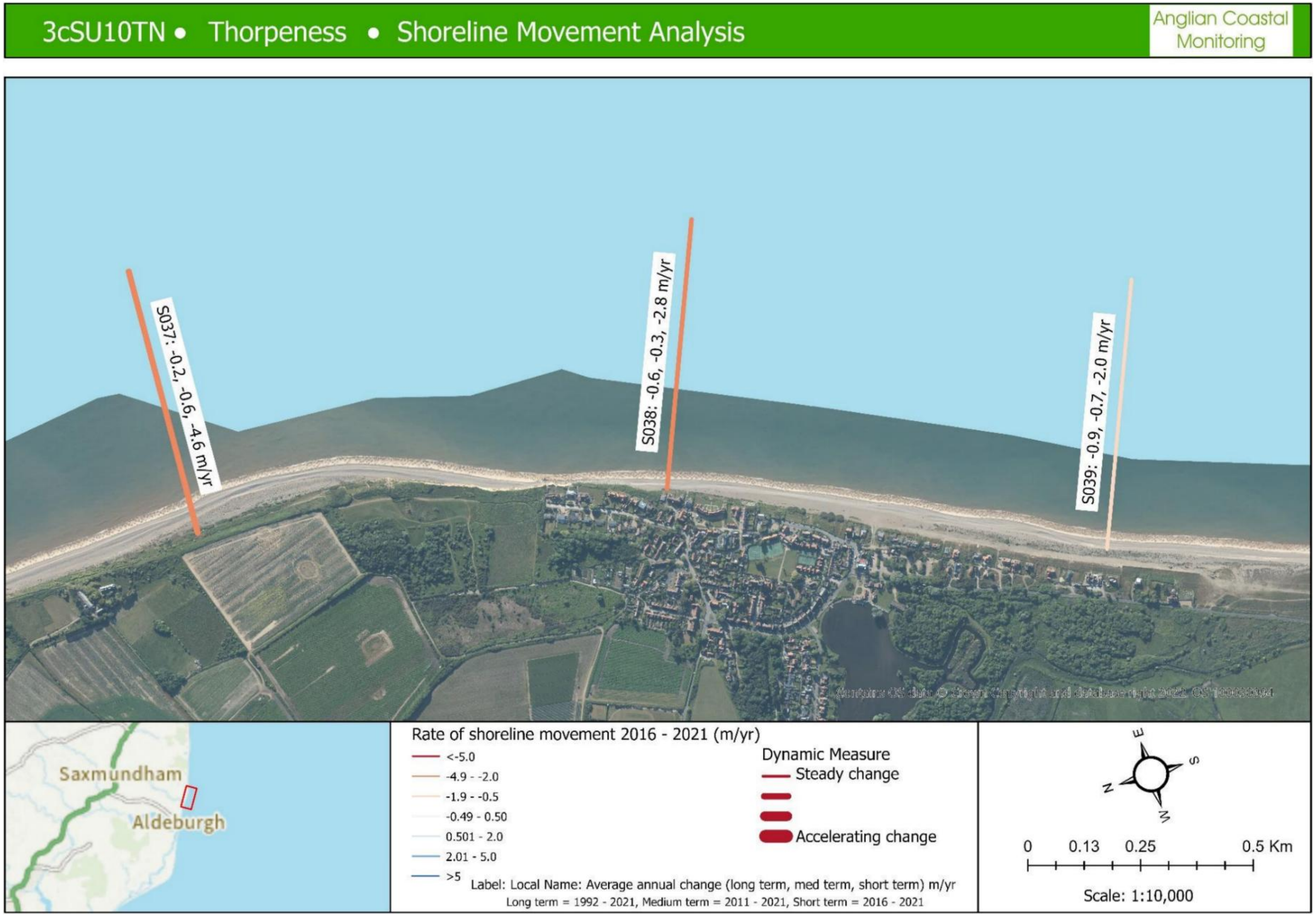

Plate 1-111.11 Rates of Shoreline Movement (at Mean Sea Level) for the Thorpeness monitoring cell (Anglian Regional Coastal Monitoring Programme, 2022).

Aldeburgh (Cell 3cSU11AL)

1.7.38 The cell extends from the sluice that drains the Hundred River valley, it includes the entire frontage of Aldeburgh which is protected by a concrete flood wall. The cell ends south of Fort Green car park (Plate 1-12~~Plate 1.12~~) (Anglian Regional Coastal Monitoring Programme, 2022).

1.7.39 The ACMP (2022) reports no significant change to the sediment budget throughout this cell, as losses and gains of beach material are balanced between 2011/12 and 2019/20 (Plate 1-13~~Plate 1.13~~ and Plate 1-14~~Plate 1.14~~). The study also notes that the height of the gravel berm that fronts Aldeburgh shows no change since the 2011/12 survey. Erosion is recorded on the north side of the sluice structure, whereas material has accreted on the southern side (Plate 1-13~~Plate 1.13~~).

1.7.40 The study describes an embayment in the centre of the monitoring cell that has formed as the foreshore has lowered over a ~500 metres length of the village frontage. Gravel has accreted at both ends of the embayment (Anglian Regional Coastal Monitoring Programme, 2022).

1.7.41 The ACMP (2022) has calculated mean rates of change associated with Transects S040, S041 and S042 since 1991 (Plate 1-15~~Plate 1.15~~).

- Each transect within the Thorpeness monitoring cell shows a long-term and short-term erosional trend, but at a slow rate:
- Transect S040 (which directly aligns with the Suffolk landfall site) is reported to show a net loss of intertidal beach since 1991, as chainage values have decreased since. Mean rates of shoreline movement measured from 2016 to 2021 are also negative but negligible (-0.1 m/yr) (Anglian Regional Coastal Monitoring Programme, 2022).
- Since 2016, Transect S041 shows a more consistent erosional trend, whereas, at the south end of the flood wall, Transect S042 has experienced a long-term trend of beach stability. However, beach narrowing of -1 m/yr has occurred between 2016-2021 (Anglian Regional Coastal Monitoring Programme, 2022).

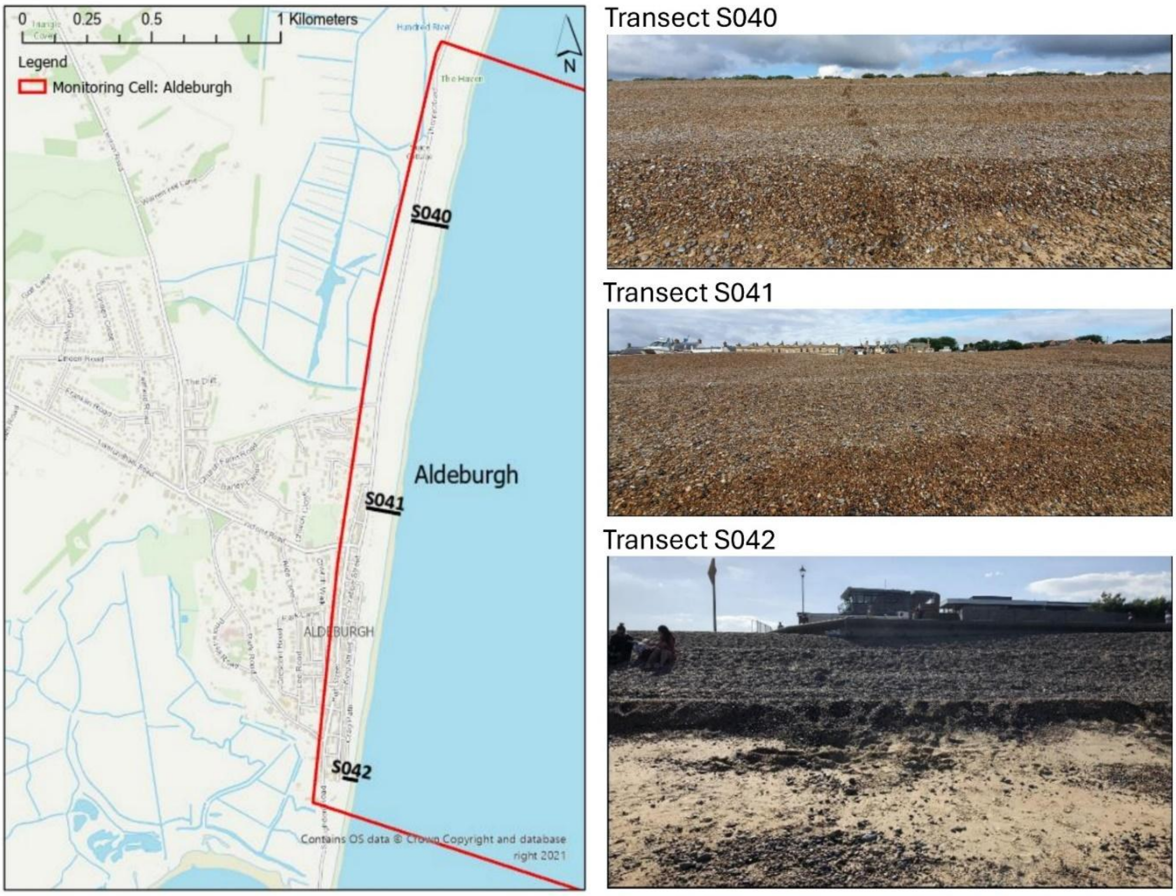

Plate 1-12~~1.12~~ Geographical extent of the Aldeburgh monitoring cell, and the location and reference of strategic transects within it (Anglian Regional Coastal Monitoring Programme, 2022).

1.7.42 Using the beach profile data collected by the ACMP (2022), ABPmer (2024) displays the long-term variations in beach levels at Profiles S038, S039, S040, S041 and S042:

- Profile S038 shows high variability between 2013-2021. The lowest, narrowest beach occurred in Winter 2013 where the recovery time to pre-storm positions took 2 years (Plate 1-16~~Plate 1.16~~) (ABPmer, 2024a).
- At Profile S039, the lowest and narrowest beach was measured in Summer 2011 which then recovered to its former width by the following Winter (Plate 1-17~~Plate 1.17~~) (ABPmer, 2024a).
- Profile S040 (which is aligned with the Suffolk landfall site) shows that between 1991 – 2013/2014 the beach retreated 10-20 m reaching its narrowest in 2013-2014. Between 2014 – 2022, the beach has partially stabilised, in that there is no longer a continuous erosional trend, however this section of beach still shows profile variation over the years (Plate 1-18~~Plate 1.18~~) (ABPmer, 2024a).
- Profile S041 shows a high variability. There has been an accretional trend between 2001 to about 2013. From 2013 – 2022 the beach at this point experienced overall retreat (Plate 1-19~~Plate 1.19~~).

- Profile S042 is less variable showing an accretional trend between 1991 to around 2013. Between 2013 – 2022, the beach shows overall retreat (Plate 1-20~~Plate 1.20~~) (ABPmer, 2024a).

1.7.43 Analysis of the historical beach profiles from the ACMP for decadal intervals confirms that the beach level/position was relatively stable from 1991 to 2000 but that there was a large event around 2000/2001 that caused a sudden landward retreat. The beach has since been relatively stable over the last two decades in its new position. Analysis of the beach profile data indicates that:

- the system has potential for larger change;
- larger change has been historically episodic;
- short-term vertical variability in beach levels of the order 1 m is typical;
- long-term vertical variability in beach levels of the order 2.5 m has been observed.

1.7.44 Variability in vertical elevation at locations along a profile coinciding with the buried cable alignment extending offshore covering the period 1997 to 2023 (Plate 1-21) shows a maximum change in vertical elevation of less than 2.5 m found at the location of the shingle beach. This is consistent with results obtained from the decadal analysis of profile data described above.

1.7.45 Implementing a Hold the Line policy for the coastline immediately to the south of the landfall (unit Aldeburgh ALB14.3) will provide a fixed ‘hard point’ which will limit the extent of natural retreat within the landfall section (unit ALB14.2) of the coastline. The No Active Intervention policy for the coastline to the north is likely to result in increased sediment supply southwards (the direction of net littoral sediment transport) which would have the potential to increase the volume of lower sections of the profile at the landfall section.

1.7.46 The latest available beach monitoring, bathymetric survey and LiDAR datasets for profile S040 were downloaded from the ACMP website. The datasets have been merged to provide a continuous representation of the profile down to a level of –9 m LAT, as shown in Plate 1-22. The plot confirms the maximum variation in elevation of the beach surface to be approximately 2.5 m which is consistent with the analysis previously reported.

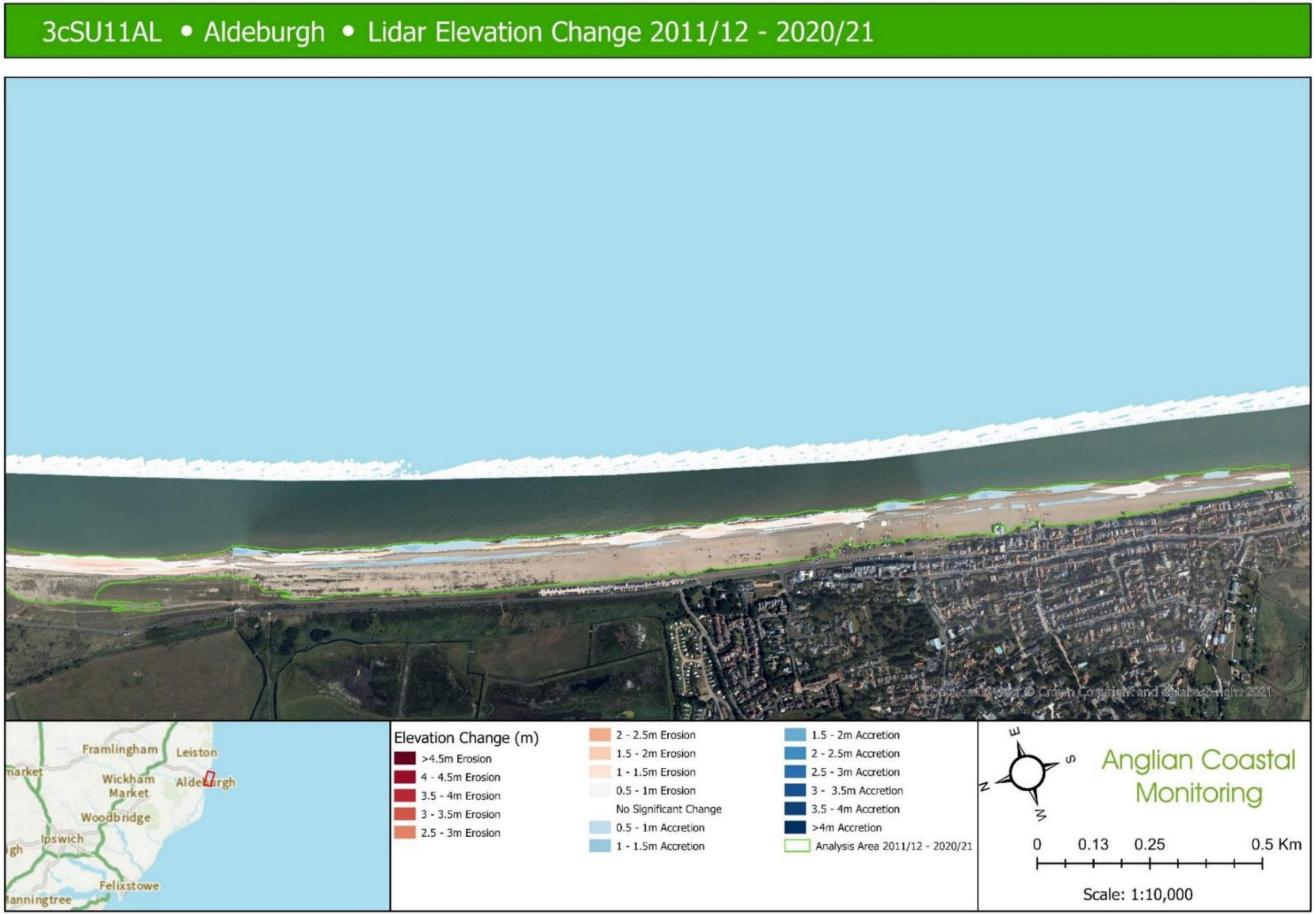

Plate 1-13~~1.13~~ The difference in elevation from the LiDAR surveys in 2011 and 2021 for the Aldeburgh monitoring cell (Anglian Regional Coastal Monitoring Programme, 2022).

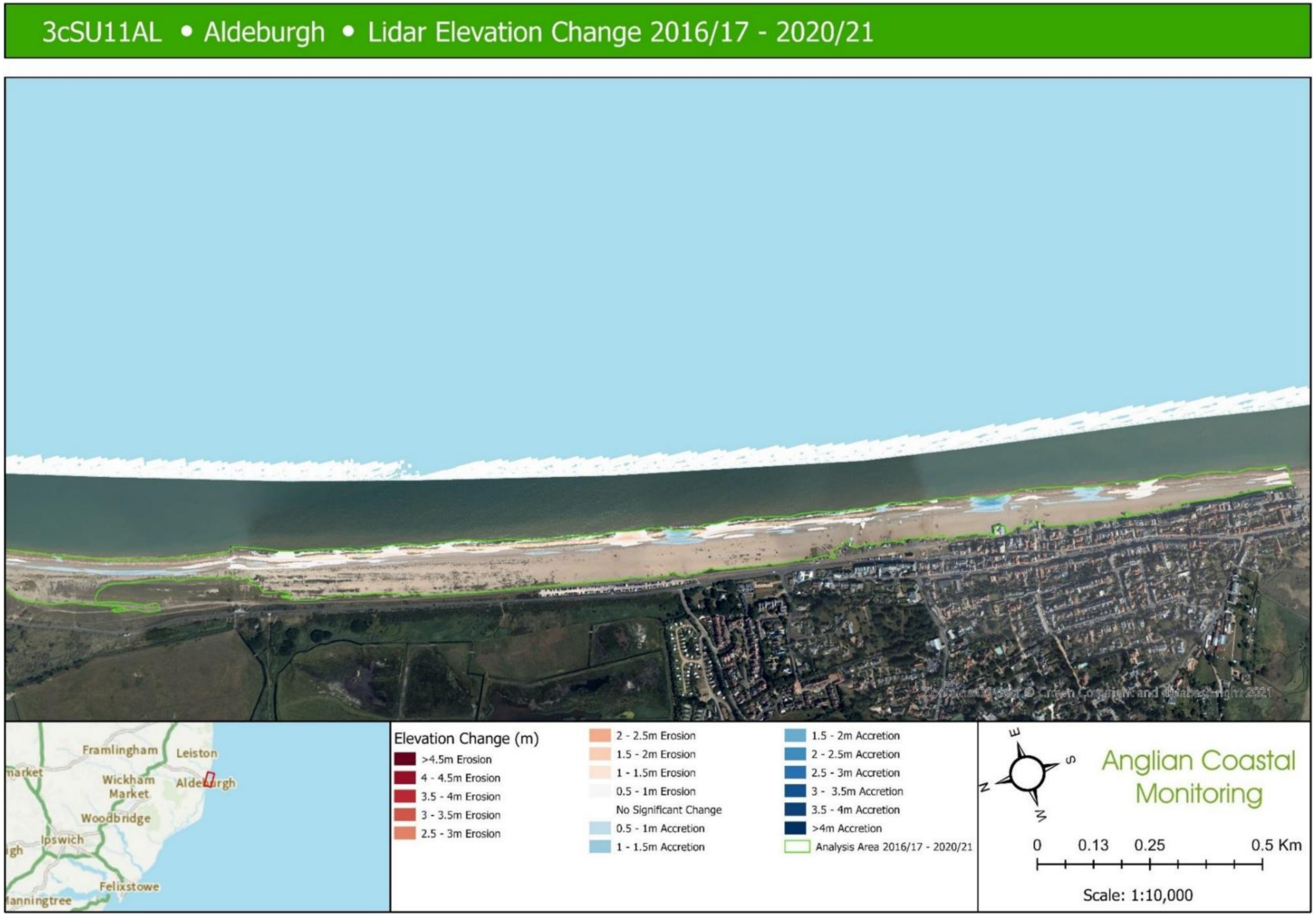

Plate 1-141.14 The difference in elevation from the LiDAR survey in 2016 and the most recent survey in 2021 for the Aldeburgh monitoring cell (Anglian Regional Coastal Monitoring Programme, 2022).

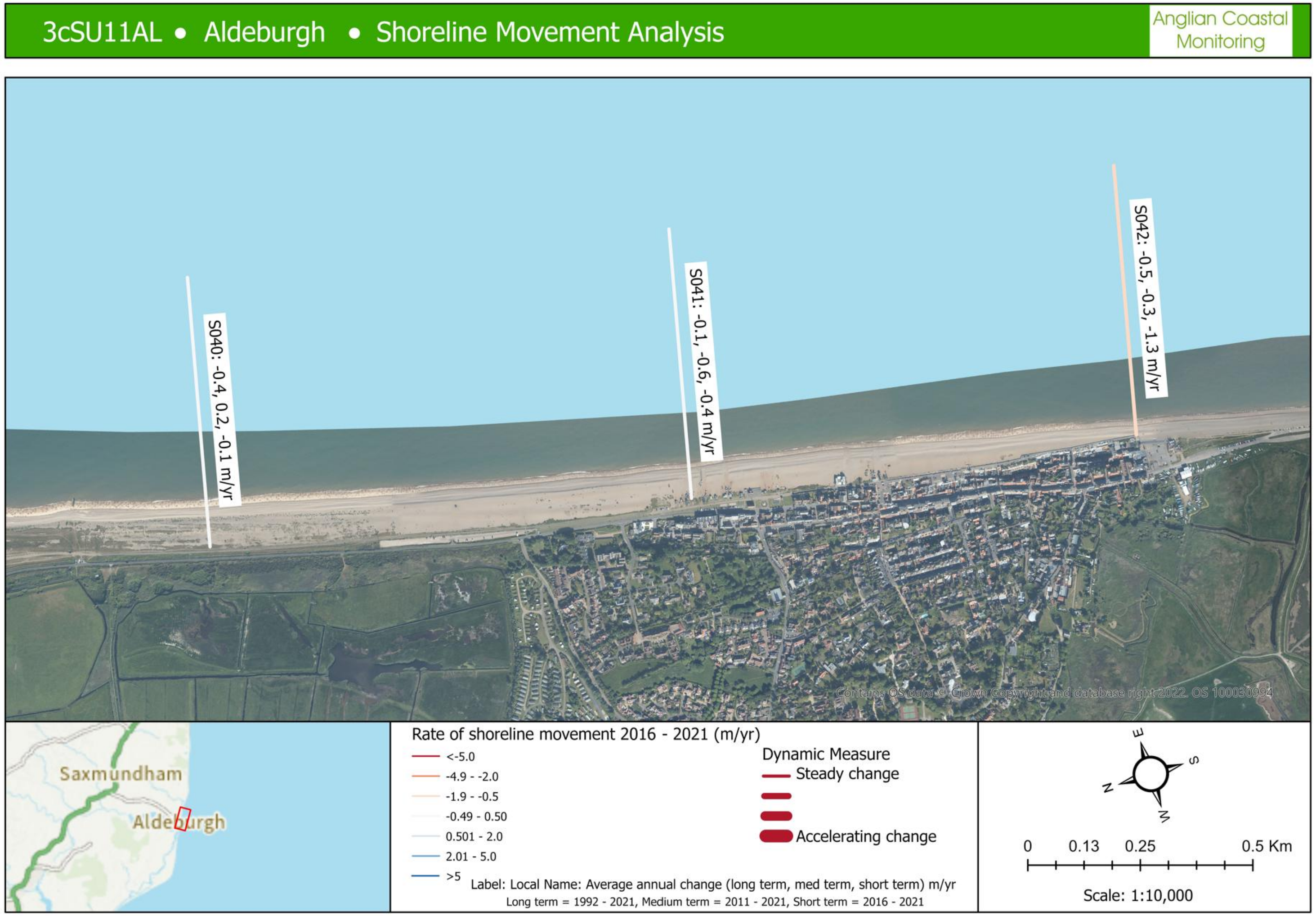

Plate 1-15~~1.15~~. Rates of Shoreline Movement (at Mean Sea Level) for the Aldeburgh monitoring cell (Anglian Regional Coastal Monitoring Programme, 2022).

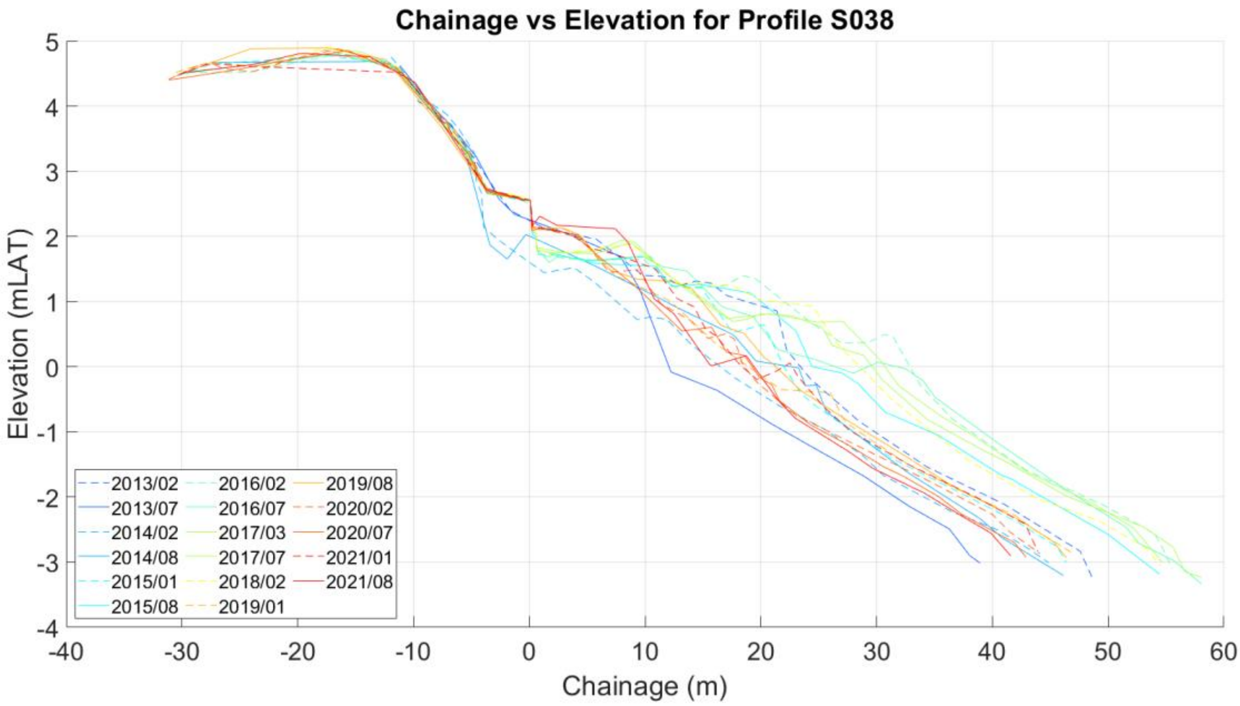

Plate 1-16~~1.16~~ Profile changes 2013-2021 – Profile S038 (ABPmer, 2024a)

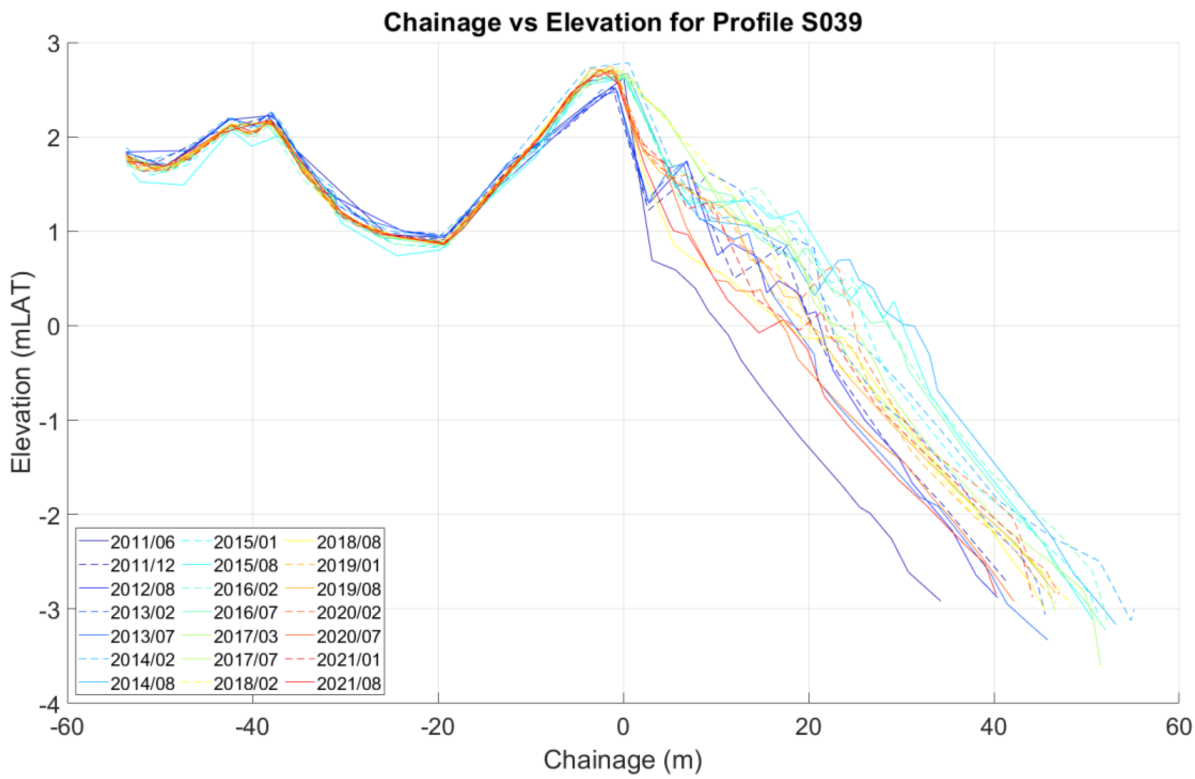

Plate 1-17~~1.17~~ Profile changes 2011-2021 – Profile S039 (ABPmer, 2024a)

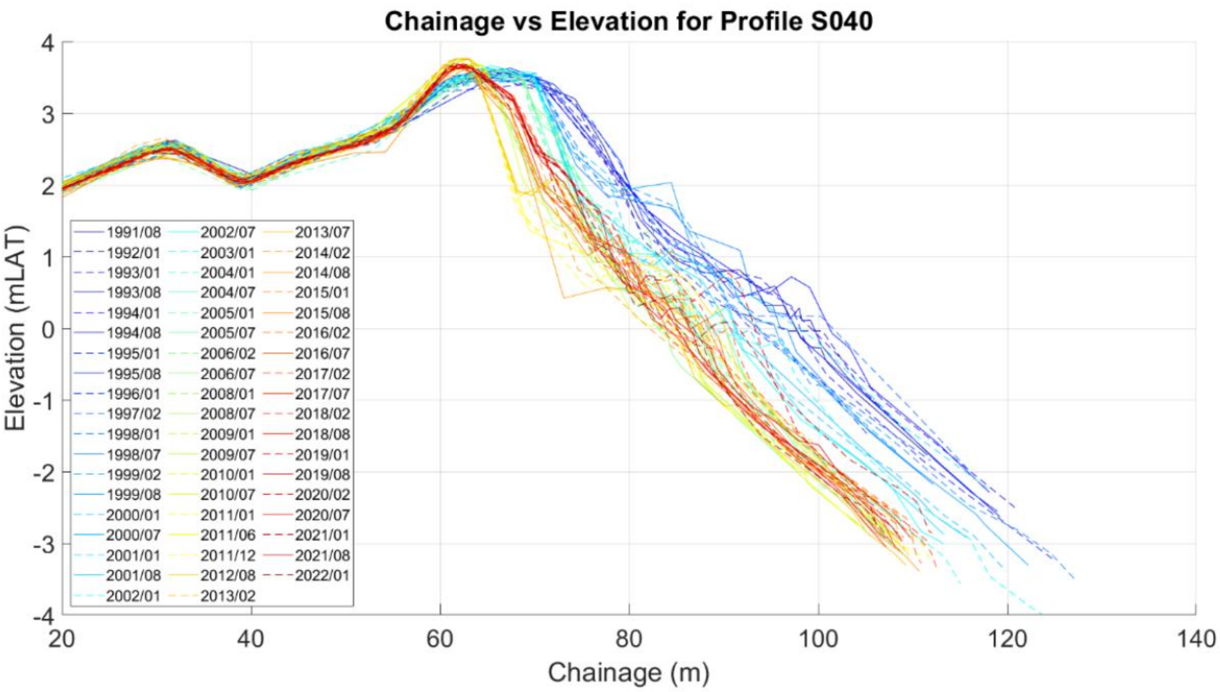

Plate 1-18~~1.18~~ Profile changes 2013-2021 – Profile S040 (ABPmer, 2024a)

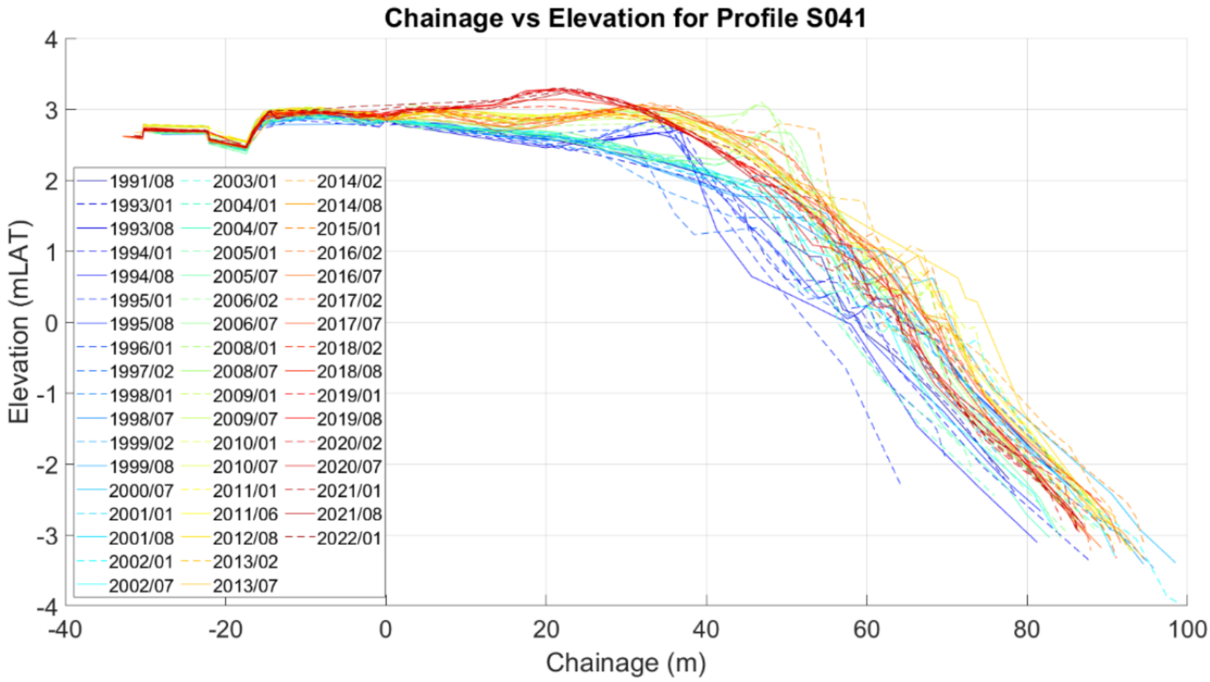

Plate 1-19~~1.19~~ Profile changes 2013-2021 – Profile S041 (ABPmer, 2024a)

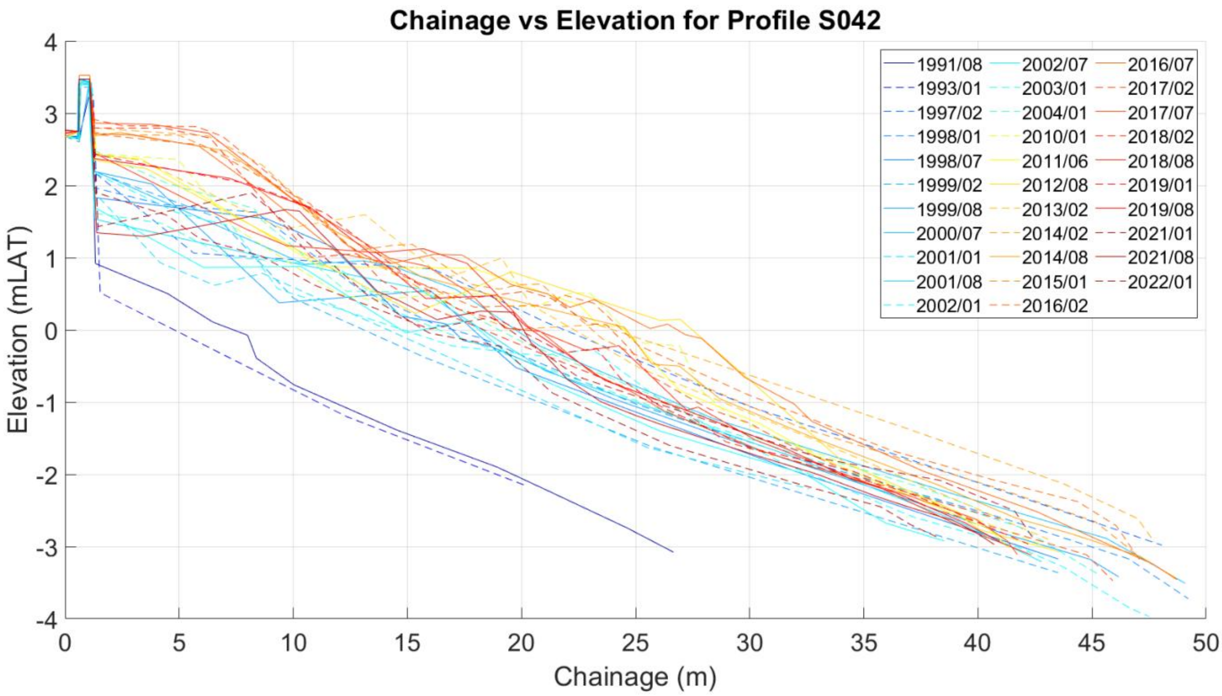

Plate 1-201.20 Profile changes 2013-2021 – Profile S042 (ABPmer, 2024a)

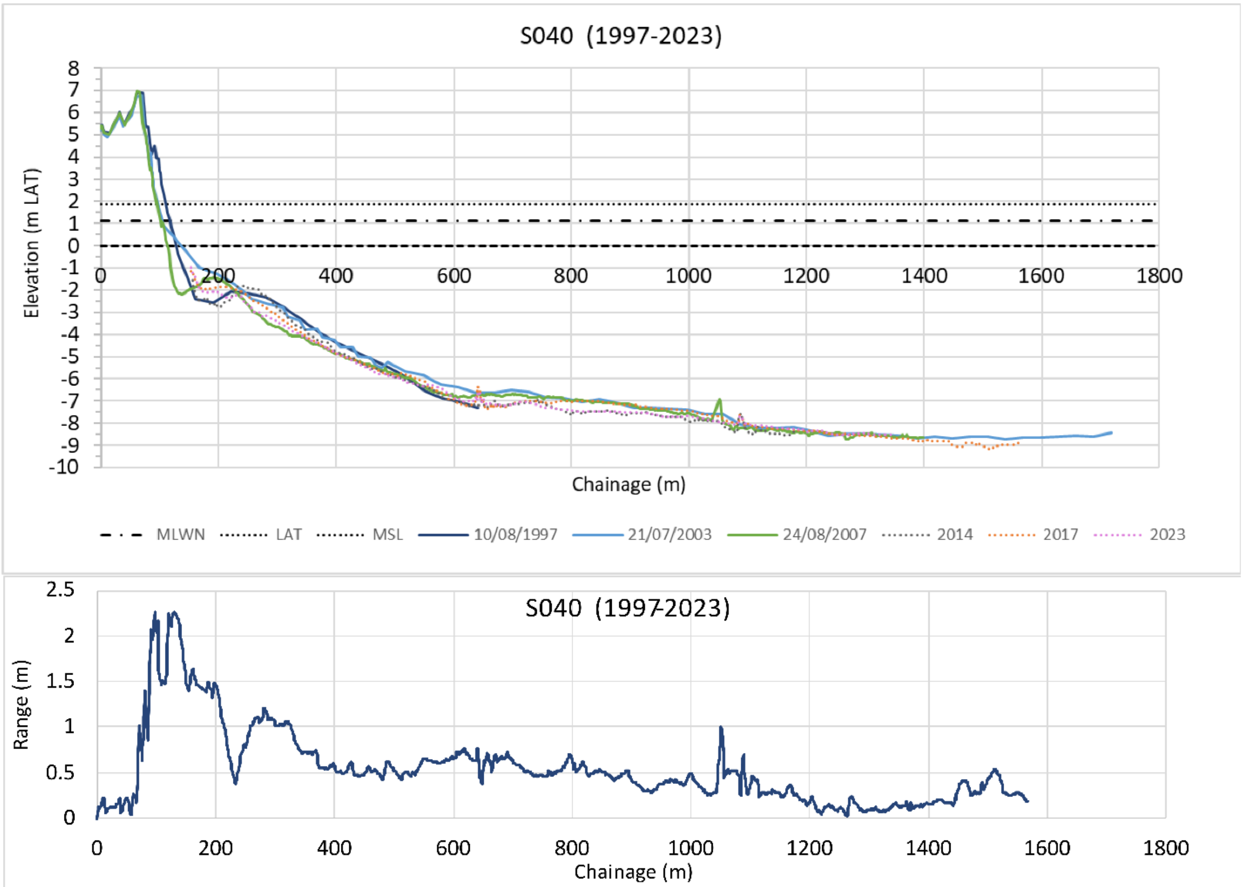

Plate 1-21. Extended beach and subtidal profiles at landfall location (upper) and range of variation in elevation (lower) for the period 1997 to 2023 (ABPmer, 2024a).

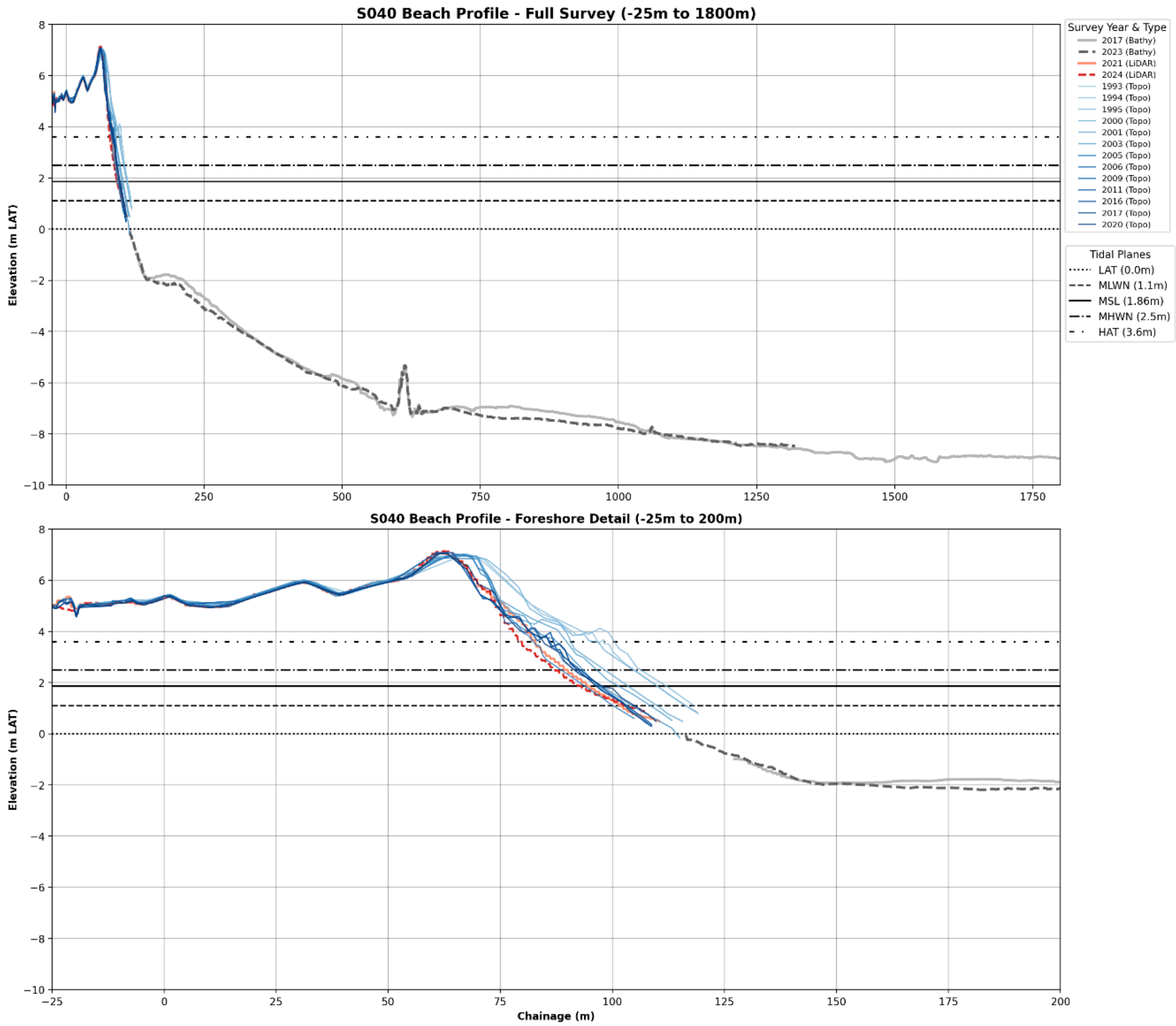

Plate 1-22. Analysis of beach profile (S040) and merged bathymetry/LiDAR data for the period 1993 to 2024 for the full profile (Top) and the active shingle ridge (Bottom)

Overview of the Kent Landfall Coastal Environment

~~1.7.43~~1.7.47 Pegwell Bay, where the Offshore Scheme 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 (Plate 1-23~~Plate 1.21~~). The coastline from North Foreland to Ramsgate (West Cliff) is characterised by near vertical 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 (Halcrow Group Limited, 2010).

~~1.7.44~~1.7.48 The shoreline of Pegwell Bay is orientated northeast – southwest and is characterised by a sand beach stretching from Ramsgate in the north, to the southern end of Pegwell Bay Nature Reserve in the south. The nature reserve features coastal habitats such as saltmarsh and mudflats which make up part of the Sandwich Bay to

Hacklinge Marshes SSSI (Halcrow Group Limited, 2010). The River Stour terminates in Pegwell Bay forming a meandering channel across the mudflats on the western side of the bay.

Shoreline management policy

~~1.7.45~~1.7.49 The Kent Offshore Scheme makes landfall in Pegwell Bay, part of the Isle of Grain to South Foreland SMP (10). The landfall site is located within Policy Unit 4b 20: Ramsgate Harbour (West) to North of the River Stour (Halcrow Group Limited, 2010).

~~1.7.46~~1.7.50 For Policy Unity 4b 20, the SMP recommends to ‘Hold the Line’ 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-, medium- and long-term plans for the frontage (Halcrow Group Limited, 2010).

~~1.7.47~~1.7.51 Situated within Pegwell Bay, the landfall is also in close proximity to Policy unit 4b 21, situated 500 m west of the landfall site, extending from the mouth of the River Stour to the Sandwich Bay Estate North. In this policy unit, the plan is to promote, where possible, a natural functioning coastline. This frontage is mainly undefended except for the natural dune system which starts south of the River Stour and extends to Sandwich Bay Estate (north). The SMP recommends monitoring the dune system to ensure a suitable standard of flood protection is maintained. This ‘no active intervention’ policy is recommended for the short, medium and long-term plans for the frontage (Halcrow Group Limited, 2010).

Plate 1-231.21 Kent landfall coastline (image edited from Google Earth)

Kent Landfall Metocean Conditions

Water level

1.7.481.7.52 Tides within the North Sea basin are generated by a tidal wave travelling from the north of Scotland coming from the Atlantic. The Dover Strait connects the North Sea with the English Channel. This region is characterised by strong tidal forcing (Prandle, 1981).

1.7.491.7.53 On the flood tide, the water flows from the southwest through the English Channel towards the North Sea for approximately 6 hours. On the ebb tide, water flows from the North Sea into the English Channel for approximately 6.5 hours. Around North to South Foreland, flow is oriented south – north on the flood tide, and north to south on the ebb tide (UK Hydrographic Office, 2021).

1.7.501.7.54 Table 1-14Table 1.14 presents the water levels from the UKHO Admiralty tide tables (UK Hydrographic Office, 2021) for Ramsgate (approximately 2 km east from the Kent landfall).

Table 1-141.14 Ramsgate tidal water levels (UK Hydrographic Office, 2021)

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

Extreme wave conditions

1.7.511.7.55 ABPmer (2024b) used wave data from SEASTATES to assess the extreme wave conditions at KP 115 and are therefore representative of wave conditions on the approach to the landfall, just outside of Pegwell Bay.

1.7.521.7.56 Table 1-15Table 1.15 shows wave parameter data for 5 different return periods, including wave height (Hs) and wave period (Tp) for all wave directions (ABPmer, 2024b).

1.7.531.7.57 Plate 1-24Plate 1.22 plots the directional extreme wave heights for a 1:50 year return period. The most extreme wave heights are from the east (1.8 m), followed by waves from the northeast and south at 1.7 m (ABPmer, 2024b).

Table 1-151.15 Omnidirectional extreme wave results at KP 115 for five different return periods (ABPmer, 2024b)

Wave parameter	Return Period				
	1:1	1:5	1:10	1:50	1:100
Hs (m)	1.6	1.7	1.8	1.8	1.8
Tp (s)	6.9	7.2	7.3	7.4	7.4

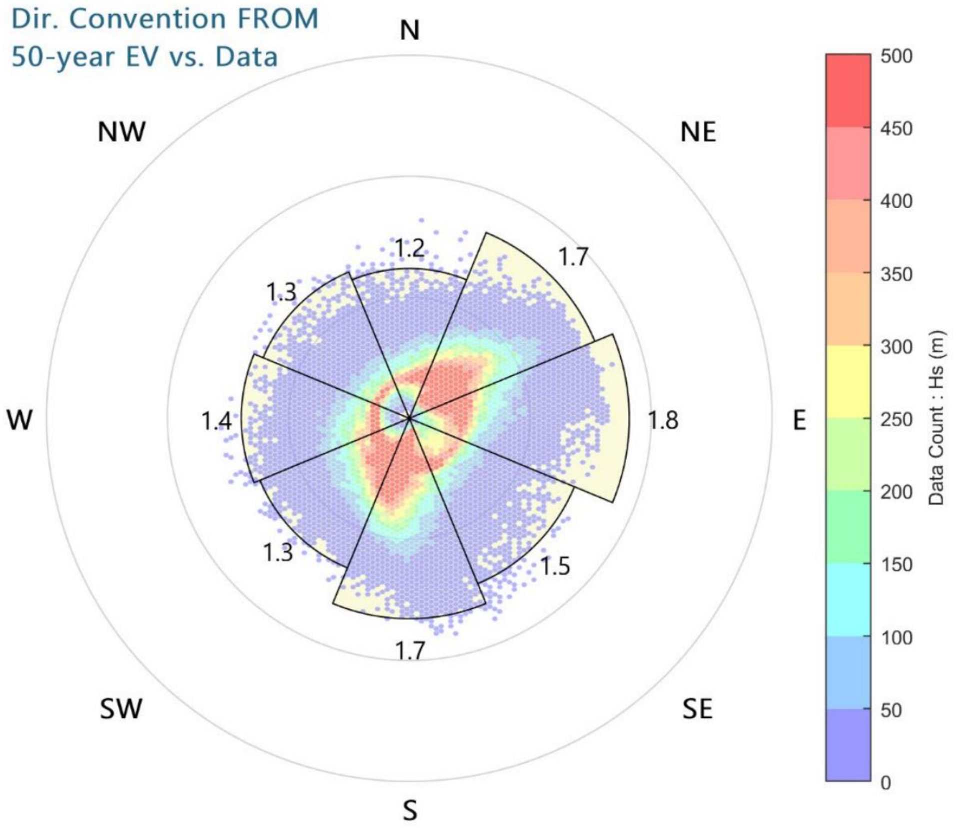

Plate 1-241.22 Wave rose of extreme wave heights at 1:50 return period for KP 115, showing the amount of wave height data per sector and in black the extreme wave height per direction sector (ABPmer, 2024b).

Sea temperature

1.7.541.7.58 The Channel Coastal Observatory provides average sea temperatures for Sandbanks MCZ, the nearest monitoring point to Pegwell Bay (approximately 11 km southeast from the landfall). Average sea temperatures for the years 2017-2023 are provided in Table 1-16Table 1.16.

Table 1-161.16 Average sea temperature at the Goodwin Sands Directional Waverider Buoy for the years 2017-2023 (Channel Coastal Observatory , 2020)

Month	Sea temperature (degrees C)
January	8
February	7
March	7.5
April	9.2

Month	Sea temperature (degrees C)
May	11.8
June	14.8
July	17.2
August	18.2
September	17.6
October	15.5
November	12.8
December	9.6

Kent Landfall Geomorphology and Sediment Transport

Kent coastal geomorphology and geology and regional sediment transport

~~1.7.55~~1.7.59 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.

~~1.7.56~~1.7.60 The Isle of Thanet (Margate to Ramsgate) is a relatively geologically resistant chalk headland that exerts a control on the geomorphological evolution of the Kent coastline due to its influence on tidal flows interacting between the North Sea and English Channel, and by acting as a point of stability at the southern boundary of the Outer Thames Estuary (Royal Haskoning , 2005; ABPmer, 2024b). Within Pegwell Bay, the chalk formation extends offshore outcropping as a series of chalk reef platforms on the northeastern side and central sections of Pegwell Bay and supports a range of habitats and species. **Figure 6.4.4.1.1 Kent Landfall geology** shows that from just north of Cliffsend, the chalk geology gives way to the Thanet Sandstone Formation composed of sands, silts and clays which extends south towards Sandwich Bay. The Chalk formation then returns characterising the frontages of Sandwich Bay, Deal and Dover, including chalk reef platforms that outcrop within the intertidal and nearshore environments (**Figure 6.4.4.1.1 Kent Landfall geology**).

~~1.7.57~~1.7.61 Plate 1-25~~Plate 1.23~~ shows net sediment transport paths through the Outer Thames Estuary. It shows that from North Foreland net littoral transport is to the south, while sediment transport from the Sandwich Bay is towards the north (Kenyon & Cooper, 2005; ABPmer, 2024b), meaning that Pegwell Bay is a convergence site for sediment deposition in the region.

~~1.7.58~~1.7.62 Within Pegwell Bay sediment is transported southwards across the bay from Ramsgate Harbour. The harbour structure has altered the natural longshore transport of sediment (ABPmer, 2018b; ABPmer, 2018c; ABPmer, 2024b).

~~1.7.59~~1.7.63 Sediment supply into Pegwell Bay is limited as there is a lack of new sediment entering the system as a result of North Foreland acting as a barrier to sediment transport moving south (Halcrow Group Limited, 2010). 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 which are mainly south-easterly events (Halcrow Group Limited, 2010).

~~1.7.60~~1.7.64 The main natural sediment sources supplying Pegwell Bay are the Sandbanks MCZ and the River Stour (Halcrow Group Limited, 2010). The softer geology associated with the silts, sands and muds of the Thanet Sandstone Formation that characterise the western side of Pegwell Bay (**Figure 6.4.4.1.1 Kent Landfall geology**) are thought to supply sediment to the foreshore environment as it is more readily eroded (ABPmer, 2018b).

~~1.7.61~~1.7.65 Extensive sand flats and mud flats are present within Pegwell Bay. Seabed surveys show a distinct zone of finer sand separating the nearshore mudflats and the mixed coarser sediment found in the outer bay (**Figure 6.4.4.1.2 Pegwell Bay Surficial Sediments**).

~~1.7.62~~1.7.66 South of Pegwell Bay are the mudflats of Sandwich Bay. Both the Pegwell Bay and Sandwich Bay mudflats and marshes form the Sandwich Bay to Hacklinge Marshes SSSI, the Sandwich Bay SAC, the Pegwell Bay NNR, the Thanet Coast & Sandwich Bay Ramsar site, and the Thanet Coast and Sandwich Bay SPA. These designations also include a coastal sand dune system, sandy coastal grassland and freshwater grazing marsh and scrub woodland. The sand dune system acts as a natural coastal defence against flooding. The beach front along Sandwich Bay is generally characterised by an upper shingle ridge and a lower sandy foreshore.

~~1.7.63~~1.7.67 The River Stour channel is an important feature within Pegwell Bay. At the river mouth, the channel meanders across the mudflats which become exposed at low tide. **Figure 6.4.4.1.3 Intertidal Elevation Difference Pegwell Bay** shows that between 2007 to 2022, the channel has migrated several metres across the intertidal mudflats. Even over shorter time periods, between 2018 and 2022, the channel morphology is shown to have migrated so that the channel reaches further out into the bay (**Figure 6.4.4.1.3 Intertidal Elevation Difference Pegwell Bay**).

~~1.7.64~~1.7.68 At the channel mouth there is another important dynamic geomorphological feature near the landfall site on the western side of Pegwell Bay. The shingle spit at Shell Ness in part, controls the location of the River Stour exit channel. ABPmer (2018b) explains that the spit has shown consistent progradation northwards at an average rate of 4 m per year since 1940s and its morphology varies in relation to seasonal variation of the wave climate. The spit also protects the intertidal zone from easterly waves entering Pegwell Bay (ABPmer, 2018b).

~~1.7.65~~1.7.69 Based on a review of the Kent landfall assessment report (ABPmer, 2018b), although unlikely, there is a possibility that the River Stour low water channel could migrate northwards to coincide with the buried cable alignment during the operational life of the Proposed Project. Such migration would just as likely be ongoing and any particular scenario of overlap would be temporary and localised. The present morphology of the wider beach is consistent with the River Stour channel position to the south of the buried cable alignment. Ongoing maintenance dredging carried out by the local port authority has also proved to be an effective measure in helping to stabilise the channel position for navigation purposes and reduces the risk of future channel migration. The particular pattern and timing of future channel migration is subject to episodic natural variability and complex interaction of coastal processes and river management strategies. Historical trends of progradation of the Shell Ness spit will not necessarily continue indefinitely, or cause predictable migration of the river channel.

The associated uncertainty cannot be reduced by additional modelling or surveys of present day conditions.

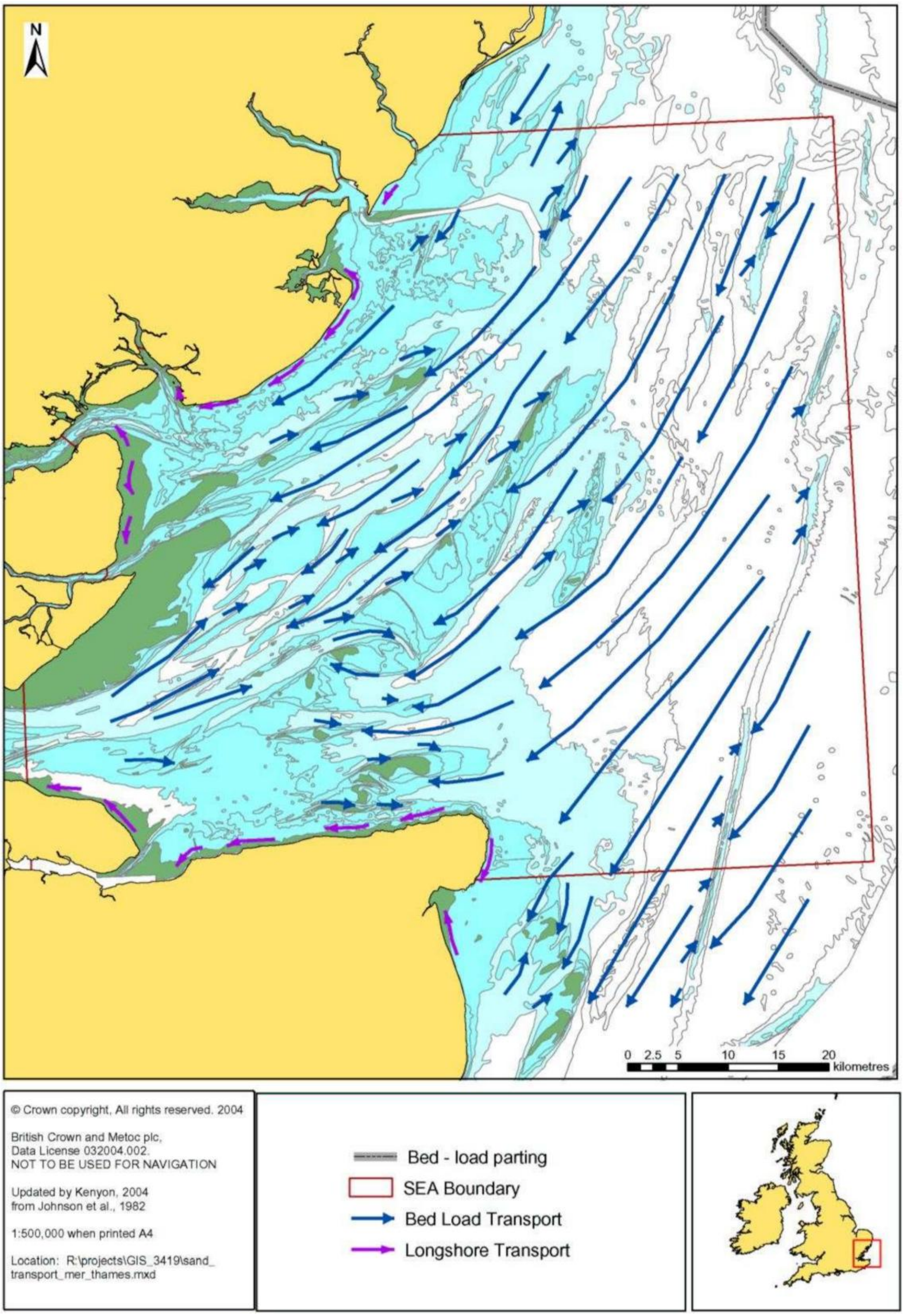

Plate 1-25~~1.23~~ Map of net sand transport paths in the Outer Thames Estuary (Kenyon & Cooper, 2005).

Beach morphology and erosion

~~1.7.66~~1.7.70 The extent of the intertidal sand and mudflats of Pegwell Bay have remained relatively stable since 2007, with little evidence of notable erosion or accretion having taken place.

~~1.7.67~~1.7.71 ABPmer (2024b) explain that the differences in elevation along the Offshore Scheme within Pegwell Bay are small (in the order of 0.5 - 1 m), and therefore the cable burial depth is well below the level affected by natural variability based on available data.

~~1.7.68~~1.7.72 The western side of the bay has experienced greater amounts of erosion and deposition in association with the migration and morphology change of the River Stour (**Figure 6.4.4.1.3 Intertidal Elevation Difference Pegwell Bay**). Plate 1-26~~Plate 1.24~~ and Plate 1-27~~Plate 1.25~~ show the morphological change associated with the south side of the River Stour (ABPmer, 2024b) as its point of entry into Pegwell Bay and the channel's route across the beach varies year-to-year.

~~1.7.69~~1.7.73 Since 2007 accretion has taken place around Shell Ness as the river channel has eroded further north (**Figure 6.4.4.1.3 Intertidal Elevation Difference Pegwell Bay**).

~~1.7.70~~1.7.74 Plate 1-28~~Plate 1.26~~ shows the beach at Sandwich Bay. The dunes that back the northern end of Sandwich Bay have largely accreted since 2007 in many locations the dune system has gained >1.2 m in elevation. The foreshore and intertidal Sandwich Flats area has lowered by between 0.2 m to 1 m since 2007 (**Figure 6.4.4.1.4 Intertidal Elevation Difference Sandwich Bay**).

~~1.7.71~~1.7.75 Since 2007, between Sandwich Bay and Deal the dune system and beach generally show accretion increasing by >1 m across much of the coastline. At a location approximately 1 km north of Sandown Castle (Deal), the dune system has experienced some areas of erosion since 2007. At this same site, between 2018-2022, the beach front has also lowered by approximately 1 m (**Figure 6.4.4.1.5 Intertidal Elevation Difference Flats**).

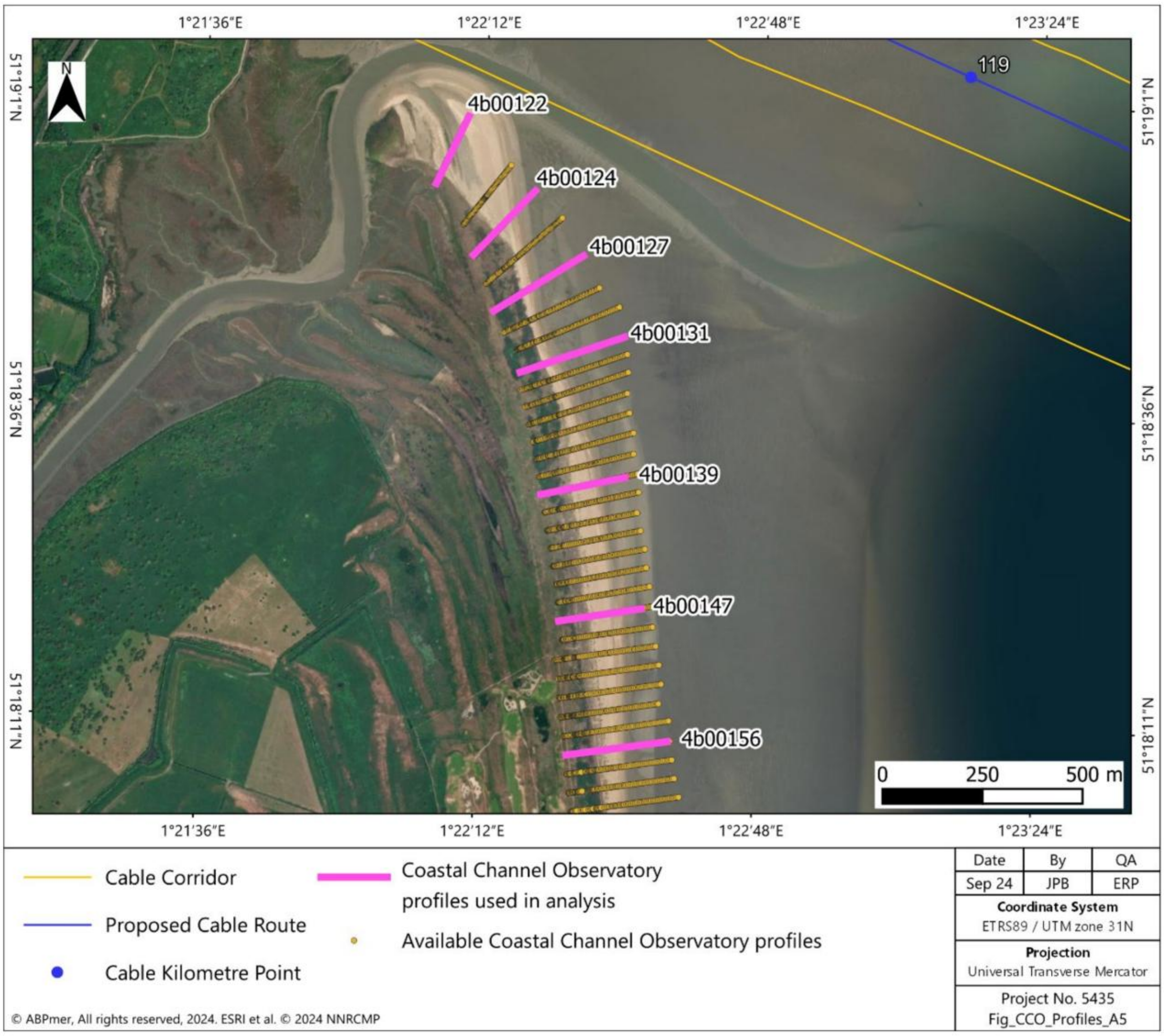

Plate 1-261.24 Location of topographic profiles available (in yellow) and selected for analysis (in pink) (ABPmer, 2024b).

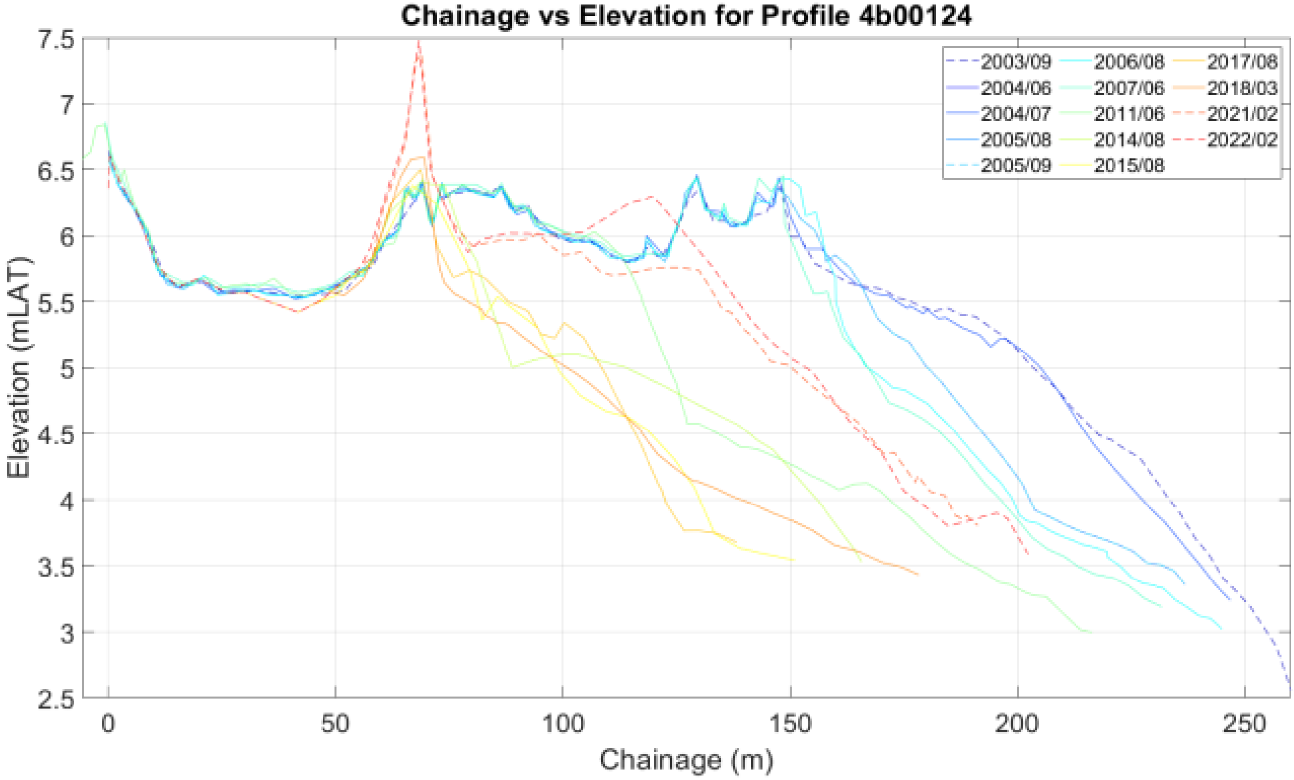

Plate 1-27~~1.25~~ Profile 4b000124 elevation change (ABPmer, 2024b)

Plate 1-28~~1.26~~ Sandwich Bay – a view looking north and south (University of Sussex, 2003)

Nearshore Seabed features

Cross Ledge sandbank

~~1.7.72~~1.7.76 Cross Ledge sandbank is situated in the approach to Pegwell Bay (**Figure 6.4.4.1.6 Nearshore Sandbanks Kent Landfall**) where it provides shelter from the prevailing waves from the northeast and southeast into Pegwell Bay. Mapped sand waves are present to the north of the Cross Ledge sandbank (MMT, 2022) (Plate 1-29~~Plate 1.27~~ and Plate 1-30~~Plate 1.28~~). The crests of the mapped bedforms in Pegwell Bay are mainly aligned north north-west to south-east, indicating the direction of bedload transport at the time of the survey was east to west. However, as Vattenfall Wind Power Ltd (2018) further explain, the entrance to Pegwell Bay is a dynamic environment due to the effects of wave shoaling, wave breaking associated with shallower nearshore areas, which under extreme conditions may further influence sediment transport processes, therefore the geomorphology of the seabed is likely variable.

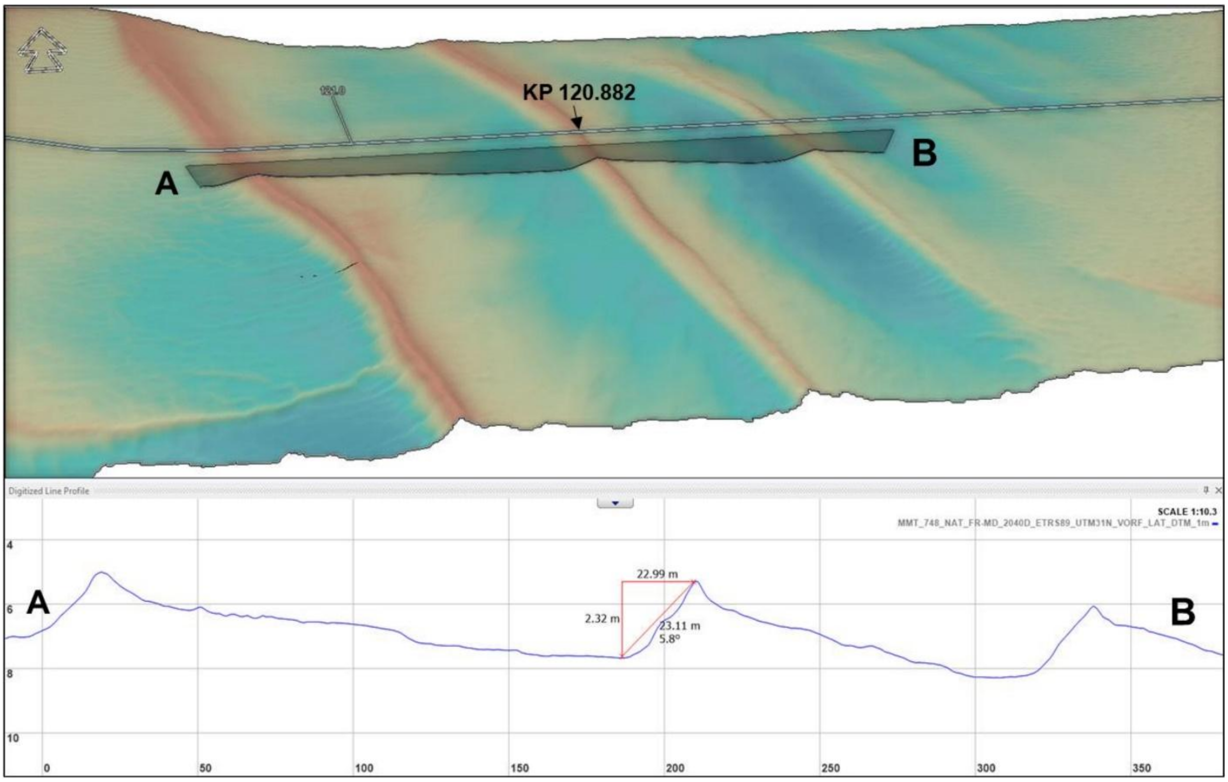

Plate 1-29~~1.27~~ Bedforms along the route associated with mega ripple stoss slopes, example shown at KP120.882 (MMT, 2022)

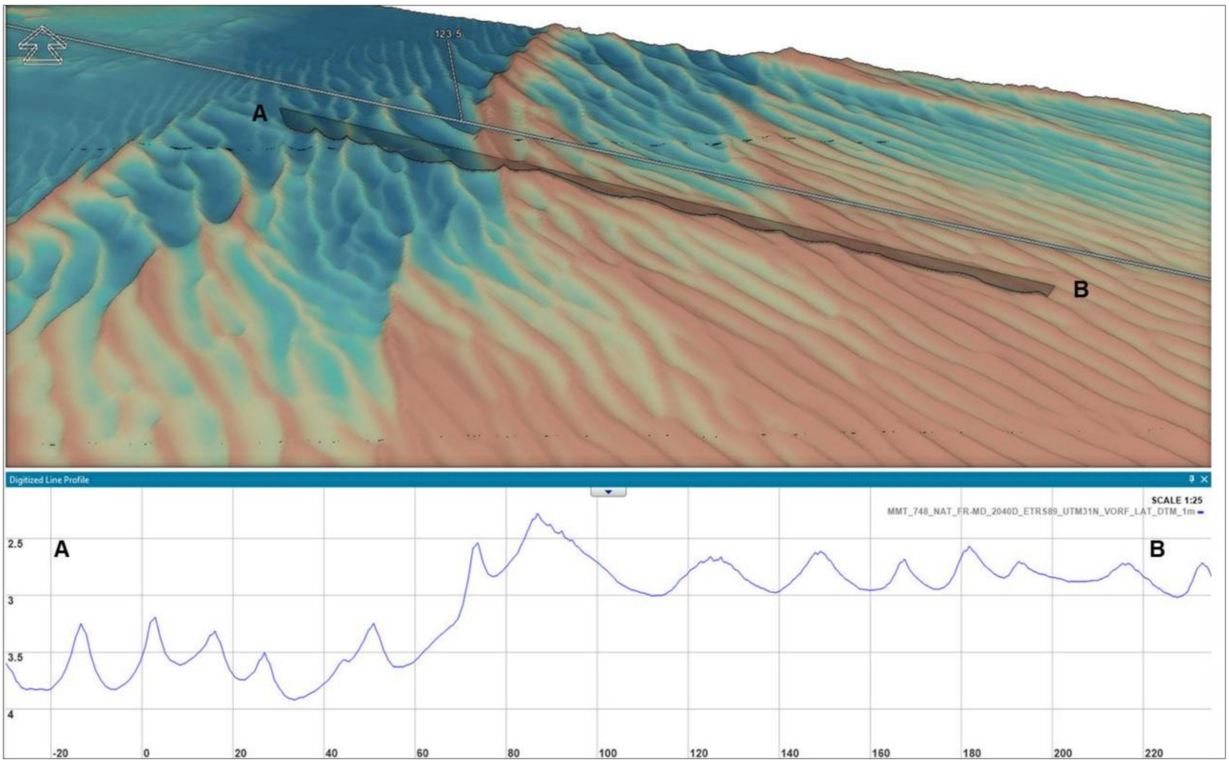

Plate 1-30~~1.28~~ Bedforms along the route associated with lee slopes of a mega ripple area at KP 123.475 (MMT, 2022)

Water Quality

~~1.7.73~~1.7.77 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 **Application Document 6.2.2.4 Water Environment** and **Application Document 6.2.3.4 Water Environment** (for the Suffolk and Kent landfalls respectively).

Water Framework Directive

~~1.7.74~~1.7.78 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 (Environement Agency, 2021).

~~1.7.75~~1.7.79 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).

~~1.7.76~~1.7.80 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.

Bathing water

1.7.771.7.81 Water quality at designated bathing water sites in England is assessed by the Environment Agency (Environment Agency, 2021b). The bathing water near the Kent landfall is classified as 'Good'. There is no designated bathing water at the Suffolk landfall.

Offshore

1.7.781.7.82 As outlined in Section 1.6, this chapter defines the 'nearshore environment' based on water depth as it better relates to the Physical Environment discussed within the assessment. Where water depth is less than 15 m and the 'offshore environment' where water depths are greater than 15 m (Plate 1-31Plate 1.29). This aligns approximately with KP 10, near Suffolk and KP 110 near Pegwell Bay.

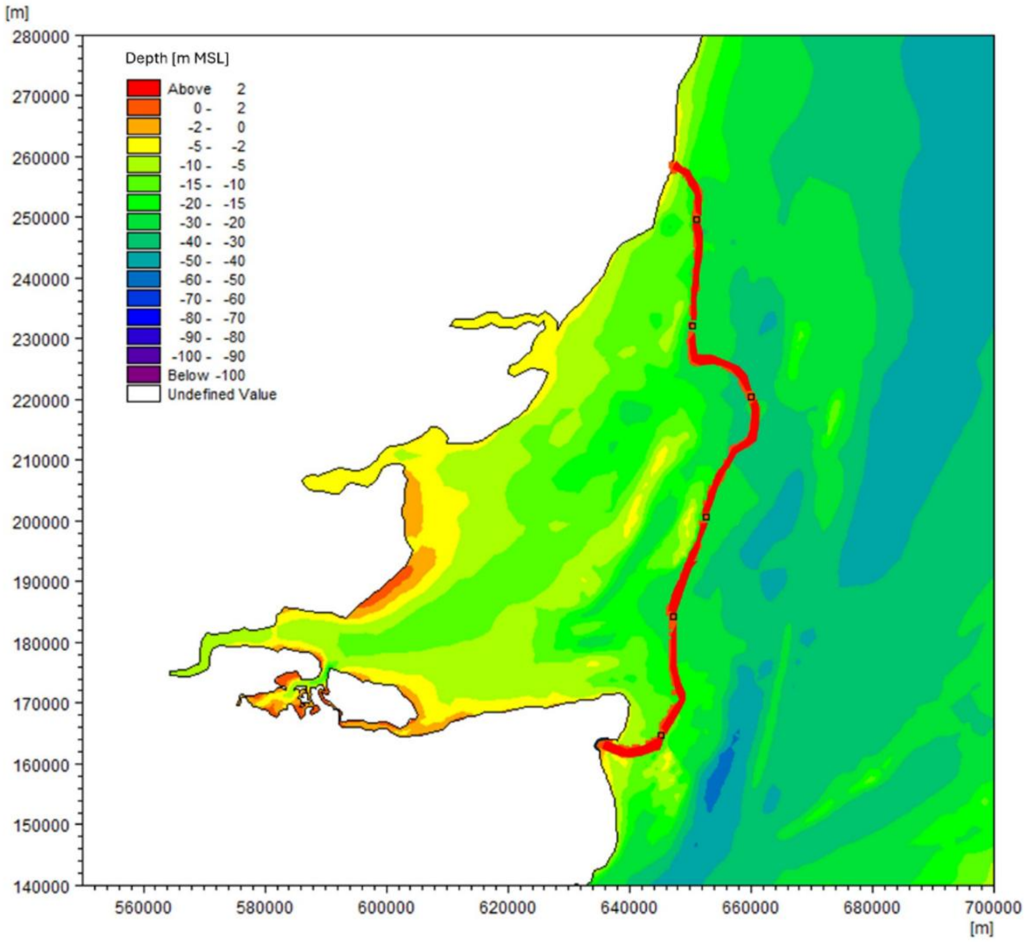

Plate 1-311.29 Water depth (m MSL)

Offshore wind and wave climate

1.7.791.7.83 The offshore wind and wave climates are shown in **Figure 6.4.4.1.7 Wind and Wave Climate KP 10 - KP 60** and **Figure 6.4.4.1.8 Wind and Wave Climate KP 70 - KP 110** that depict wind speed and direction, significant wave height and direction at 10 km intervals along the Offshore Scheme (ABPmer, 2018b).

~~1.7.80~~1.7.84 Between KP 10 and KP 110, the wind direction originates from all directions, but is predominantly from the southwest and west. Between KP 10 and KP 110, mean wind speed is between 7.1 m/s and 7.5 m/s (ABPmer, 2018b).

~~1.7.81~~1.7.85 The wave climate is more variable along the Offshore Scheme. Between KP 10 and KP 20, wave direction is predominantly from the south and northeast. Mean wave height at these locations is 0.9 m (ABPmer, 2018b).

~~1.7.82~~1.7.86 Between KP 30 to KP 60 waves are mainly from the south and northeast directions plus a now larger component originating from the southwest. Mean wave height at these locations is between 0.9 m and 1 m (ABPmer, 2018b).

~~1.7.83~~1.7.87 At KP 70 waves are from the south, northeast and southwest with a smaller component originating from the west. Mean wave height at KP 70 is 0.9 m (ABPmer, 2018b).

~~1.7.84~~1.7.88 Between KP 80 and KP 90 wave direction is from the south, northeast and west. The southwest component is no longer present due to the proximity of the Kent headland situated southwest of this point along the Offshore Scheme. Mean wave height at between KP 80 and KP 90 is between 0.8 m and 0.9 m (ABPmer, 2018b).

~~1.7.85~~1.7.89 At KP 100, wave direction is predominantly from the south and northeast, with a smaller component from the north and northwest. Mean wave height at KP 100 is 0.9 m (ABPmer, 2018b).

At KP 110, wave direction is predominantly from the south and northeast with smaller components from southwest and north. Mean wave height at KP 110 is 0.8 m (ABPmer, 2018b).

Offshore tidal current patterns

Neap tide

~~1.7.86~~1.7.90 **Figure 6.4.4.1.9 Neap EbbTide Neap FloodTide** shows tidal current patterns and current speed on then neap ebb and neap flood tides from a calibrated regional model (**Application Document 6.2.4.1.A Suspended Sediment Modelling**)**.** At the Suffolk landfall, the nearshore current speed on the neap ebb tide is between 0.2 m/s and 0.4 m/s, travelling northwards. On the neap flood tide the current direction is towards the south and the nearshore current speed is also between 0.2 m/s and 0.4 m/s.

~~1.7.87~~1.7.91 At the Kent landfall, the nearshore current speed on the neap ebb tide is between 0.0 m/s and 0.2 m/s in association with the more sheltered environment of Pegwell Bay. Just outside of Pegwell Bay (approximately 5 km from the landfall site) the current speed is between 0.4 m/s and 0.6 m/s and predominantly northwards. The ebb current speeds near Pegwell Bay are greater on the ebb tide than they are on the flood tide due to the strong flow from the English Channel into the southern North Sea (**Figure 6.4.4.1.9 Neap EbbTide Neap Flood Tide**).

~~1.7.88~~1.7.92 On the neap flood tide the current direction is towards the south and the nearshore current speed remains low at between 0.0 m/s and 0.2 m/s within Pegwell Bay and between 0.2 m/s and 0.4 m/s just outside Pegwell Bay (approximately 5 km from the landfall site).

~~1.7.89~~1.7.93 Offshore current speeds (where water depths are >15 m) reach between 0.6 m/s and 0.8 m/s on the neap ebb tide in association with the Offshore Scheme. Current direction is towards the north – northeast.

~~1.7.90~~1.7.94 Offshore on the neap flood tide current speeds reach between 0.8 m/s and 1.0 m/s at between KP 20 and KP 70. Between KP 70 and KP 90 current speeds are between 0.6 m/s and 0.8 m/s. Between KP 90 and KP110 current speeds are slower at between 0.4 m/s and 0.6 m/s due to the presence of the North Foreland headland. Current direction on the neap flood tide is towards southwest across the Offshore Scheme, becoming more oriented south approaching the nearshore environment (<15 m water depth) as flow becomes forced by the north-south aligned coastline of Kent.

Spring tide

~~1.7.91~~1.7.95 **Figure 6.4.4.1.10 Spring EbbTide Neap FloodTide** shows modelled tidal current patterns and current speed on then spring ebb and spring flood tides.

~~1.7.92~~1.7.96 At the Suffolk landfall, the nearshore current speed on the spring ebb tide is between 0.4 m/s and 0.6 m/s, travelling northwards. On the neap flood tide the current direction is towards the south and the nearshore current speed is also between 0.4 m/s and 0.6 m/s.

~~1.7.93~~1.7.97 At the Kent landfall, the current speed on the spring ebb tide is between 0.0 m/s and 0.6 m/s in association with the more sheltered environment of Pegwell Bay. Just outside of Pegwell Bay (approximately 5 km from the landfall site), the current speed is between 0.6 m/s and 1.0 m/s and moving northwards. The ebb current speeds near Pegwell Bay are again, greater on the ebb tide than they are on the flood tide due to the strong flow from the English Channel into the southern North Sea (**Figure 6.4.4.1.10 Spring EbbTide Neap FloodTide**).

~~1.7.94~~1.7.98 Offshore (>15 m water depth) current speeds reach between 0.8 m/s and 1.2 m/s on the spring ebb tide in association with the Offshore Scheme. However, between KP 80 and KP 110, current speeds are slower nearer the North Foreland headland at between 0.6 m/s and 1.0 m/s. The offshore current direction is towards the north – northeast.

~~1.7.95~~1.7.99 Offshore (>15 m water depth) on the spring flood tide current speeds reach between 1.0 m/s and 1.4 m/s at between KP 20 and KP 80. Between KP 80 and KP 110 current speeds are slower at between 0.8 m/s and 1.0 m/s. Current direction on the spring flood tide is towards southwest across the Offshore Scheme, again becoming more oriented south approaching the nearshore environment as flow becomes forced by the north-south aligned Kent coastline.

Seabed sediments and bathymetry

~~1.7.96~~1.7.100 Surficial seabed sediments along the Offshore Scheme have been mapped (MMT, 2022; NEXTGEO, 2024) and are presented in **Figure 6.4.4.1.11 Offshore Seabed Surficial Geology** and summarised below:

- Between KP 1 and KP 3.5 (nearshore), the seafloor comprises of ripples and megaripples made of SILT. At KP 1 there is an area of stiff CLAY.
- Between KP 3 and KP 4.5 (nearshore), the seafloor comprises off rippled and megaripples SAND. Between KP 4.5 – KP 6 the seafloor comprises CLAY.
- Between KP 6 and KP 10, the seafloor comprises of Gravelly SAND to Sandy GRAVEL. At KP 8 to the right hand side of the Offshore Scheme, there is a CLAY outcrop extending southeast for 132 m, and rising 3 m above the surrounding seabed (Plate 1-32~~Plate 1.30~~).

- Between KP 10 and KP 18, the seafloor comprises mainly of Gravelly SAND to Sandy GRAVEL. However, between KP 9 and KP 13 there is a stretch of SAND. At KP 12 – KP 13 there are patches of CLAY. Several outcropping features lie directly on the route between KP 10 – KP 10.5 rising approximately 2 m above the surrounding seabed (Plate 1-33~~Plate 1.31~~).
- Between KP 18 – KP 28 the seabed comprises of silty SAND with areas of rippled SAND and clayey SAND (Plate 1-34~~Plate 1.32~~).
- Between KP 28 and KP 32 the seabed comprises of silty and clayey SAND associated with areas of eroded depressions, ripples and mega-ripples, alongside large areas of gravelly SAND which are rippled or mega-rippled seabed. Smaller localised patches of sandy GRAVEL and sandy SILT are also present.
- Between KP 32 and KP 82, SAND gives way to an area of coarser material, recorded as Gravelly SAND to Sandy GRAVEL. Between KP 36 – KP 42 the seabed comprises sandy GRAVEL and muddy sandy GRAVEL with intermittent areas of CHALK, silty SAND and SAND. Between KP 49.5 and KP 52.5, KP 55 and KP 56, KP 59 and 59.5, and KP 73 and KP 76 the coarser material is interrupted by SAND. Between KP 62.5 and KP 65.5 lenses of stiff CLAY are also present. Throughout this section there are areas of megaripples and ripples of varying sizes present made of the different types of mobile sediments. Plate 1-35~~Plate 1.33~~ shows that at KP 50.5 there are 2 m high megaripples across the Offshore Scheme, and between KP 78 – KP 80 there is a large area of megaripples covering the entire corridor.
- Between KP 80 and KP 86, the seabed comprised a mixture of SAND and areas stiff CLAY. From KP 86 to KP 96.5, stiff CLAY is no longer found and SAND dominates.
- Between KP 101 and KP 106 the seabed is characterised by sand waves made of gravelly SAND. The seabed is also comprised of featureless sandy GRAVEL.
- Between KP 106 and KP 114 the seabed comprises of mobile mega-rippled SAND to silty SAND with patches of occasional and numerous boulder fields. There is also gravelly SAND to sandy GRAVEL with areas of hummocky seabed, areas of mobile sand waves and boulder fields (Plate 1-36~~Plate 1.34~~).
- Between KP 114 – KP 121 (nearshore), the seafloor comprises mainly of Gravelly SAND to Sandy GRAVEL. At KP 118 there is a patch of stiff CLAY and GRAVEL. The seafloor through this section is also characterised by sandwaves (Plate 1-37~~Plate 1.35~~).

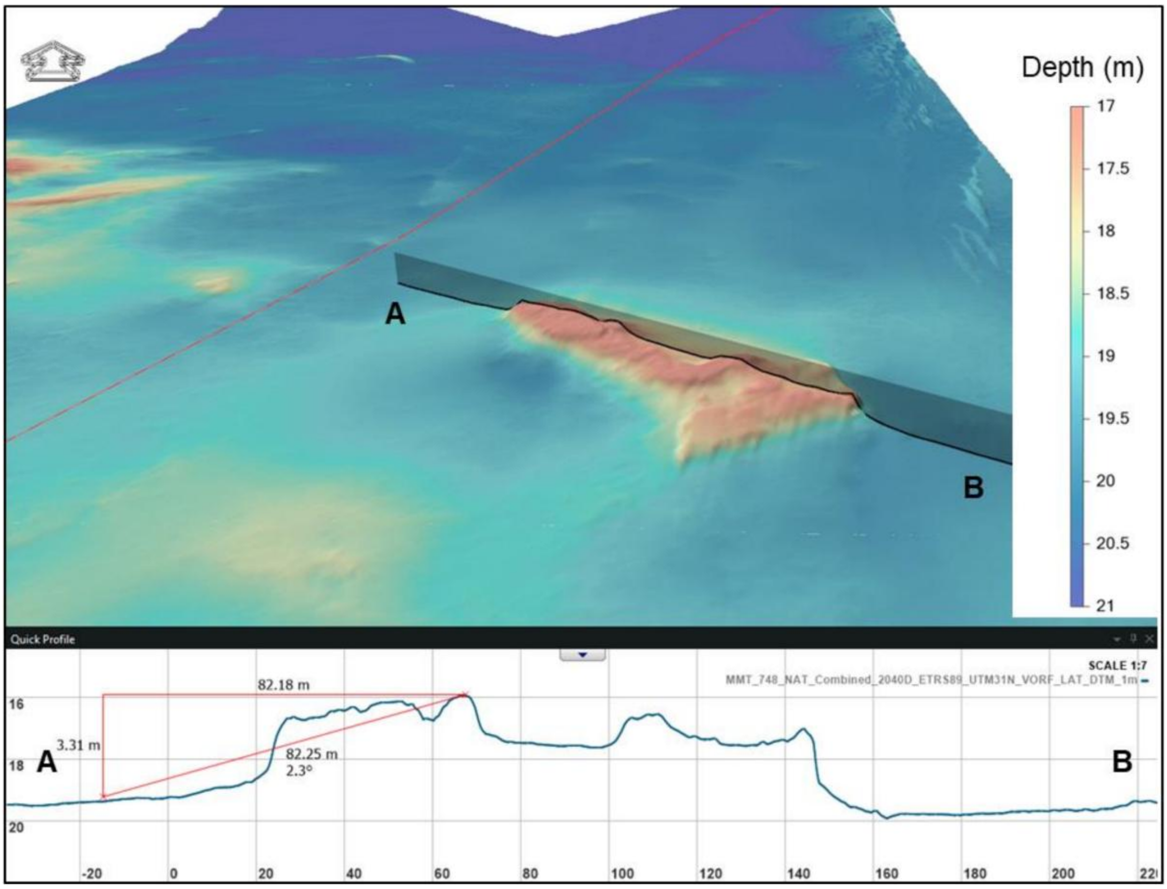

Plate 1-32~~1.30~~ Outcrop at KP 8 with a height of 3.3 m above the surrounding seafloor (MMT, 2022)

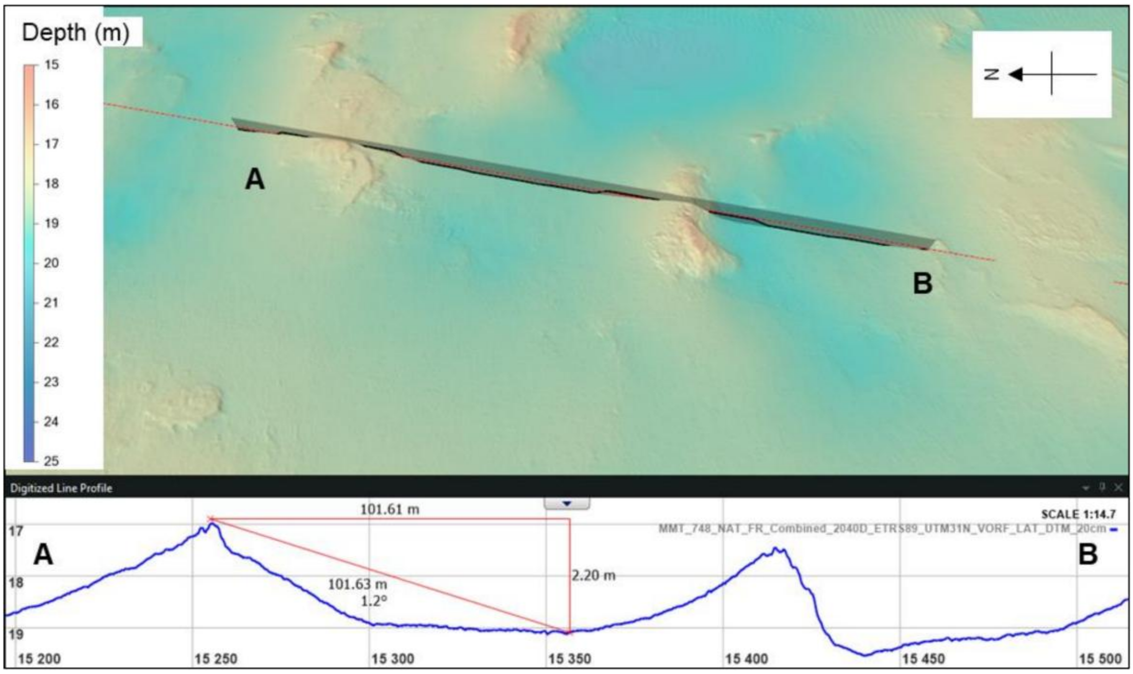

Plate 1-33~~1.31~~ A profile along the route between KP 10 and KP 10.5 over a sample of the outcrops in the area. The outcrops stand >2 m above the surrounding seabed (MMT, 2022)

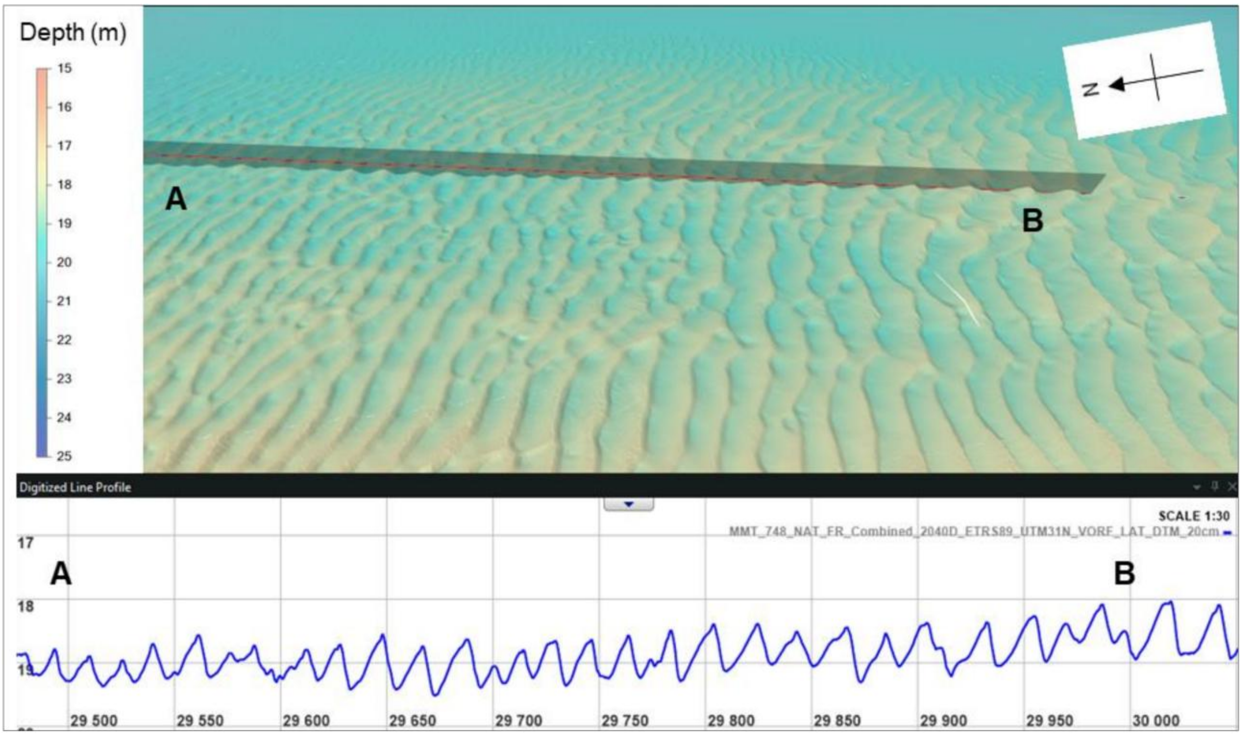

Plate 1-341.32 Example of the sand waves near KP 22 - KP 26. Maximum height 1 m. The red line in the image does not correspond to updated Offshore Scheme route (MMT, 2022)

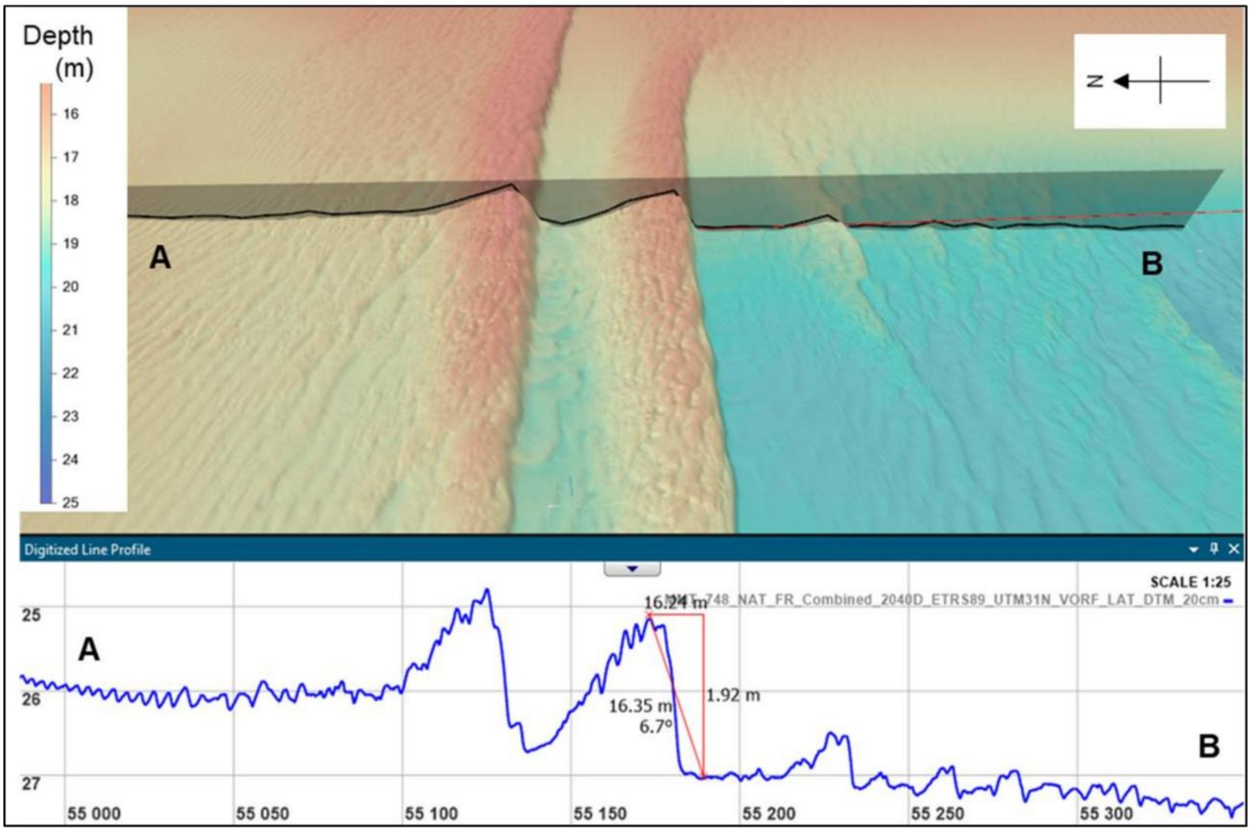

Plate 1-351.33 2 m high sandwave on the route at KP 50.5 (MMT, 2022)

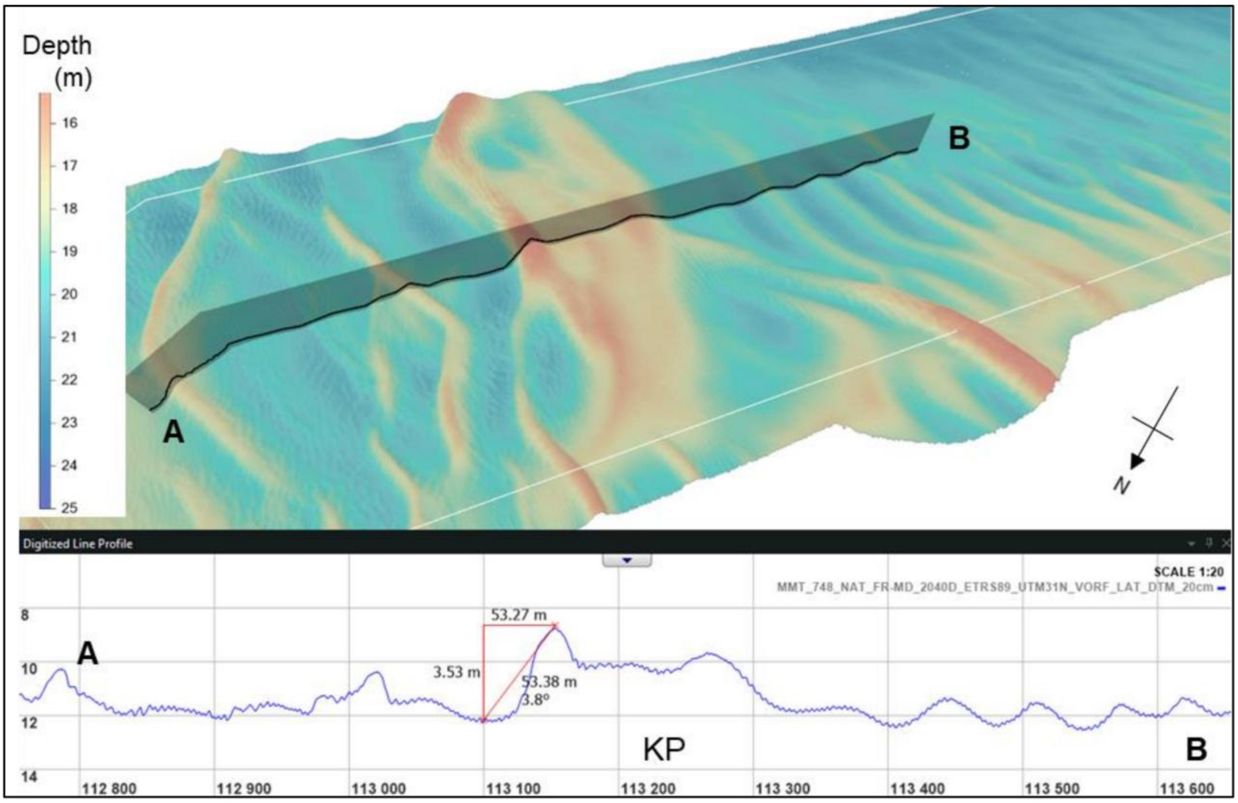

Plate 1-36~~1.34~~ Bedforms up to 3.53 m high located near KP 108 (MMT, 2022)

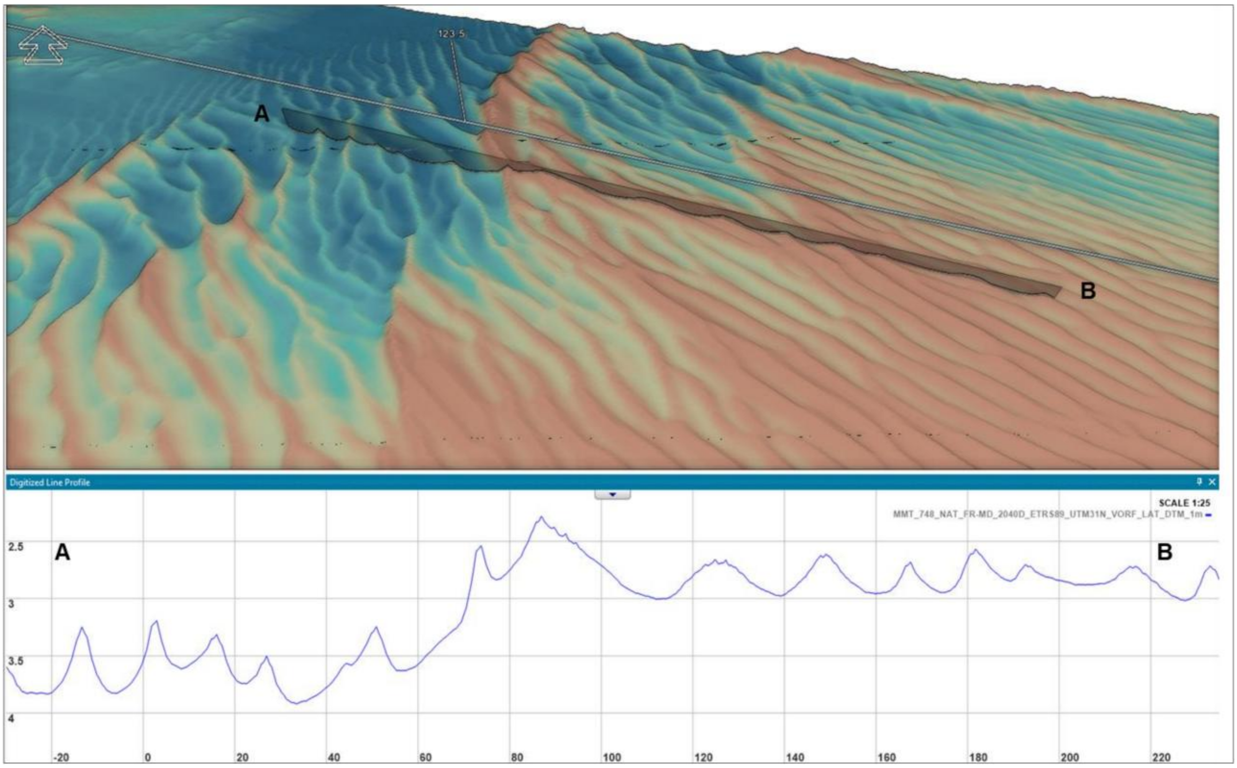

Plate 1-37~~1.35~~ Slopes along the route associated with lee slopes of a mega ripple area at KP 117 (MMT, 2022)

~~1.7.97~~1.7.101 **Figure 6.4.4.1.12 Marine Designated Sites** depicts the marine designated sites associated with the Offshore Scheme route.

~~1.7.98~~1.7.102 Goodwin Sands MCZ (see also Section 1.7.120~~1.7.75~~) is a sand bank system situated between 4 km and 12 km to the east of Deal and 1 km south of the Offshore Scheme Boundary (**Figure 6.4.4.1.12 Marine Designated Sites**). The Isle of Grain to South Foreland SMP Review (Halcrow Group Limited, 2010) states that the Goodwin Sands MCZ exerts a large-scale control over the development of Pegwell Bay by protecting the shoreline from direct incident wave attack.

~~1.7.99~~1.7.103 Kenyon and Cooper (2005) explain that Goodwin Sands MCZ is a near-coast sinuous bank associated with a zone of bedload convergence where no overall bedload transport takes place.

Greater Thames Estuary/The Greater Thames Region

~~1.7.100~~1.7.104 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). It is characterised by large subtidal sandbanks and channels extending up to 80 km in length and 7.5 km wide, aligned with the tidal streams (northeast – southwest) (Burningham & French, 2011) (Plate 1-38~~Plate 1.36~~).

~~1.7.101~~1.7.105 The Offshore Scheme passes near to the Greater Thames Estuary sandbanks and through the Aldeburgh Ridge (see section on Suffolk landfall geomorphology and sediment transport). 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 (Burningham & French , 2008).

~~1.7.102~~1.7.106 Burningham & French (2009) show that sediment transport pathways across the Greater Thames Estuary are predominantly from northeast to southwest and become more southerly beyond the North Foreland (Plate 1-25~~Plate 1.23~~).

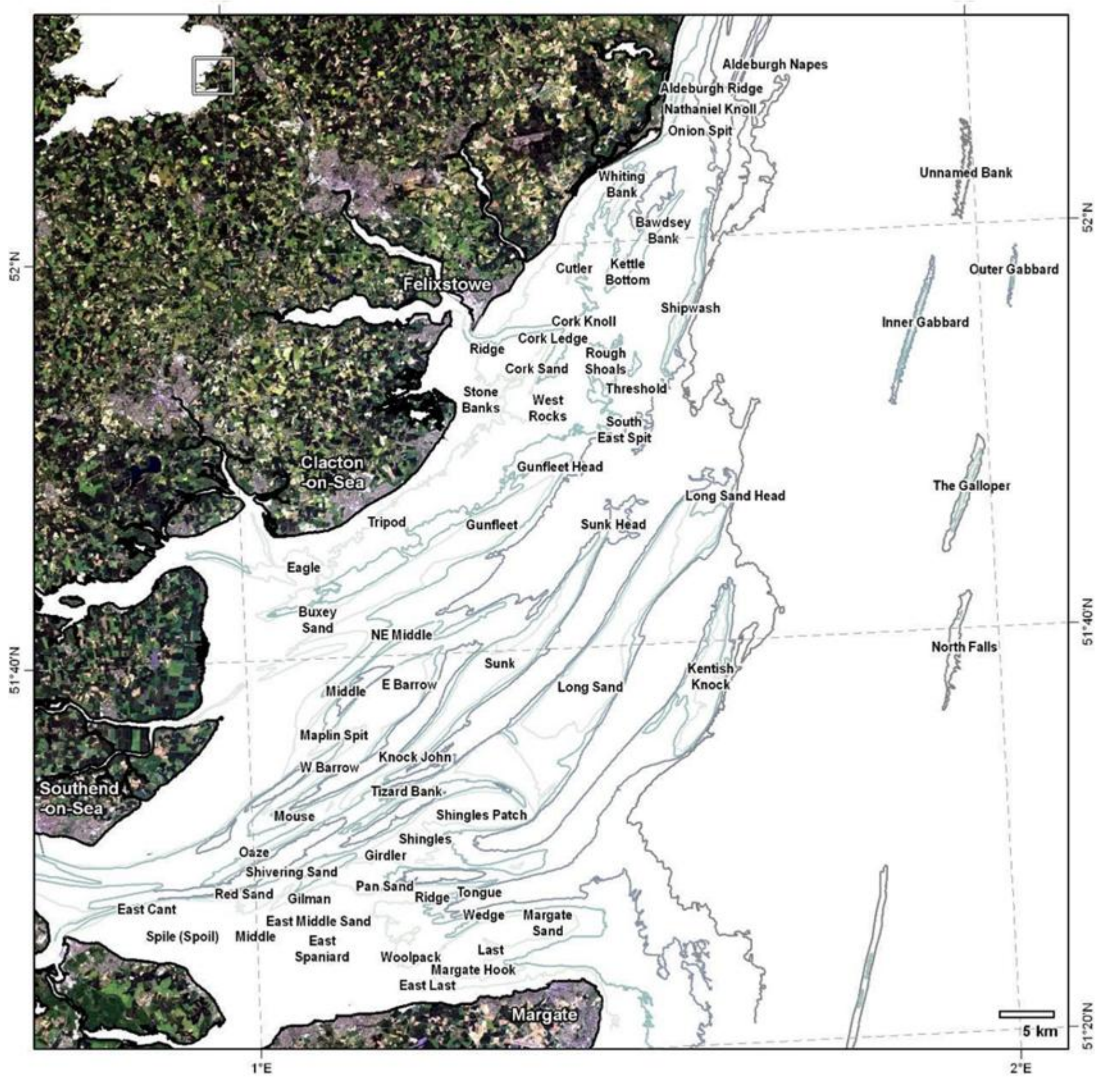

Plate 1-38~~1.36~~ The Greater Thames Estuary, showing the main bank features (Burningham; French, 2009)

Designated sites

Leiston to Aldeburgh SSSI

~~1.7.103~~1.7.107 The Leiston to Aldeburgh SSSI is situated where the Offshore Scheme makes landfall (**Figure 6.4.4.1.12 Marine Designated Sites)** It contains multiple habitats including grasslands, heath, scrub, woodland, fen, open water and vegetated shingle. These habitats support a large community of breeding and wintering birds, rare plants and dragonfly species (Suffolk Coasts and Heaths , 2020).

Thanet Coast Special Areas of Conservation SAC

~~1.7.104~~1.7.108 The Thanet Coast SAC has the longest stretch of chalk cliffs (23 km) in the UK with caves, stacks and arch formations (IFCA, 2024) (Natural England, 2025). The cliffs extend into chalk reef platforms along the shore where the cliffs extend into the littoral zone, which also extend further offshore as a series of steps dissected by gullies that hosts unusually rich littoral algal flora species (JNCC, 2024). The Thanet Coast SAC overlaps with a wider network of designated sites including a Marine Conservation Zone (MCZ), Special Protection Area (SPA), Ramsar Site and Site of Special Scientific Interest (SSSI) (Natural England, 2025). The Thanet Coast SAC also overlaps with the Offshore Scheme Boundary in Pegwell Bay (**Figure 6.4.4.1.12 Marine Designated Sites**).

~~1.7.105~~1.7.109 The Thanet Coast hosts many submerged and partially submerged sea caves that vary in size. The caves act as a unique natural habitat that support unique and varied algal and lichen communities (JNCC, 2024; IFCA, 2024).

~~1.7.106~~1.7.110 The upper Cretaceous chalk at Thanet is notably softer and more porous than other coastal chalk exposures, making it more susceptible to erosion and biological boring (Natural England, 2025).

Sandwich Bay SAC

~~1.7.107~~1.7.111 The Sandwich Bay SAC is characterised by a largely inactive dune system which hosts a large area of fixed dune grassland habitat (JNCC, 2024). The Sandwich Bay SAC overlaps the Offshore Scheme Boundary in Pegwell Bay where the cable makes landfall (**Figure 6.4.4.1.12 Marine Designated Sites**).

~~1.7.108~~1.7.112 At the northern end of Sandwich Bay there are ‘shifting dunes’ that sit seawards of the fixed dune system that hosts a range of foredune species (JNCC, 2024).

~~1.7.109~~1.7.113 Embryonic shifting dunes are present at the seaward edge of Sandwich Bay which hosts strandline species and sand-binding grasses inland (JNCC, 2024).

Thanet Coast MCZ

~~1.7.110~~1.7.114 The Thanet Coast MCZ covers 6,279 ha from the mean high water to areas of subtidal chalk from Ramsgate, Thanet and to Herne Bay. The MCZ protects subtidal chalk rock, subtidal coarse, mixed sediments and sand, peat and clay exposures, and habitats (DEFRA, 2019) (**Figure 6.4.4.1.12 Marine Designated Sites**).

Sandwich Bay to Hacklinge Marshes SSSI

~~1.7.111~~1.7.115 The Sandwich Bay to Hacklinge Marshes SSSI contains the most important dune system and associated sandy grassland habitats in southeast England. The mudflats, saltmarsh, chalk cliffs, freshwater grazing marsh, scrub and woodland that characterise the area are also noted as important habitats (Natural England, 2010). It is situated to the south of the Kent landfall (**Figure 6.4.4.1.12 Marine Designated Sites**).

Sandwich and Pegwell Bay National Nature Reserve (NNR)

~~1.7.112~~1.7.116 The Sandwich and Pegwell Bay NNR is characterised by a complex series of habitats designated for its international importance for its bird population. It is situated to the south of the Kent landfall (**Figure 6.4.4.1.12 Marine Designated Sites**).

~~1.7.113~~1.7.117 The Kent Wildlife Trust's nature reserve is made up of intertidal mudflats, saltmarsh, shingle beach, sand dunes, ancient dune pastures, chalk cliffs, wave-cut platforms and coastal scrubland (Natural England , 2017).

Thanet Coast & Sandwich Bay RAMSAR

~~1.7.114~~1.7.118 The Thanet Coast & Sandwich Bay Ramsar site comprises a diverse range of coastal habitats including extensive intertidal sand and mudflats, chalk reefs and cliffs, shingle beaches, sand dunes, saltmarsh, and areas of coastal grazing marsh. These habitats support high biological diversity, providing feeding, roosting, and nursery areas for marine invertebrates, fish, and waterbirds (JNCC, 2008).

Thanet Coast and Sandwich Bay SPA

~~1.7.115~~1.7.119 The Thanet Coast and Sandwich Bay Special Protection Area (SPA) is an 18.8 km² coastal site located at the north-eastern tip of Kent in southern England, comprising an extensive rocky shoreline with adjoining estuarine habitats, sand dunes, maritime grassland, saltmarsh, and grazing marsh (Kent and Essex Inshore Fisheries and Conservation Authority, 2025).

Goodwin Sands MCZ

~~1.7.116~~1.7.120 The Goodwin Sands MCZ is situated off Sandwich Bay and covers an area of 277 km2. It is a large and dynamic area of sand and coarse sediments that is regularly exposed at low tides becoming a haul out site for seals and foraging grounds for seabirds (DEFRA, 2019 b). Around the sands is an area of coarser subtidal sediments including pebbles and boulders that is associated with high biodiversity (DEFRA, 2019 b).

~~1.7.117~~1.7.121 The Goodwin Sands complex is a largely self-sustaining system with limited input and output of sediment, making the volume of sand within the system relatively stable (HR Wallingford , 2015). The system relies on a clockwise circulatory sediment transport pattern to maintain its sandbanks (HR Wallingford , 2015).

~~1.7.118~~1.7.122 The covering and uncovering of shipwrecks over decades within the Goodwin Sands complex indicates it morphological dynamic nature as its sandbanks migrate. The Admiral Gardner wreck had been buried since 2002 until 2008, suggesting the southern sandbank of the complex (Sand Head) had migrated west between 2002-2008 (Royal HaskoningDHV, 2016).

~~1.7.119~~1.7.123 A study by HR Wallingford (HR Wallingford, 2008) describes dredging of the Goodwin Sandbanks (in Area 342) and the removal of 244,060 m3 of sand in 1998, however by 2006 bed levels in this area had recovered (HR Wallingford, 2008) (Royal HaskoningDHV, 2016). Between 1995 - 2006 there was an overall increase in bed level across the majority of the of the Goodwin Sands complex (HR Wallingford, 2008) (Royal HaskoningDHV, 2016).

~~1.7.120~~1.7.124 The UK Hydrographic Office (UKHO) and the Maritime and Coastguard Agency (MCA) routinely survey the Goodwin Sands complex to assess bathymetric change. Plate 1-39~~Plate 1.37~~ shows the bathymetric changes between the 2021 and 2009 surveys. It shows the migration of the northern sandbanks toward the south east and the southern sandbanks towards the west.

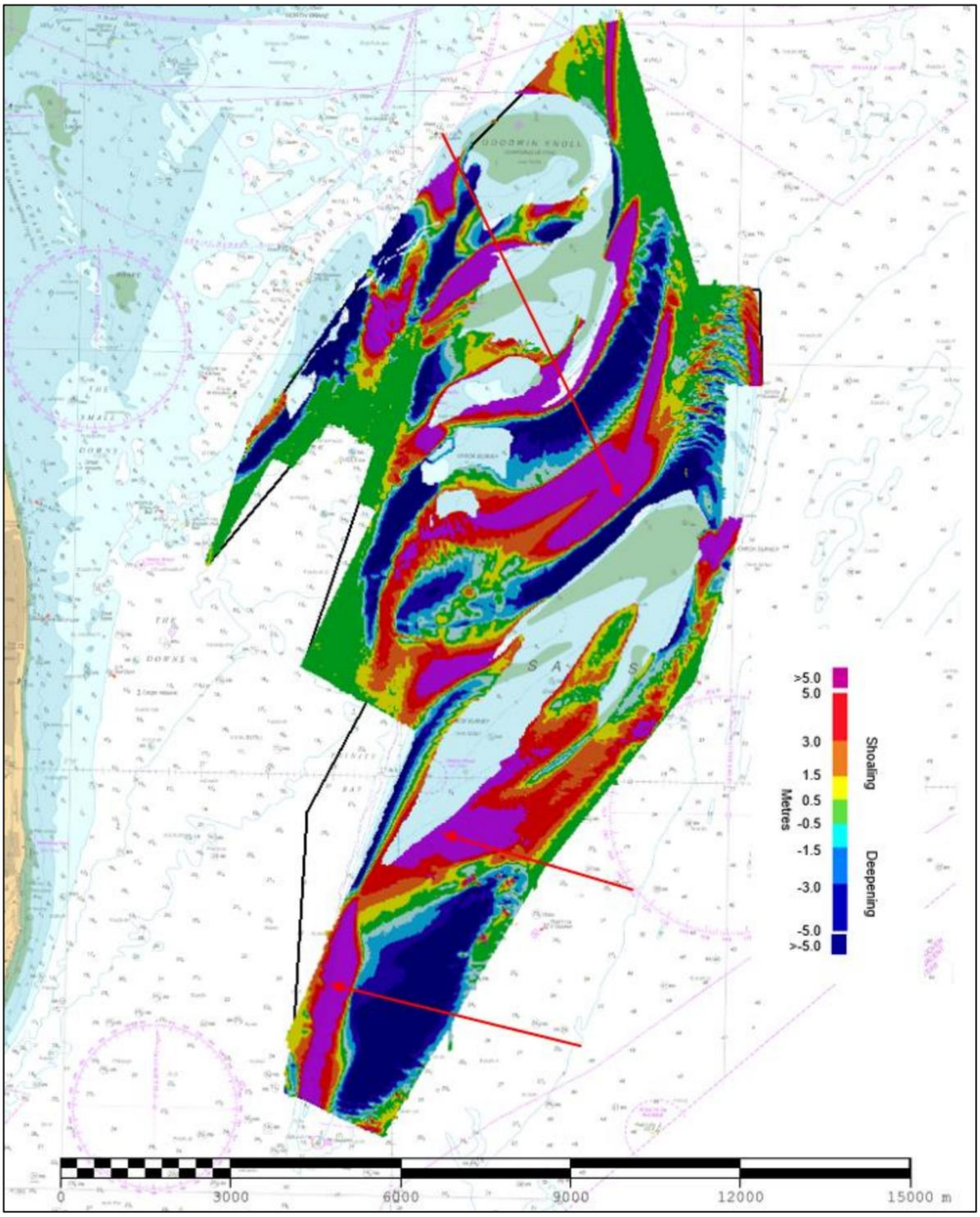

Plate 1-39~~1.37~~ Difference surface showing bathymetric changes between the 2021 and 2009 surveys (Red arrows represent sandwave migration since 2009 survey) (UK Hydrographic Office, 2021)

Marine Sediment Quality

~~1.7.121~~1.7.125 Marine sediment quality can be affected by the deposition and subsequent accumulation of substances on the seabed. Historically, English nearshore and offshore waters have been heavily impacted by anthropogenic activities, such as dredging, industrial discharges, agricultural runoff and wastewater discharge, and therefore sediment resuspension can lead to the associated release of chemical pollution. Chemical pollution can come from heavy metals, hydrocarbons and a range of persistent organic compounds such as polycyclic aromatic hydrocarbons (PAHs).

~~1.7.122~~1.7.126 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 marine sediments include barium (Ba), chromium (Cr), lead (Pb) and zinc (Zn). Trace metal contaminants are prone to various environmental interactions and transformations (physical, chemical and biological), potentially increasing their biological availability.

~~1.7.123~~1.7.127 Total Organic Carbon (TOC) is often used as a non-specific indicator of water quality (Shetty & Goyal, 2022). Furthermore, organic material in disturbed sediments can act as an energy source for marine micro-organisms, reducing the dissolved oxygen availability in the water.

~~1.7.124~~1.7.128 Total Hydrocarbon Content (THC) values are used to describe the quantity of hydrocarbon contaminants 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.

~~1.7.125~~1.7.129 As part of the MMT (2022) survey, 32 grab sample sites were selected for analyses of concentrations of metals, organics, PAHs, and THC.

~~1.7.126~~1.7.130 Trace metal concentrations varied along the survey route. Cefas Action Level 1[2] threshold values were exceeded at 32 sites for arsenic (As), two sites for cadmium (Cd), five sites for chromium (Cr), one site for copper (Cu), one site for lead (Pb), 22 sites for mercury (Hg), two sites for nickel (Ni) and two sites for Zinc (Zn). These trace metals were found at all of the sampling sites, however none of the samples exceeded the CEFAS (MMO, 2014) Action Level (AL) 2 threshold. This is despite the North Sea having a long history of increased background levels of heavy metals (Kersten et al., 1994).

~~1.7.127~~1.7.131 Arsenic was found to be the most prominent contaminant within the surveyed area, exceeding CEFAS (MMO, 2014) AL 1 threshold value at 15 of the grab sample stations, and the CCME Interim Sediment Quality Guidelines (ISQG) (CCME, 2001) assessment criteria at 32 sites (MMT, 2022).

~~1.7.128~~1.7.132 The highest concentrations of lead and copper were measured at sample station S036, approximately 5 km southeast of the port of Ramsgate, exceeding both CEFAS (MMO, 2014) AL 1 and CCME ISQG assessment criteria (CCME, 2001), however the

[2] Cefas Action Levels are used to determine whether dredged material is suitable for disposal at sea, by providing a proxy risk assessment for potential impacts to biological features such as fish and benthos.

neighbouring survey sample stations recorded concentrations that do not exceed any of the thresholds (MMT, 2022).

~~1.7.129~~1.7.133 No correlation between metals and TOC, organic matter or sediment composition were observed. TOC and organic matter varied along the survey route, with an average content of 0.3% (SD=0.2) and 1.1% (SD=0.6), respectively (MMT, 2022).

~~1.7.130~~1.7.134 THC concentrations varied along the survey route and did not exceed the Dutch RIVM intervention value, which is a generic sediment quality standard used to classify historically contaminated areas at any of the grab sample sites (MMT, 2022). PAH concentrations exceeded CEFAS (MMO, 2014) AL 1 and CCME ISQG (CCME, 2001) threshold values for three PAHs at one grab sample station within the Offshore Scheme Boundary, located at approximately KP 5.3.

~~1.7.131~~1.7.135 Overall, concentration levels from within the survey area were not observed at levels that are of concern.

Environmental baseline data for the pre-sweeping interval

~~1.7.132~~1.7.136 For the pre-sweeping interval (KP96.32–KP113.883), the baseline incorporates MMO-validated 2024 vibrocore data from 16 pre-sweep locations (Next Geosolutions & Benthic Solutions Ltd. , 2025):

~~1.7.133~~1.7.137 The chemistry results show that PAH concentrations were very low, with most values below the laboratory detection limit and well under all CCME and OSPAR guideline thresholds, indicating minimal organic contamination. Heavy and trace metals were also generally low, with only arsenic showing repeated exceedances of Cefas cAL1, a pattern typical of the southern North Sea’s natural geological background, and occasional isolated nickel exceedances in single layers. Overall, the chemistry dataset indicates that sediments in the pre-sweeping area are not significantly contaminated and present low environmental risk (Next Geosolutions & Benthic Solutions Ltd. , 2025).

Table 1-17~~1.17~~ Pre-Sweeping Environmental Summary Table (Next Geosolutions & Benthic Solutions Ltd. , 2025)

Site	KP (km)	Water Depth (m LAT)	Surface Sediment	Middle Sediment	Bottom Sediment	Metals Summary	PAHs Summary
A	96.6	17.6	Muddy Gravel	—	Muddy Gravel	Low	Low
B	97.4	14.9	Muddy Gravel	Muddy Gravel	Muddy Gravel	Low	Low
C	98.4	15.5	Muddy Gravel	Muddy Gravel	Muddy Gravel	Low	Low
D	99.4	15.4	Muddy Gravel	Muddy Gravel	Muddy Gravel	As high	Low
E	100.5	14.3	Muddy Sandy Gravel	—	Muddy Sandy Gravel	As high	Low
F	101.2	13.0	Gravelly Muddy Sand	Sandy Gravel	Sandy Mud	Ni elevated	Low
G	102.3	12.7	Muddy Sandy Gravel	Muddy Gravel	Muddy Gravel	Low	Low
H	103.2	12.0	Muddy Gravel	Muddy Gravel	Muddy Gravel	Low	Low
I	104.2	10.9	Gravelly Sand	Muddy Gravel	Muddy Gravel	As high	Low
J	105.5	10.5	Sandy Gravel	Muddy Gravel	Muddy Gravel	Low	Low

Site	KP (km)	Water Depth (m LAT)	Surface Sediment	Middle Sediment	Bottom Sediment	Metals Summary	PAHs Summary
K	106.4	10.8	Slightly Gravelly Sand	—	Gravelly Mud	As high	Low
K_A	106.4	10.8	Slightly Gravelly Sand	Muddy Gravel	Gravelly Mud	As high	Low
L	107.2	10.7	Slightly Gravelly Sand	Gravel	Muddy Gravel	Low	Low
M	108.1	10.7	Gravelly Mud	Muddy Gravel	Muddy Gravel	As high	Low
N	109.5	9.6	Gravelly Sand	Muddy Gravel	Muddy Gravel	As high, Ni elevated	Low
O-a	110.7	8.9	Muddy Gravel	Muddy Gravel	Muddy Gravel	Low	Low

PAHs: Low = mostly below detection, no concerns.
Metals: As high = arsenic above Cefas cAL1 (20 mg/kg)
Ni elevated = single-layer nickel ERL exceedance
Low = all metals generally below thresholds

Future Baseline

~~1.7.134~~1.7.138 There is a degree of uncertainty associated with the characterisation of the future baseline for the physical environment. To assess the potential impacts of climate change, projections of sea level rise and changes in storm conditions, as outlined in UK guidance, have been applied to the current baseline.

~~1.7.135~~1.7.139 Guidance on changes in future wind and wave conditions are provided by the Environment Agency (Environment Agency, 2022). 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.

~~1.7.136~~1.7.140 UKCP18 (Met Office, 2019), 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 0.24 m above 2024 levels at the Kent and Suffolk landfall sites. This is estimated for a high emissions scenario (RCP 8.5) in the 95th percentile.

~~1.7.137~~1.7.141 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 (East Suffolk Council, 2020). 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.

~~1.7.138~~1.7.142 At the Kent landfall, ABPmer (2024) explain that changes of the order of 0.5 to 1 m are to be expected in the intertidal and subtidal area of Pegwell Bay and therefore the gross morphology is expected to remain relatively stable over time with no notable change.

~~1.7.139~~1.7.143 ABPmer (2024) outlines some future morphological scenarios for consideration within Pegwell Bay. While the scenarios are plausible, they are considered to have a low probability of occurrence. There is much uncertainty around how and when they might occur, further, their occurrence will likely be dependent on anthropogenic actions and the mitigation measures that could be put in place. It is therefore recommended that monitoring of the morphological development of the landfall site and Pegwell Bay is carried out over the lifetime of the Proposed Development. The potential future scenarios are listed below:

- The spit associated with the River Stour may continue to migrate Northwards at higher pace risking interaction with the Offshore Scheme Boundary.
- Stronger river flows existing the River Stour on entering Pegwell Bay could conceivably cut through the intertidal channel that meanders across the beach. It is impossible to predict how such a scenario may develop; however, it is plausible it may divert toward the Offshore Scheme Boundary.

Estimated future coastal erosion

~~1.7.140~~1.7.144 The National Coastal Erosion Risk Mapping 2025 dataset shows projected areas within England at risk from erosion and predicted erosion extents for different periods, including Medium Term (up to 2055) and Long Term (up to 2105), under various management scenarios, including No Future Intervention (NFI) and with the implementation of Shoreline Management Plan (SMP) policies.

~~1.7.141~~1.7.145 In order to assess the worst-case scenario for future erosion extent at the Kent and Suffolk landfalls, the NFI NCERM 2025 dataset was downloaded that estimates erosion based on the UKCP18 high emissions scenario, Representative Concentration Pathway (RCP) 8.5, in the 95th percentile.

~~1.7.142~~1.7.146 The NCERM dataset provides two erosion areas near the Suffolk landfall site; one approximately 1.7 km north and the other approximately 8.7 km south.

~~1.7.143~~1.7.147 At the Kent landfall the NCERM dataset also provides two erosion areas nearby; one approximately 500 m northeast and the other approximately 4.9 km south.

~~1.7.144~~1.7.148 The nearby datasets were used to estimate the potential future erosion at each landfall site where no data is available. At Kent, only the dataset to the south was used as it better matched the character of the coastline compared to the data to the north where more erosion resistant chalk cliffs are present.

~~1.7.145~~1.7.149 The erosion extent was measured every 100 m along the frontages to provide an average value for erosion that can be applied to each landfall site. Erosion estimates for the Suffolk and Kent landfall sites can be seen in Table 1-18~~Table 1.18~~. **Figure 6.4.4.1.13 Suffolk estimated future erosion** and **Figure 6.4.4.1.14 Kent estimated future erosion** show the estimated future erosion extents associated with each landfall site.

Table 1-18~~1.18~~ Estimated average erosion width from the NCERM dataset for 2055 and 2105 epochs

Landfall	Average erosion extent (m)	
	2055	**2105**
Suffolk	77	118

Kent	47	82

Limitations and assumptions

~~1.7.146~~1.7.150 Using these adjacent erosion extents to estimate future erosion at the landfall sites has significant limitations and only provides an approximation for future erosion with no future intervention at the landfall site.

~~1.7.147~~1.7.151 It should be noted that the NCERM data shows areas of land likely to be at erosion risk but does not show the precise future position of the shoreline. Erosion may happen faster or slower, and risk may change over time.

1.8 Proposed Project Design and Embedded Mitigation

1.8.1 The Proposed Project has been designed, as far as possible, following the mitigation hierarchy in order to, in the first instance, avoid or minimise Physical Environment impacts and effects through the process of design development, and by embedding measures into the design of the Proposed Project.

1.8.2 As set out in **Application Document 6.2.1.5 Part 1 Introduction Chapter 5 EIA Approach and Methodology**, mitigation measures typically fall into one of the three categories: embedded measures; control and management measures; and mitigation measures.

Embedded Measures

1.8.3 Embedded measures have been integral in reducing the Physical Environment effects of the Proposed Project. Measures that that have been incorporated are:

- Sensitive routeing and siting of infrastructure and temporary works.
- Installation of cables should not create pre-cut trenches in the Coralline Crag due to the sensitivity of the system. Instead, rock bags or mattresses should be used to protect the cable; and
- Commitments made within **Application Document 7.5.2 Outline Offshore Construction Environmental Management Plan** and **Application Document 9.84 Register of Environmental Actions and Commitments (REAC)**.

Control and Management Measures

1.8.4 The following measures have been included within **Application Document 7.5.2 Outline Offshore Construction Environmental Management Plan** and **Application Document 9.84 Register of Environmental Actions and Commitments (REAC)** relevant to the control and management of impacts that could affect Physical Environment receptors:

- B42 - Where HVDC cables cross saltmarsh habitat associated with the Thanet Coast & Sandwich Bay SPA / Ramsar and Sandwich Bay SAC, they would be installed using a trenchless technique at the landfall to avoid direct impacts on the saltmarsh habitat.

- B43 - Measures will be adopted to avoid the trenchless drilling equipment getting stuck at the Kent landfall. No excavation will be undertaken to remove stuck drilling equipment except within 40m of the entry or exit point, where the drill is at shallow depth (<5m), and outside any areas of saltmarsh.
- B59 - In relation to trenchless landfall works at both Suffolk and Kent, the contractor(s) will prepare the following suite of plans:

  Kent Landfall:

  - HDD Landfall Method Statement and Drilling Fluid Management Plan, in consultation with NE, Kent Wildlife Trust (KWT), Royal Society for the Protection of Birds (RSPB), National Trust, and Thanet District Council, and submit the same for approval by the Marine Management Organisation (MMO) in accordance with the Cable Specification and Installation Plan prior to the commencement of any HDD activities.
  - Undertake HDD landfall hydrofracture modelling which is to be shared for information only with NE, KWT and RSPB when completed.

  Suffolk Landfall:

  - HDD Landfall Method Statement and Drilling Fluid Management Plan, in consultation with NE, Royal Society for the Protection of Birds (RSPB) and East Suffolk Council (ESC) and submit the same for approval by the Marine Management Organisation (MMO) in accordance with the Cable Specification and Installation Plan prior to the commencement of any HDD activities.
  - Undertake HDD landfall hydrofracture modelling which is to be shared for information only with NE, RSPB and ESC when completed.

  At each landfall location (Suffolk and Kent) Natural England, ESC, RSPB and KWT (respectively) will be notified of changes to landfall HDD depth or changes to the location of the landfall exit pits.
- B67 - To ensure there will be no vehicular or pedestrian access across the saltmarsh, access and egress of vehicles to the mudflats will be via the former hoverport with a buffer between the defined access route and the seaward (distal) limit of the saltmarsh. The locations and widths of access routes across the mudflats will be defined post consent in consultation with Natural England, Kent Wildlife Trust and the National Trust as appropriate and will be informed by a pre-construction saltmarsh habitat survey. All vehicles accessing the intertidal mudflats will be low pressure bearing.
- B68 - The Undertaker will prepare a Pegwell Bay Landfall Construction Method Statement as part of the Cable Specification and Installation Plan (CSIP) prior to commencement of the landfall works in Kent, in consultation with Natural England, Kent Wildlife Trust and the National Trust covering marine cable pull-in and cable burial (including excavations) between Mean Low Water Springs (MLWS) and the trenchless crossing exit pits.
- B69 - Trenchless crossing exit pits in Pegwell Bay will be at least 105 m seaward from the edge of the saltmarsh. The temporary working area and access routes will be located at a minimum distance of 50 m from the edge of the saltmarsh.

- BE04 – Where possible, cable protection materials will use locally sourced materials or environmentally benign sources.
- BE06 - All phases of the cable routing and design will seek to minimise impacts on habitats of principal importance (qualifying as Habitats Regulations Annex I habitats; Natural Environment and Rural Communities (NERC) Section 41 habitats and species), including micrositing and consideration of the use, type and location of cable protection.
- GM01 – dDesignated (and as minimal as possible) anchoring areas and protocols shall be employed during marine operations to minimise physical disturbance of the seabed.
- GM03 – aAn 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.
- GM07 - The Applicant will ensure that the contractor considers measures to avoid use of microplastics where possible.
- GM08 - The Applicant will factor in the removability of cable protection when identifying the external cable protection for the Proposed Project. The Applicant will ensure it uses all available best practice guidance for cable decommissioning in its decision making.
- LVS01 – aAll 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 – aAll 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 – dDrilling fluids required for trenchless operations will be carefully managed to minimise the risk of unplanned releases into the marine environment. Specific avoidance measures will include:
  - the use of inert or 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 ALDFG onto the vessel deck. In these instances, marked ALDFG will be

returned to the Marine Management Organisation (MMO) / local Inshore Fisheries and Conservation Authority (IFCA) 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 – Tthe minimum depth of lowering (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 m to 2.5 m, to be achieved where possible dependant on the seabed geology. At both the Kent and Suffolk landfalls, seaward of the marine HDD exit, a target DOL of 1.5 m will apply.
- 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 Proposed Project. This includes the repair of cables due to accidental damage.
- MPE04 - 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.

MPE05 - Depth of Burial Monitoring surveys to be undertaken by the Undertaker post installation.

- MPE05 - -As outlined within the Cable Specification and Installation Plan secured under Condition 4 of the DdML, during the lifetime of the project, scheduled monitoring of the system would be undertaken via a preliminary inspection, maintenance and repair (IMR) programme as the basis for preventative maintenance may comprise of the following:
  - Base-line as-built depth of lowering (DOL) survey (ideally a continuous survey after installation and protection completed).
  - Initial DOL monitoring survey 12 months after commissioning and handover to operations.
  - Monitoring surveys (either using DTAS or vessels) to establish any areas where any DOL or cable system anomalies may develop and inform the maintenance programme
- MPE06 - Over the operational lifetime of the Proposed Project, monitoring of the beach profile and erosion rates will be carried out at both the Suffolk and Kent landfall sites in relation to the trenchless technique construction areas associated with the exit pits. The frequency and scope of monitoring would be dependent on the outcomes of the pre-construction surveys and ‘as-built’ status of the Offshore Scheme. The Applicant will produce a monitoring plan, in substantial accordance with the outline In-Principle Monitoring Plan to be submitted to the MMO to cover works below Mean High Water Springs within three months of the 'as-built survey' unless otherwise agreed in writing by the MMO. Over the operational lifetime of the Proposed project, monitoring of the beach profile and erosion rates is carried out at

~~the Suffolk and Kent landfall site where rock bags are planned to be placed at the Horizontal Directional Drilling (HDD) exit pits.~~

- MPE07 - Installation of cables should not create pre-cut trenches at the Coralline Crag outcrop (as defined within **Application Document 9.113 (A) The Coralline Crag Technical Note [REP4-102]**), due to the sensitivity of the system.
- MPE08 - Further analysis will be undertaken to consider the potential for coastal erosion over the lifetime of the project in line with the Final Offshore Construction and Environmental Management Plan (CEMP). This information will be used to inform the detailed design of the Proposed Project, to ensure that the risk of future exposure of the intertidal and offshore buried cables is as reduced as far as practicable.
- MPE09 - The River Stour Channel will be monitored throughout the operational life of the asset in line with a monitoring and contingency plan secured as a Requirement. The plan will set out the frequency and methods for monitoring the location of the channel, contingency actions to be undertaken should the River Stour migrate to a location close to the cable and a 'trigger' point for when actions would be taken.
- MPE10 - At the Kent landfall, reinstatement of the excavation pits through both natural and, if required, mechanical backfill within the intertidal mudflats will be completed following removal of the cofferdams. This measure will be included in the Pegwell Bay Landfall Construction Method Statement which is already secured within the Offshore CEMP.
- MPE11 - Cofferdams at the Suffolk Landfall are not included within the Proposed Project. The Landfall HDD exit pits at the Suffolk Landfall are in c. 7.5 m (LAT) of water, therefore cofferdams are not required.
- MPE12 - Boulders would be relocated locally to similar habitats and placed to be reflective of the surrounding habitats and not in a linear berms which have the potential to disrupt sediment transport.
- MPE13 - The Applicant does not anticipate the need for continuous external cable protection adjacent to the Goodwin Sands MCZ, on the basis of confidence in achieving the required depth of cable lowering. However, if external cable protection is required locally, the Applicant commits to limiting its use to no more than 500 metres in total, whether continuous or cumulative, within sections of the offshore cable corridor adjacent to the Goodwin Sands MCZ (unless otherwise agreed with the MMO, in consultation with Natural England and the MCA). In such circumstances, the installed height of any external cable protection will be limited to a maximum of 1 metre above the surrounding seabed. Furthermore, where reasonably practicable, and in line with the Applicant's commitment to sensitive routing, the offshore cable corridor will be micro routed to maintain a separation distance of at least 100 metres from the boundary of the Goodwin Sands MCZ.
- MPE14 - At the Suffolk landfall, where a trenchless landfall construction technique is employed, the Applicant commits to ensuring that the drilled alignment achieves a minimum depth defined as follows:
  - For the length of landfall installed between the western boundary of the RSPB North Warren Reserve and the western boundary of The Haven Local Nature Reserve, the minimum depth of the trenchless landfall shall be 12 metres below existing ground level

  - For the length of landfall installed beneath The Haven Local Nature Reserve, the trenchless landfall shall be below elevation -10.5 m OD.

- The specification of these minimum depths is such that the trenchless works remain at sufficient depth beneath sensitive designated land and the dynamic coastal zone to provide a conservative margin against reasonable worst case future coastal change and erosion over the lifetime of the Proposed Project.
- ~~BE04 – Where possible, cable protection materials will use locally sourced materials or environmentally benign sources.~~
- W37 - The Applicant will prepare a hoverport condition monitoring plan post consent to monitor the condition of the hoverport during construction. This will include measures for identifying and managing any potential contamination risk and will be prepared in consultation with the EA, NE, KWT and TDC for approval by TDC.

1.9 Assessment of Impacts and Likely Significant Effects

1.9.1 The assessment of the effects of the Offshore Scheme on Physical Environment receptors described in this section considers the embedded, control and management measures described in Section 1.8.

Table 1-19~~1.19~~ Summary of impact pathways and maximum design scenario (Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project)

Potential Impact	Maximum Design Scenario
Construction	
Impact to inshore seabed morphology	Total area Suffolk: 0.0002 km^2 of disturbance Total area Kent: 0.0721 km^2 of disturbance
Impacts to designated coastal feature receptors (due to construction activities).	**Nearshore vessels / equipment** Suffolk landfall: ~~-~~ ~~-~~Area of Seabed disturbance from Jack up Barge, as a result of spud cans: At each Jack-up location: 50 m^2. 4 locations = 200 m^2. Area of seabed disturbance from back-hoe dredger, which maintain position via anchor or spud can: 50 m^2 at each exit pit location. Kent landfall: One barge / Jack-up ~~or back-hoe dredger~~. Area of Seabed disturbance from Jack-up Barge, as a result of spud cans: At each Jack-up location: 50 m^2. 4 locations = 200 m^2. Area of seabed disturbance from Cable Lay Barge (CLB): 32 m^2 (at each anchor worked location). Each anchor 2 m in length and deployed up to 600 m from CLB.

Potential Impact	Maximum Design Scenario

	~~Area of seabed disturbance from back-hoe dredger, which maintain position via anchor or spud can: 50 m^2 at each exit pit location.~~
	
	There may be a requirement to install temporary ~~bog mats~~trackway comprising environmentally suitable materials at locations where the former hoverport access corridor crosses the Nemo and Thanet cables. This would be to provide protection for these cables during construction and to minimise the potential for any disturbance to the ground around the cables. Final details of the construction access route and requirements for ground protection mats will be set out in the Landfall Construction Method Statement (**Application Document 7.5.2 Outline Offshore Construction Environmental Management Plan and Application Document 9.84 Register of Environmental Actions and Commitments (REAC)**).
	
	HDD exit pit excavation
	Suffolk landfall: Area of seabed directly impacted by work associated with excavation of exit pits (incl. equipment spread) - 200 m^2.
	
	Depth of lowering: 0 m to -2 m below seabed level.
	
	Kent landfall: Area of seabed directly impacted by work associated with excavation of exit pits (incl. equipment spread) – 200 m^2.
	
	Kent landfall - Temporary Cofferdam dimensions
	Maximum number of cofferdams: 4 (Note there will be no use of a cofferdam at the Suffolk landfall).
	• Number of cofferdam repositions: 4.
	
	Size of cofferdams:
	• Option of sheet-piled construction: Indicative 30 m length x 5 m width x 3m height above seabed x 2 m depth below seabed.
	  • Option of pre-fabricated tanks construction: Indicative 25 m x 15 m width x 3 m height above seabed x 2 m depth below seabed
	  • Option of moonpool barge construction: 35 m length x 7.5 m width x 3 m height above seabed x 2 m depth below seabed
	
	Cofferdam construction materials: Pre-fabricated filled tanks, moonpool barges, sheeted piles.
	HDD exit pits located within the cofferdams.
	
	Phases 1A, 1B and 2 (access routes, cofferdam installation and HDD drilling and duct installation)

Potential Impact	Maximum Design Scenario

	• Working area 120 m by 180 m (21,600 m^2). This includes:
	  - Cofferdams (30 m x 5 m per cofferdam = 150 m^2 (600 m^2 for four cofferdams)
	  - HDD exit pits (located within the cofferdams)
	• Seabed excavation will only occur in the cofferdams (600 m^2)
	• Footprint of access routes is to be determined but will not involve any seabed excavation.
	• Maximum duration of working area = 120 days
	• Estimated programme (Q1-Q3 2027)
	• 0.00036 km^2 temporary placement of rock bags/concrete mattresses at the HDD exit points (0.45 m x 3 m x 6 m)
	• 200 m2 (0.0002 km2) disturbance from jack-up barge (JUB) ~~or back-hoe dredger (50 m2 at each HDD exit location)~~
	• 256 m2 (0.0003 km2) disturbance from cable lay barge and anchors (8 x 32 m2 footprint per anchor)
	
	Phases 3, 4 and 5 (marine cable pull-in, cable burial between mean low water spring (MLWS) and HDD exit pits and removal of access)
	• Marine cable pull-in and cable burial:
	  - Maximum working corridor swathe of 40 m (assuming cables are unbundled at MLWS and installed in two trenches)
	  - Distance from MLWS to HDD exits = 1,250 m
	  - Total area of temporary disturbance = 50,000 m^2
	• Cable trench (within the working corridor) will up to 1.2 m per trench (3,000 m^2 maximum area of seabed excavation for two trenches)
	• Estimated area of disturbance of 0.05 km^2 for two cable trenches. This footprint fully encompasses the MDS of seabed disturbance for both the marine cable pull in(including the temporary placement of cable rollers on the mudflats and the use of excavators) and subsequent marine cable burial in the same location.
	• Maximum duration of marine cable pull in and associated works (no trench excavations) = 16 days per cable
	• Maximum duration of cable burial = 7 days per trench including reburial of cable protection at the HDD exits.
	• Q2 to Q3 2029.
	
	Construction Access (all Phases)
	• Maximum Design Scenario for MDS is up to 20 construction plant/vehicles at any one time (based on cable pull in) and 40 movements per day, at peak times. All vehicles removed from the intertidal daily. There will be placement of temporary ground protection mats between the hoverport and the HDD work area
	• No works in the intertidal area are planned for 2028.

Potential Impact	Maximum Design Scenario
Increases in SSC, water column turbidity and deposition of disturbed sediments to the seabed due to dredging for seabed preparation prior to cable installation.	**Drilling fluid discharged within the intertidal area during HDD excavation process.** • Suffolk Landfall Up to 7,240 m^3 of drilling fluid discharged at 4 HDD entry/exit point locations (1,810 m^3 per HDD entry/exit point) • Up to 40 m^3 of drilling fluid discharged at 4 HDD entry/exit point locations (10 m^3 per HDD entry/exit point)
Impact to offshore seabed morphology due to cable installation activities.	**Offshore Scheme installation:** - **Boulder Plough or Grab** At present, no expected boulder removal is anticipated to be required along the route. However, should boulders be identified that are considered an impediment to the construction during the pre-installation survey, these would be removed by either a subsea grab or a displacement plough in line with commitments it has made within **Application Document 9.92 Outline Cable Specification and Installation Plan**. If boulders are encountered the normal clearance swathe would be +/- 10 m from planned installation route position list (RPL). - **Pre-lay Grapnel Run (PLGR)** Width: Swathe of 1 m to 3 m per cable trench. Length: 120 km. 0.36 km^2 of disturbance - **Displacement Plough** Width of disturbance per trench: 10 m to 25 m. - **Jet Plough** Width of disturbance per trench: 8 m to 20 m. - **Jet Trencher** Width of disturbance per trench: 6 m to 12 m. Length up to 43.5 km. Indicative total footprint: 520,000 m^2 - **Mechanical Trencher (chain cutter)** Width of disturbance per trench: 5 m to 15 m. Length up to 59 km. Indicative total footprint: 885,000 m^2 - **Mechanical trencher (Cutting Wheel – Bedrock)** Width of disturbance per trench: 5 m to 15 m.

Potential Impact	Maximum Design Scenario
	Length up to 16 km. Indicative total footprint: 240,000 m^2 - **Areas where multiple options could be deployed** Width of disturbance: up to 20 m. Length up to 47 km Indicative total footprint: 940,000 m^2 - **Maximum trench widths** Trench Width: 1.5 m Burial Depth (Depth of Lowering to Top of Cable) up to 2.5 m
Sand wave crest level preparation resulting in a change to the seabed morphology and changes to the associated local hydrodynamic, wave and sediment transport processes that interact with sand waves and bedforms. Impacts to sand bank receptors	**Sand wave lowering (Pre-sweeping)** <u>Removal</u> Width: Swathe of 10 m to 20 m per cable trench. Length: 17.6 km (KP96.32 to KP113.883). Area: 351,300 m^2 Average depth of sand to be removed (where there are sand waves): 2 m Volume of material: 250,000 m^3 <u>Deposit</u> Assumption is up to 3 m of sand may require to be pre-swept above the non-mobile reference level. Due to the high energy environment and expectation that the mobile bedforms would migrate at each storm event, a realistic assumption of 2 m sand removal is made along the interval designated for pre-sweeping (KP96.32 to KP113.883). Area: 351,300 m^2 of disposal area; within the Offshore Scheme Boundary. There is no designated disposal area, the sand would be deposited within the Order Limits (in line with its commitments within the **Application Document 9.92 Outline Cable Specification and Installation Plan**) within the area of pre-sweeping in such a way that the local currents would not backfill the pre-sweep area prior to cable installation and protection. The mechanism to infill the rock trench and allow the seabed to revert to natural bedforms is by natural backfill and sediment circulation / deposition. Volume: 250,000 m^3.
Operation & Maintenance	
Changes to the tidal regime. Changes to the wave regime	**Remedial Rock Berms** Total volume of remedial rock berms (no lowering): 48,000 m^3 Total area of remedial rock berms (no lowering): 84,000 m^2

<table>
<tr><th>Potential Impact</th><th>Maximum Design Scenario</th></tr>
<tr><td>Changes to sediment transport and sediment transport pathways and seabed morphology due to the presence of the cable protection measures.</td><td rowspan="5">Rock berm dimensions (no lowering): 1.0 m (H) x 1.0 m (top) 7.0 m (base) with 1:3 slope.

Rock Backfill
Total length of rock backfill in high-risk trench areas: KP 35 to KP 58; KP 81.5 to KP 96.5 (38,000 m)
Total area of rock backfill in High Risk trench areas: 17,100 m^2
Total volume of rock backfill in High Risk trench areas: 34,200 m^3

Concrete Mattresses:
0.3 m x 3.0 m x 6.0 m or 0.45 m x 3.0 m x 6.0 m
Assumed to be 5 per HDD exit, both landfall points

Cable Crossings
10 in-service offshore cable crossing points.
Maximum footprint per crossing: 5,000 m^2
Total volume of post-lay rock berms: 500,000 m^3
Total footprint of all 10 in-service crossings: 50,000 m^2
(Potential for additional footprint of up to 9 planned crossings: 45,000 m^2)
Crossing length: up to 500 m (+/- 250 m)
Crossing width: 7 m to 10 m
Crossing height: up to 1.5 m

Maintenance
The Offshore Scheme is designed for a lifespan of approximately 40-60 years.
The cable system installation is designed such that a regular maintenance regime is not required to maintain the integrity of the link.

0.00072 km^2 buried cable protection (concrete mattresses/rock bags) at the HDD exits (buried to minimum of 0.5 m below seabed level)</td></tr>
<tr><td>Impacts to sand bank receptors due presence of cable and cable protection measures and any associated change to hydrodynamics or sediment transport patterns.</td></tr>
<tr><td>Impacts to designated coastal feature receptors due presence of cable and cable protection measures and any associated change to hydrodynamics or sediment transport patterns.</td></tr>
<tr><td>Impacts to designated features due presence of cable and any associated change to hydrodynamics or sediment transport patterns.</td></tr>
<tr><td>Increases in SSC, water column turbidity and deposition of disturbed sediments to the seabed.</td></tr>
<tr><td colspan="2">Decommissioning</td></tr>
<tr><td>Increases in SSC, water column turbidity and deposition of disturbed sediments to the seabed.</td><td>An initial decommissioning plan will be written once the final route and installation methodology is engineered by the contractor. This will be in accordance with all applicable legislation and best practice guidance at the time of compilation.
Dependent on requirements at end of asset life, the redundant cables could either be recovered for recycling (in its entirety, or in parts) or left in-situ.</td></tr>
</table>

Potential Impact	Maximum Design Scenario
Impacts to coastal features related to coastal morphological alteration.	Leading up to the end of the Proposed Project's operational life, options for decommissioning will be evaluated through environmental, technical, and economic assessments. The objective in undertaking these assessments will be to minimise the short- and long-term effects on the environment. The level of decommissioning will be based upon the regulations, best practices, and available technology at the time of decommissioning.

Construction Phase

Preparation of route

Changes to seabed morphology and bedforms

1.9.2 Several route preparation methods, such as PLGR may be used along the route to clear the Offshore Scheme of obstacles (Table 1-18~~Table 1.18~~). The penetration depth of preparation activities is assumed to have the capacity to reach up to 2 m and has the potential to locally alter the sedimentary makeup of the seafloor by churning and overturning the sediment. Finer sediments may be exposed to the surface and more readily eroded from the seabed.

1.9.3 Any seabed disturbance during route preparation to a mobile substrate of sandy or gravelly sediments will be relatively minor involving the partial or full disturbance of ripples and decimetre-scale sized bedforms. Small bedforms are likely to recover quickly as sediment transport processes continue following the completion of the preparation. Therefore, the seabed is considered to have a very low sensitivity, and the impact magnitude is small. This will result in a **negligible** effect that is **not significant.**

1.9.4 Pre-sweeping/sand wave lowering will be required where sand waves are identified within the Offshore Scheme Boundary (KP96.32 to KP113.883) to ensure the target burial depths area achieved. Sand waves will be swept out of the way with suitable equipment, for example a suction hopper dredger or Mass Flow Excavation (MFE). The total length of the Offshore Scheme subject to alteration by sand wave lowering is 17.6 km, an area of up to 351,300 m^2, with a corresponding total volume of up to 250,000 m^3 (**Application Document 6.2.1.4 (D) Part 1 Introduction Chapter 4 Description of the Proposed Project [REP1A-003]**). An additional assessment specifically for the Sunk following identification of the Port Authorities Areas of Safeguarded Water Depths for their future dredging activities is presented within **Application Document 9.126 Areas of Safeguarded Water Depth – Consideration of Additional installation Requirements [REP5-139]**~~ submitted at Deadline 6~~. Pre-sweeping/sand wave lowering will result in a change of bathymetry and seabed morphology.

1.9.5 The excavated sand wave material will be deposited within the Order Limits within the area of pre-sweeping and crucially kept within the sand wave system keeping the available volume of sediment the same in the sediment cell (**Application Document 6.2.1.4 (D) Part 1 Introduction Chapter 4 Description of the Proposed Project [REP1A-003]**). Over time, this sediment will be re-worked back into the dune system via natural sediment transport processes.

1.9.6 There is limited research available on the response of sand waves to human interventions such as dredging activities, however available studies explain that sand waves are expected to recover and re-establish a state of equilibrium (Krabbendam, et al., 2022). For larger volumes of sediment removed from a sand wave, longer sand wave recovery times will be required to reach a new equilibrium state (Campmans, Roos, Van der Sleen, & Hulscher, 2021). Recovery time may vary depending on differences in mean water depth, local sand availability, grain size and current regimes (Krabbendam, et al., 2022). In the inner shelf marine environment (water depths 0-30 m - applicable to the majority of the Offshore Scheme) where there is wave and current action and an adequate supply of sediment, sand wave recovery may be < 1 year (Kraus & Carter, 2018).

1.9.7 Smaller bedforms (megaripples and ripples) will recover and reinstate themselves more quickly, over minutes, days and months (Slinn, 2006), due to the smaller volumes of sediment needed for their formation and the associated faster migration rates.

1.9.8 The sensitivity of the seabed bathymetry and the bedforms that characterise it are assessed to have a medium sensitivity based on the short to long-term timescales over which bedforms may recover following sand wave lowering. However, they also have capacity to self-recover. The magnitude of the impact of sand wave lowering on the mobile seabed is considered medium. This will result in a **minor** effect that is **not significant**.

Coastal geomorphological change and associated changes to sediment transport regimes

1.9.9 The use of rock bags/concrete mattresses at the HDD exit pits prior to cable pull in will be temporary to protect the exit pits / ducts. Removal of rock bags/concrete mattresses will occur approximately 1 week before cable pull-in. During their emplacement in the nearshore environment, they will likely interact with and modify the local nearshore wave regimes and associated sediment transport patterns. This may result in localized scour about the rock bags/concrete mattresses and increase the rate and extent of erosion. The Kent landfall site is assessed to have low sensitivity to erosion due to its sheltered setting within Pegwell Bay and historically stable beach levels.

1.9.10 The sensitivity of the Suffolk landfall coastline is of high sensitivity reflecting its environmentally designated status and the fact that erosion and beach lowering is already taking place at the landfall site.

1.9.11 The rock bags/concrete mattresses prior to cable pull in are temporary measures and it is assumed that they will be installed with as low a profile as possible, minimising the obstruction to wave and tidal processes to minimize the impact on the coastline. Any rock protection required post installation will be buried at the same location as previous temporary protection and will not protrude from the seafloor.

1.9.12 Both coastlines are naturally dynamic settings that are considered to have capacity to recover from any localised (nearshore/intertidal) morphological changes associated with the introduction of protective measures. Therefore, at both landfalls, the magnitude of the impact is likely to be small. This will result in a **minor** effect that is **not significant**.

Changes to local hydrodynamic, wave and sediment transport processes and wider sandbank receptors.

1.9.13 As previously described, sand wave lowering has the potential to alter the seafloor morphology, as a result, this will lead to a change in local hydrodynamic, wave and sediment transport patterns. Changes associated with these are ‘pathways’ as opposed to receptors.

1.9.14 The removal of sand waves that are part of a wider sand wave system (i.e. the Outer Thames Estuary sand banks) is not likely to impact the overriding processes, including the flow regimes, water depth and sediment supply, that govern the evolution of these systems, therefore the removal of sand waves is unlikely to alter the overall form and function of the wider system, therefore the system is expected to recover via natural sediment transport and hydrodynamic processes over months-years. Therefore, the impact of sand wave lowering on pathways, including hydrodynamic, wave and sediment transport processes which are of low sensitivity, has been assessed as having a small magnitude, which will result in a **minor** effect that is **not significant**.

Increased SSC in the water column

1.9.15 Route preparation will temporarily disturb the seabed and result in a potential increase in levels of suspended sediment, having the potential to increase the water column turbidity above ambient levels.

1.9.16 The magnitude of the impact of increased water column turbidity due to increased SSC is assessed to be small as the amount of sediment disturbed during route preparation will be low as the proposed methods do not penetrate far into the unconsolidated seabed (likely no more than 40 cm). Further, any measurable change in SSC will be temporary and relatively localised. The coarser sediment fractions (gravel and coarse sand) ejected into the water column, will be lifted a few metres and will subsequently re-deposit either directly back into the trench or within a few metres of the Offshore Scheme Boundary within timescales in the order of seconds to tens of seconds. The finer fractions (including fine sands, silts and clays) will be transported further by prevailing tides and currents, this will cause SSC levels to reduce as the particles are dispersed through the water column and diluted over a wider area, returning water column turbidity to baseline conditions.

1.9.17 Compared to the amount of sediment potentially suspended during the Construction phase (discussed in paragraph 1.9.63~~1.9.62~~), the amount of sediment suspended during route preparation is much less.

1.9.18 The sensitivity of the water column to receiving increased levels of suspended sediment is considered to be very low. This will result in a **negligible** effect that is **not significant.**

Installation of the cable

1.9.19 At the landfall sites, HDD installation (trenchless technique) will take place, requiring the excavation of the exit pits at both landfall sites to a depth of up to 2 m below existing seabed level (**Application Document 6.2.1.4 (D) Part 1 Introduction Chapter 4 Description of the Proposed Project [REP1A-003]**).

1.9.20 Cable trenching and burial methods for the Proposed Project will likely include a combination of the following:

- Cable burial ploughs (displacement or non-displacement).
- Jet trenching (towed, free swimming or tracked).
- Mechanical trenchers (tracked); and

- Mass (or controlled) flow excavators.

1.9.21 It is intended that the cable will be lowered into the seabed with the exception of cable crossings. **Application Document 9.21 Sea Link Cable Burial Risk Assessment [PDA-039]** for the Proposed Project has considered the technical feasibility of the route in balance with the consenting/environmental feasibility, based on the collected benthic, bathymetric, geophysical, and geotechnical survey data acquired during and after the seabed survey. This engineering assessment has provided a high level of confidence that the ground conditions for the Proposed Project are sufficient to lower the cable along the entire cable route. By completing this initial Cable Burial Risk Assessment, the Applicant is able to identify and plan the correct methods of lowering appropriately with the Principal Contractor.

1.9.22 The minimum 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 m (in low-risk areas) to 2.5 m, to be achieved where possible dependent on the seabed geology. The intervals of Target Depth of Lowering (TDOL) are outlined in **Application Document 6.2.1.4 (D) Part 1 Introduction Chapter 4 Description of the Proposed Project [REP1A-003].**.

-Changes to nearshore seabed morphology at the landfalls, and beach morphology, including changes associated with designated sites

Nearshore vessels and equipment

1.9.23 The use of nearshore vessels, equipment at both landfall sites in association with the excavation of the HDD exit pits (including, jack up barge, cable lay barge, spud cans and back-hoe dredger), and the potential use of temporary protective matting on the mudflats at Pegwell Bay (for construction access), are expected to impact nearshore seabed morphology (**Application Document 6.2.1.4 (D) Part 1 Introduction Chapter 4 Description of the Proposed Project [REP1A-003]**). The estimated impact footprints associated with each vessel or equipment is defined in Table 1-19~~Table 1.19~~.

1.9.24 The sensitivity of the seabed in shallow marine and intertidal environments to seabed morphological change at both landfall sites is considered High due to their environmentally designated status. However, they are also a naturally dynamic environments with sediment transport driven by wave and tidal action that will 'smooth-out' any variations in the seabed returning the bed to equilibrium conditions.

1.9.25 Due to the short-term presence of the vessels, equipment and matting on the nearshore environment, the magnitude of the impact is assessed to be negligible. This will result in a **negligible** effect that is **not significant**.

Cofferdam at Kent landfall

1.9.26 During HDD works at the Kent landfall, it is expected that cofferdams either multiple or one large Moonpool or piled cofferdam will be constructed around the four HDD exits to contain drilling fluid along with any artesian water that might be present in the chalk aquifer, through which the HDD must drill. The cofferdam(s) will act as a barrier to tidal inundation and waves, keep dry the working area within the intertidal zone, preventing premature backfill into the exit pits prior to cable pull-in. Due to its location within the intertidal zone, the cofferdam will interact with sea when water levels are high enough and will locally force a change in flow patterns about the structure. Any wave interaction with the cofferdam will likely increase flow turbulence and cause scouring at the toe of the cofferdam structure.

1.9.27 **Application Document 9.13 (B) Pegwell Bay Construction Method Technical Note** explains that the assessed worst-case scenario assumes the construction of smaller cofferdams (maximum length 30 m, width 5 m, with piling depth approximately 6 m below ground level and excavation depth within the cofferdams to a depth below seabed of 2 m) on four separate occasions during HDD drilling and duct installation. Based on previous works, it is anticipated it will take up to seven days to install a cofferdam around a single HDD exit pit. Only one cofferdam will be installed at any one time, and while the total duration for all cofferdams in place is 120 days, each cofferdam is expected to be in place for only 30 to 60 days. Therefore, any impact will be temporary.

1.9.28 The cofferdams will be located essentially at Mean Sea Level (+0.20 m ODN elevation, MSL is approximately +0.15 m ODN. Therefore, for 50% of the time the area surrounding the cofferdam will be dry and no scour will be taking place. Further, **Application Document 9.20.2 Landfall Sediment Modelling Report Pegwell Bay (ABPmer)** explains that peak current velocities in Pegwell Bay are less than 0.1 m/s, which is well below the flow rates associated with any significant scour depths.

1.9.29 The potential for sediment erosion/scour at the cofferdam site was assessed in **Application Document 9.144: Additional Sediment Dispersion Modelling - Technical Note**, by comparing calculated critical erosion thresholds with local hydrodynamic conditions. For fine sand with a grain size of 0.125 mm, a critical shear stress of Tcr = 0.14 N/m² is calculated (Soulsby, 1997) and a corresponding critical current speed of Ucr = 0.34 m/s. Mud fractions (i.e. silt/clay) in Pegwell Bay constitute a small proportion (typically 10-15%) of the mixed sediment and can therefore expect to be mobilised at the same time as the dominant sand fraction.

1.9.30 Measured tidal currents at the site are well below both thresholds, meaning tidal energy alone is insufficient to mobilise the sediment present. As a result, any disturbance would rely on wave-generated bed shear stress, which could cause limited seabed stirring but would occur irrespective of whether the cofferdam is in place. Any scour that does form would be localised, most likely around the cofferdam corners, where flow separation and eddies typically develop, and the low-energy setting means dedicated scour protection is not expected to be required, though seabed levels will be monitored during the works. Even if sediment becomes suspended during episodes of increased wave activity, the weak tidal currents would transport it only short distances, typically up to around 100 m, before it settles, with some material returning toward the cofferdam area as the tide reverses, provided wave conditions remain strong enough to keep it in suspension.

1.9.31 At any point, elevated SSC caused by the structure would persist for only three to four hours within the 12.42-hour tidal cycle. Scour depths around the cofferdam perimeter are expected to be shallow in depth and highly localised, with no significant wider-scale effects on sediment transport or coastal morphology. Overall, the temporary cofferdam is not expected to cause any meaningful change to sediment dynamics in Pegwell Bay, and any localised disturbance will be very limited in extent, short-lived, and fully recoverable under natural processes.

1.9.32 On this basis the magnitude of any change in relation to the cofferdam on nearshore seabed morphology (and the associated flow dynamics) will be small. The nearshore seabed is considered to have high sensitivity due to its designated status. Though currents in Pegwell Bay are too weak to erode sediment on their own, the combined effects of episodic wave stirring combined with tidal currents will encourage recovery of the seabed from temporary construction-related impacts without further intervention, which gives it a lower sensitivity from a physical processes point of view. This results in a **minor** effect which is **not significant**.

1.9.33 The impact of the cofferdam on the saltmarsh in Pegwell Bay relates to the blockage of tidal flows circulating within the bay or the blockage of waves propagating from offshore towards the saltmarsh. The cofferdam is in the upper intertidal area and so would be either dry or in only very shallow water most of the time. However, currents within Pegwell Bay are too weak (<0.1 - 0.2 m/s) to cause erosion of the saltmarsh edge, and any acceleration of currents due to the presence of the cofferdam would be highly localised about the structure. Any change in current speed at the saltmarsh edge would be negligible compared to an increase of the order 0.2 m/s required to initiate erosion of saltmarsh sediments. Further, currents will be further reduced at the saltmarsh edge due to frictional effects (bed roughness) in the shallower water depths.

1.9.34 Blockage of waves propagating towards the saltmarsh behind the cofferdam is a possibility although due to the orientation of the cofferdam this would be minimal with waves running along the structure before re-forming behind it. The effect of any blockage would therefore be within the range of natural variability.

1.9.35 In summary, there may be a temporary reduction in wave energy reaching the saltmarsh edge which is unlikely to cause a negative effect on the saltmarsh. This results in a **minor** effect which is **not significant**.

1.9.36 Excavation of HDD exit pits

1.9.37 The excavated sediment will be deposited within the Order Limits within the area. At Pegwell Bay, the excavated sediment will be reinstated back into the excavation pits through both natural and, if required, mechanical backfill following removal of the cofferdams.

1.9.38 At Suffolk the majority of the excavated sediment will remain within the order limits, as it will naturally be deposited back onto the seabed. Finer sediments may be transported further before settling. Under natural sediment transport processes driven by wave action and currents, the seabed morphology will naturally recover. The designated intertidal sand and mudflats of Pegwell Bay have remained relatively stable since 2007 with little evidence of notable erosion or accretion having taken place at the landfall site (see Figure 6.4.4.1.3 Intertidal Elevation Difference Pegwell Bay in **Application Document 6.4.4.1 (E) Environmental Statement Figures Marine Physical Environment [REP6-044]**). While the sensitivity of the morphology in Pegwell Bay is considered low, due to its designated status, the sensitivity of Pegwell Bay is assessed as high.

1.9.39 At the Suffolk landfall site, The Anglian Regional Coastal Monitoring Programme (2022) has calculated there is a long-term erosional trend since 1991. In more recent years (2016 - 2021), there has been notable acceleration in the erosion rate around the landfall site between Thorpeness and Aldeburgh (See Section 1.7). The presence of the Leiston to Aldeburgh SSSI and the sensitivity of the coastal morphology at the Suffolk landfall is therefore assessed to be high.

1.9.40 At both landfalls, the magnitude of the impact on nearshore morphology due to the excavation of the HDD pits is small as works will be temporary, relatively localised and the excavated sediment will be reinstated at the Kent landfall. Any changes to the in the intertidal zone seafloor morphology will naturally recover via sediment transport processes driven by wave and current action in shallow waters (predominantly via wave action in Pegwell Bay).

1.9.41 At the Kent landfall, this results in a **minor** effect which is **not significant**. At the Suffolk landfall, this results in a **minor** effect which is **not significant**.

1.9.42 The use of rock bags/concrete mattresses at the HDD exit pits prior to cable pull in will be temporary to protect the exit pits / ducts. Removal of rock bags/concrete mattresses will occur approximately 1 week before cable pull-in. During their emplacement in the nearshore environment, they will likely interact with and modify the local nearshore wave regimes and associated sediment transport patterns at the Suffolk landfall (as at Kent, these works will be caried out in the dry within the cofferdam). At Suffolk, this may result in localized scour about the rock bags/concrete mattresses.

1.9.43 The sensitivity of the Suffolk landfall coastline is of high sensitivity reflecting its environmentally designated status and the fact that erosion and beach lowering is already taking place at the landfall site.

1.9.44 The rock bags/concrete mattresses prior to cable pull in are temporary measures and it is assumed that they will be installed with as low a profile as possible, minimising the obstruction to wave and tidal processes to minimize the impact on the coastline. Any rock protection required post installation will be buried at the same location as previous temporary protection and will not protrude from the seafloor.

1.9.45 Both coastlines are naturally dynamic settings that are considered to have capacity to recover from any localised (nearshore/intertidal) morphological changes associated with the introduction of protective measures. Therefore, at both landfalls, the magnitude of the impact is likely to be small. This will result in a **minor** effect that is **not significant**.

1.9.46 Excavation of the intertidal trench at the Kent landfall

1.9.47 Part of the cable pull in involves trenching into the intertidal environment to a target depth of 1.5 m below mean seabed level. Open cut trenching will take place between the HDD exit pits and Mean Low Water Spring. Trenching works will be carried out in the dry when the tide is low using excavators. Once installation is complete, the trench will be manually backfilled.

1.9.48 Excavation down to 1.5 m will locally alter microtopography, increase sediment looseness and surface roughness and modify small-scale flow pathways until infill begins. However, because the works occur in the dry at low tide, disturbances remain spatially limited, and manual backfilling ensures the area is returned to approximate pre-construction levels immediately.

1.9.49 The intertidal seabed is expected to recover its morphology over a short to moderate timeframe, returning to natural equilibrium under normal, largely wave-driven hydrodynamic processes. Pegwell Bay’s intertidal zone exhibits strong inherent morphological recoverability as evidenced by the ability of Pegwell Bay to morphologically absorb the channel migration of the River Stour and subsequently remove the imprint of paleo channels. This responsiveness is consistent with the bay’s underlying physical characteristics, including its mobile surficial sediments, low-gradient intertidal platform, and persistent hydrodynamic forcing, all of which promote readjustment following disturbance. Despite this, the sensitivity of the morphology of Pegwell Bay is considered high due to its designated status.

1.9.50 No long-term alterations to sediment transport pathways are anticipated and the magnitude of the impact is assessed to be small. This will result in a minor effect that is **not significant**.

Changes to the Coralline Crag Ridges and associated role in the regional coastline morphology

1.9.51 The offshore Coralline Crag outcrop is interconnected to many of the physical processes that maintain the geomorphology of the 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 (Royal Haskoning DHV, 2019).

1.9.52 The Coralline 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 (medium – high) that reflects how even moderate alterations to the Ridges may then significantly impact the geomorphology of the coastline.

1.9.53 However, whilst the potential for any physical damage to the Coralline Crag feature could result in regional alterations to coastal processes and coastal geomorphology, the magnitude of the impact as a result of the installation of the cable is assessed as being small. Within **Application Document 6.2.1.4 (D) Part 1 Introduction Chapter 4 Description of the Proposed Project [REP1A-003]** it is noted that the Coralline Crag shoal/outcrop is in close proximity to the west of the break-out point and recommends installation should not create pre-cut trenches at the Coralline Crags due to the sensitivity of the system (MPE07).

1.9.54 The HDD exit point will target an exit location with sufficient depth of seafloor sediments to ensure the duct end and cable can be buried below the level of the seafloor; therefore it will be designed such that there is not a risk of exiting where the Coralline Crag is at the surface. During detailed design, the HDD contractor will microsite the exit points based on seafloor surveys and ground investigations.

1.9.55 The Register of Environmental Actions and Commitments and Deemed Marine Licence, confirms that due to the sensitivity of the Coralline Crag, the HDD exit point is to be located 45 m to the east of a continual section of outcrop (**Figure 6.4.4.1.15 Proximity of the Coralline Crag outcrops to the proposed development**). Cable protection will not therefore be required on the surface of the Coralline Crag outcrop, as such, there will be no operational impact of putting cable protective material on the Coralline Crag.

1.9.56 The integrity of the Coralline Crag outcrops will not be compromised by sub-seabed HDD cable installation. As described in **Appendix A** of **Application Document 7.3 Design Development Report**, the Coralline Crag is a weakly cemented, slightly gravelly, very silty sand with frequent shell fragments, that is expected to form a stable borehole. The HDD will be designed at sufficient depth to ensure that it is within competent ground beneath the crag outcrops to ensure that the surface outcrops are unaffected by the HDDs. Further assessment of the integrity of sub-surface sections of Coralline Crag through which the HDD borehole will pass is provided in **Application Document 9.113 (A) The Coralline Crag Technical Note [REP4-102]**~~, submitted at Deadline 4~~.

1.9.57 Accounting for the recommendations and mitigations to protect the Coralline Crag Ridges, this results in a **minor** effect which **is not significant.**

Changes to the Aldeburgh Napes and their associated role in the regional coastline morphology

1.9.58 The Aldeburgh Napes sand banks may provide a degree of protection to the Aldeburgh and Thorpeness coastlines from wave impact, however, this may vary over time depending on the erosional and depositional patterns and cycles associated with the bank, and the wave approach direction (Mott MacDonald, 2014). There is insufficient data available to better define the extent of protection the Aldeburgh Napes offers the Suffolk coastline. However, it is recognised that the Aldeburgh Napes have shown a trend of lowering over recent years thus likely becoming less effective at protecting the Aldeburgh coastline.

1.9.59 The Offshore Scheme installation activities largely avoid the Aldeburgh Napes by routing in between the Aldeburgh Ridge and Aldeburgh Napes (**Figure 6.4.4.1.17 Suffolk offshore bedforms, including the Aldeburgh Napes and Aldeburgh Ridge**), therefore the magnitude of any impact to these features is likely to be small. The marine environment is dynamic driven by the tidal currents and wave action. The presence of sandwaves is indicative of the influence of strong tidal currents. Therefore, the sandbanks are likely to recover quickly (<1 year) as the majority of any sandwave material potentially disturbed will remain within the cable corridor and mainly reworked by sediment transport patterns back into the sandbank system.

1.9.60 The sensitivity of the Aldeburgh Napes is considered High due to its designation as an Annex 1 sandbank habitat feature. This will result in a **minor** effect that is **not significant**.

Offshore changes to seabed bathymetry and morphology

1.9.61 Cable installation activities have the potential to damage seabed features such as small bedforms and alter underlying sediment conditions because of sediment disturbance. The impact of this change may cause a localised change to sediment transport regimes where sediments become newly exposed to wave and current action on the seabed. This may result in change to the local bed morphology and the scale of the bedforms from the newly exposed sediment. The preferred method of cable installation for the Proposed Development is burial.

1.9.62 The sensitivity of the seabed is assessed to be low due to its ability to recover naturally over the short-medium term (weeks, to months, to <5 years, depending on metocean conditions and sediment type). The magnitude of the impact of both jet trenching and PLIB activities is assessed to be small. This will result in a **negligible** effect that is **not significant**.

Increases in SSC and deposition of disturbed sediments to the seabed

1.9.63 During cable installation, jet trenching and ploughing activities will cause sediment to become displaced, and a proportion of the sediment will become suspended. These installation activities will result in a temporary increase in SSC, followed by the subsequent deposition of sediment back onto the seabed after having been carried in suspension. These effects are impact pathways that have potential to alter the natural turbidity of the water column, and impact habitats and species as sediment is re-deposited onto the seabed.

1.9.64 **Application Document 9.144: Additional Sediment Dispersion Modelling - Technical Note [REP6-120],** (which supersedes **Application Document 6.~~2~~3.4.1.A ES**

Appendix 4.1.A **Suspended Sediment Modelling** **[APP-195]**) describes the modelling of sediment dispersion processes resulting from burial operations along the Offshore Scheme Boundary between the Suffolk and Kent landfalls during the construction phase of the Proposed Project from 6 release locations (R0- R7) (Plate 1-40~~Plate 1.38~~). These were selected due to having the largest silt and clay content when compared to adjacent sample locations. This approach will provide an overestimate of the amount of fine sediment released into the water column giving a conservative assessment of potential effects on the marine environment.

1.9.65 Based on the sediment type, installation techniques and metocean conditions, the model is used to determine the extent and magnitude of changes in SSC levels and depths of sediment accumulation on the seabed as a result of the cable installation process along the length of the Offshore Scheme Boundary. A summary of the modelling results is outlined below:

- Total SSC would result from a combination of fine sand and mud concentrations. Close to the release location there will be additional contributions from coarser sediment fractions although these will rapidly settle out of suspension (i.e., within a few minutes).
- Both the mud and fine sand fractions are shown to develop plumes of suspended sediment which are transported by the ambient currents. The results show that with cable installation by plough, elevated SSC levels are relatively low and transitory with a short duration for any specific location along the Offshore Scheme Boundary.
- Levels of elevated SSC are higher when using the jetting method of installation compared to ploughing (**Application Document 6.~~2~~3.4.1.A** **ES Appendix 4.1.A** **Suspended Sediment Modelling** **[APP-195]**).
- Plate 1-41~~Plate 1.39~~ shows the initial development of sediment plumes for the mud fraction on flood and ebb tides on a spring tide after a 24-hour period of jetting installation covering 7 km along the Offshore Scheme Boundary centred on the eight release locations (note there is no mud in sample near Kent landfall at Point 7). The resulting plumes show relatively high peak SSC values (>20 mg/l) during the flood phase for sediment release from location R2 and R6 which reduce to less than 20 mg/l during the subsequent ebb tide. Peak concentrations are shown to be lower at the intermediate release locations (R3 to R5).
- Plots of SSC levels for the mud fraction at 7 and 14 days from the start of cable installation are provided in Plate 1-42~~Plate 1.40~~. The plots show that whilst SSC levels have generally returned to background levels, there are areas where SSC remain in the range 1-5 mg/l associated with locations R1, R2 and R5.
- Plate 1-43.~~Plate 1.41.~~ shows how the SSC levels for fine sand continue to reduce over time for releases from locations R1 to R5. The exception to this is location R6 off the Kent coast where elevated SSC levels (>20mg/l) are shown to persist locally at the end of the 14-day period.
- Plate 1-44.~~Plate 1.42.~~ shows how the SSC levels for fine sand continue to reduce over time for releases from locations R1 to R5. The exception to this is location R6 off the Kent coast where elevated SSC levels (>20 mg/l) are shown to persist locally at the end of the 14-day period.
- The largest SSC ZoI for fine sand was found for sediment released from location R6 near the Kent coast where~~, as shown in Figure 3 18~~, a relatively large area of elevated SSC levels is shown as a result of the high proportion of sand at this

location combined with complex flow patterns due to currents flowing eastwards from the Outer Thames interacting with currents flowing through the Straits of Dover.

- The circulatory currents immediately to the north of the Kent coastline provide more rapid dilution of sediment plumes relative to release locations further to the north where flow directions tend to be bi-directional rather than circulatory due to the enhanced degree of mixing.
- Plate 1-45 s~~**Error! Reference source not found.**~~shows the maximum SSC concentration reached at any given location along the Offshore Scheme Boundary over the 14-day model simulation period for both mud and fine sand. This image shows the maximum SSC levels reached during simultaneous burial at 6 discrete sections of the Offshore Scheme Boundary route and therefore represents a worst-case scenario. The plots show the peak concentrations reached within the model domain over the 14-day period, approximately a full spring-neap cycle.

1.9.66 In the offshore environment, the magnitude of the impact on water column turbidity is considered small, as any measurable change in SSC will be temporary and relatively localised. The coarser sediment fractions (gravel and coarse sand) ejected into the water column, will be lifted a few metres and will subsequently re-deposit either directly back into the trench or within a few metres of the Offshore Scheme Boundary within timescales in the order of seconds to tens of seconds.

1.9.67 The finer fractions (including fine sands, silts and clays) will be transported further by prevailing tides and currents, this will cause SSC levels to reduce as the particles are dispersed through the water column and diluted over a wider area, returning water column turbidity to baseline conditions within a few kilometres of the point of sediment release (Plate 1-41~~Plate 1.39~~ to Plate 1-44.~~Plate 1.42.~~).

1.9.68 The sensitivity of the receiving offshore water column to increased levels of SSC is low. The magnitude of the impact is considered negligible. This will result in a **negligible** effect that is **not significant**.

1.9.69 Plate 1-46~~Plate 1.44~~ shows that due to the very low threshold shear stress for re-erosion associated with the mud particles, there are few areas where they are able to settle on the seabed. The situation is similar for fine sand particles with deposition limited to small magnitude accumulations of less than 0.1 mm in the areas shown, although these areas are more widespread than predicted for the plough installation method (Plate 1-47~~Plate 1.45~~). Due to the small magnitude of the deposition thickness, any accumulation of sediment on the seabed is unlikely to be detectable in the field.

1.9.70 Given the naturally dynamic nature of the seabed and seabed features in deeper waters, the magnitude of any associated deposition on the seabed morphology is assessed to be negligible as since any accumulation is unlikely to be detectable. The sensitivity of the seabed to increased deposition is low. This will result in a **negligible** effect that is **not significant.**

1.9.71 The potential impact of increased SSC due to cable burial activities and subsequent sediment deposition on habitats and species caused by increased turbidity and smothering is assessed in **Application Document 6.2.4.3 Part 4 Chapter 3 Benthic Ecology** and **Application Document 6.2.4.4 Part 4 Chapter 3 Fish and Shellfish.**

1.9.72 The upper intertidal habitat within Pegwell Bay is predominantly mud which is relatively insensitive to smothering. For example, the sensitivity rating for intertidal mud, which is a supporting habitat for the Thanet Coast and Sandwich Bay SPA, is between low to no sensitivity to 'Light' deposition of up to 5 cm of fine material.

1.9.73 Note also that no infrastructure, other than that which is buried at the HDD exit pits or at the cable buried in a trench, will be present at Pegwell Bay over the lifetime of the project.

1.9.74 Pegwell Bay is a low energy environment in terms of tidal currents with the intertidal sections of the cable route (KP118 to KP120.5) subject to wetting and drying as the tide rises and falls. Sediment disturbed during cable burial will therefore remain in suspension for a limited period before the tide recedes and the majority of any suspended sediment deposited back onto the intertidal surface rather than being more widely dispersed.

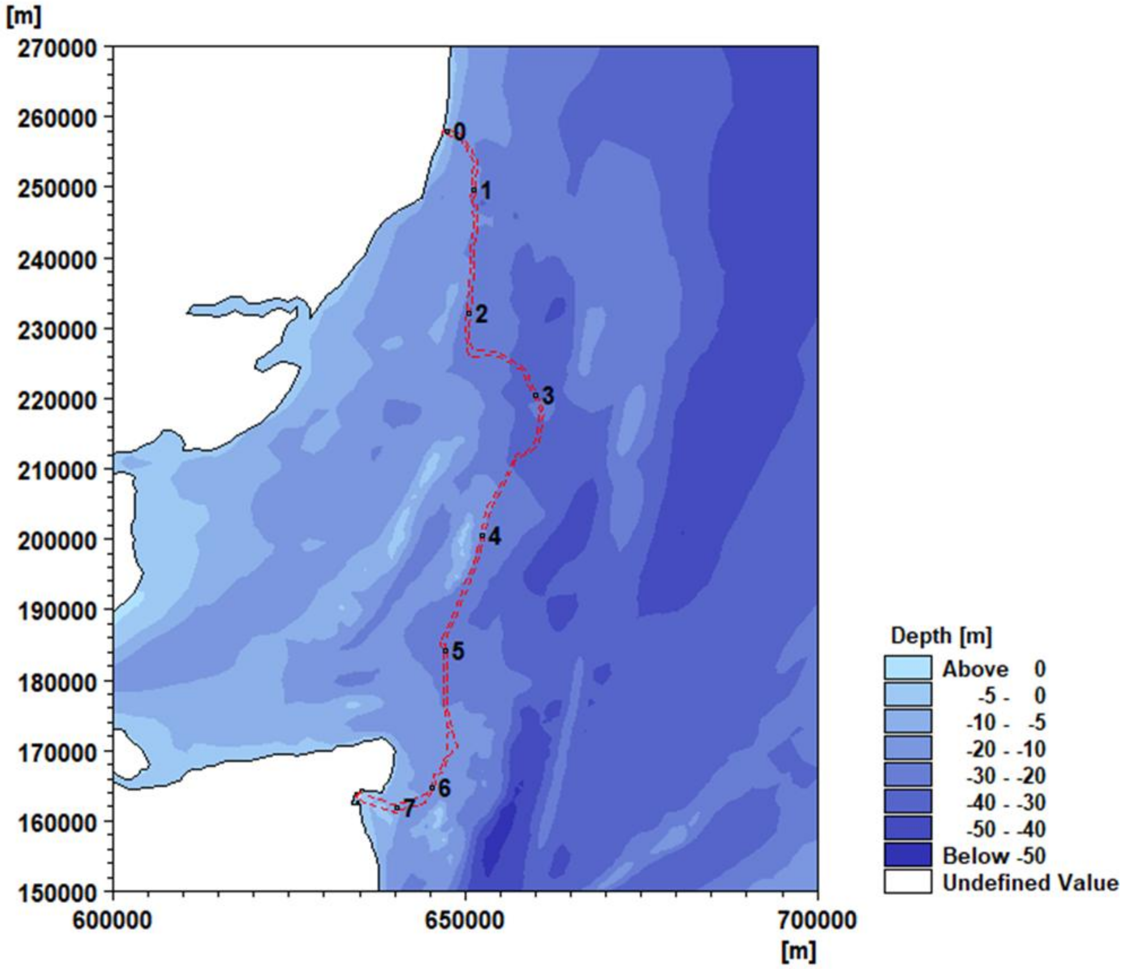

Plate 1-40~~1.38~~ Hydrodynamic model bathymetry showing the Offshore Scheme Boundary (red line) and 8 sediment release locations

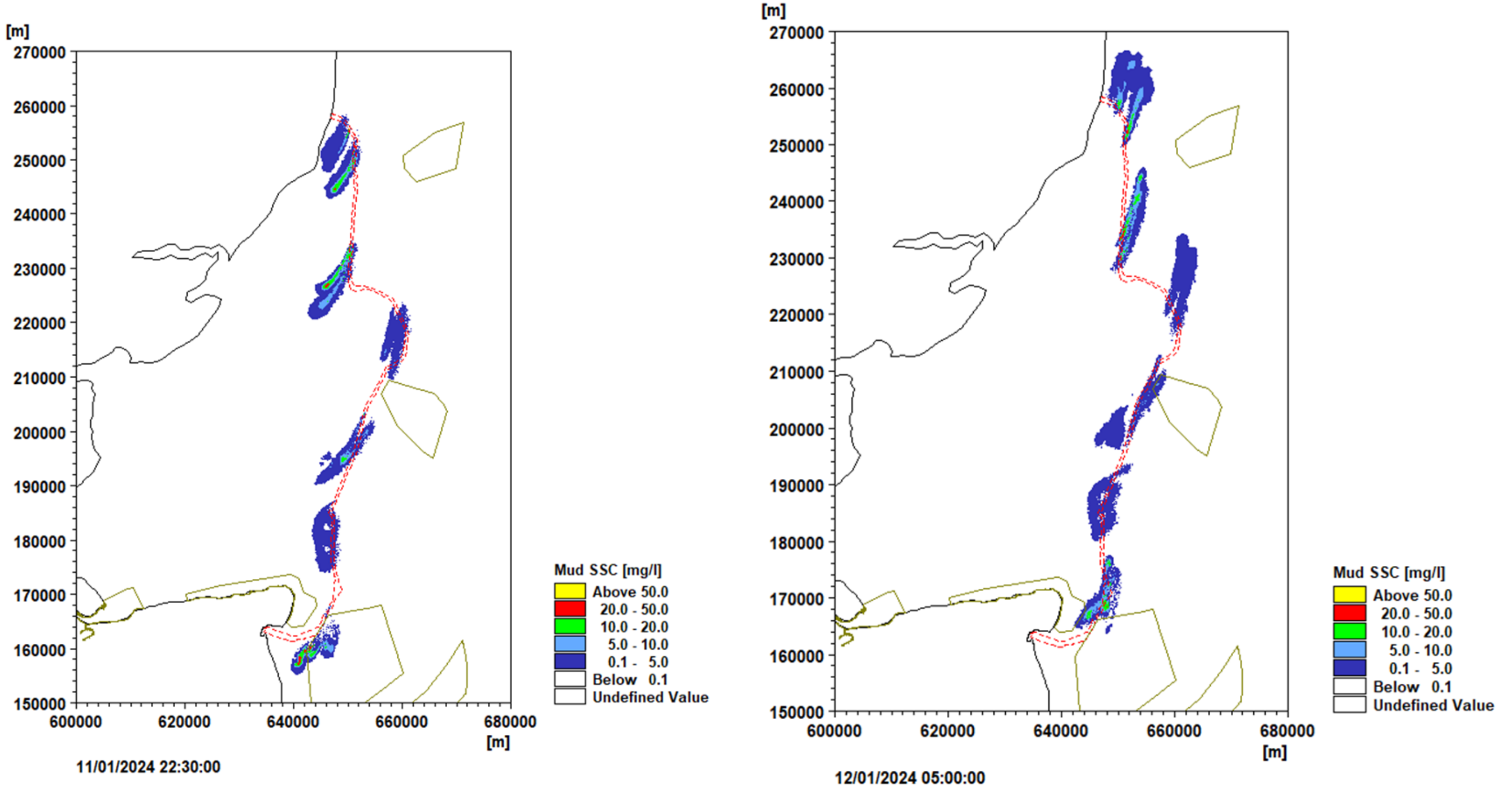

Plate 1-41~~1.39~~ Mud SSC levels for jetting installation commencing on spring tides with output on flood (left) and ebb (right) tide after first 24 hours of activity. Note no mud in sample near Kent landfall, Point 7.

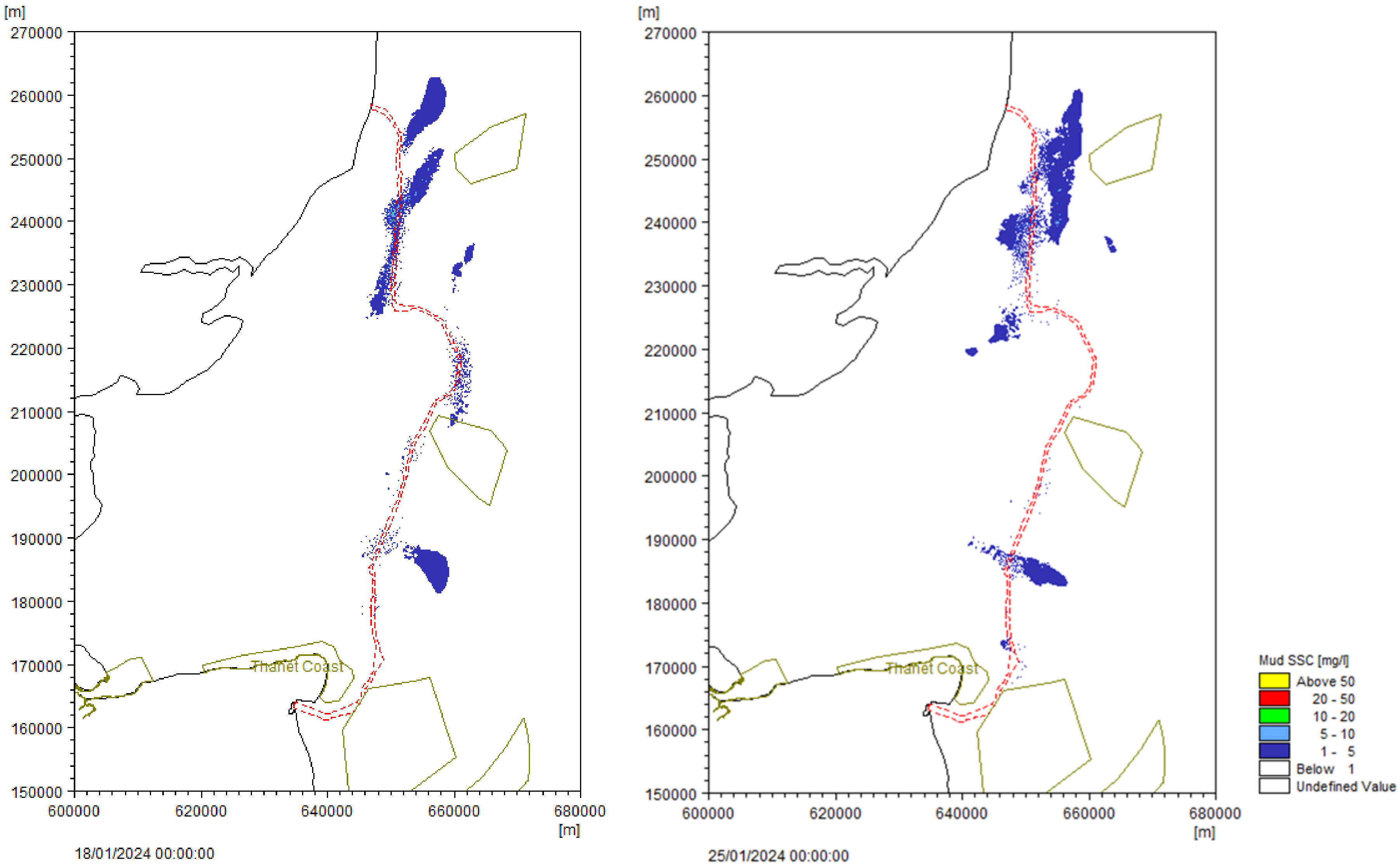

Plate 1-421.40 Mud SSC levels for jetting installation commencing on spring tides with output at +7 days (left) and +14 days (right) after start of activity.

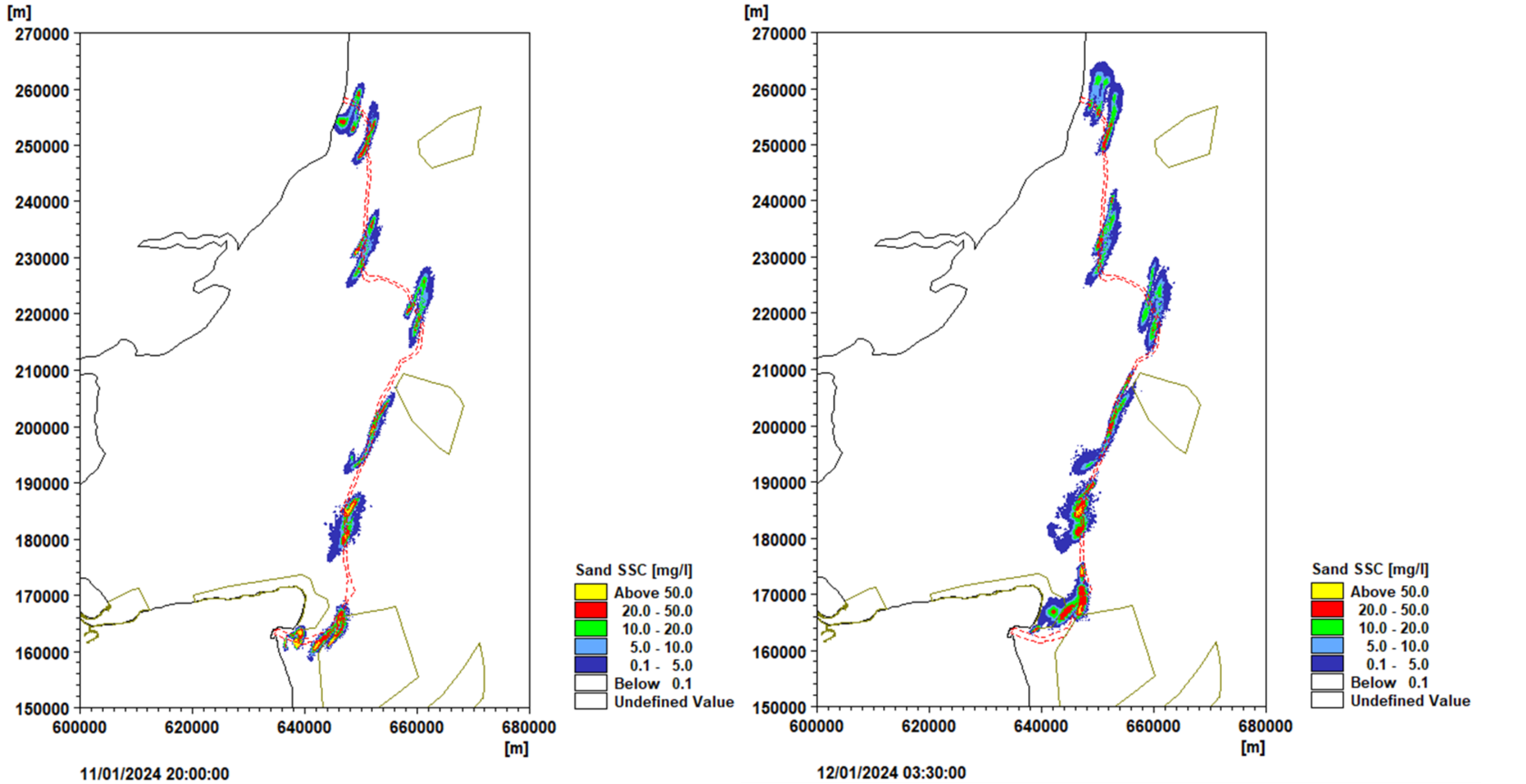

Plate 1-431.41. Fine sand SSC levels for jetting installation commencing on spring tides with output on flood (left) and ebb (right) tide after first 24 hours of activity.

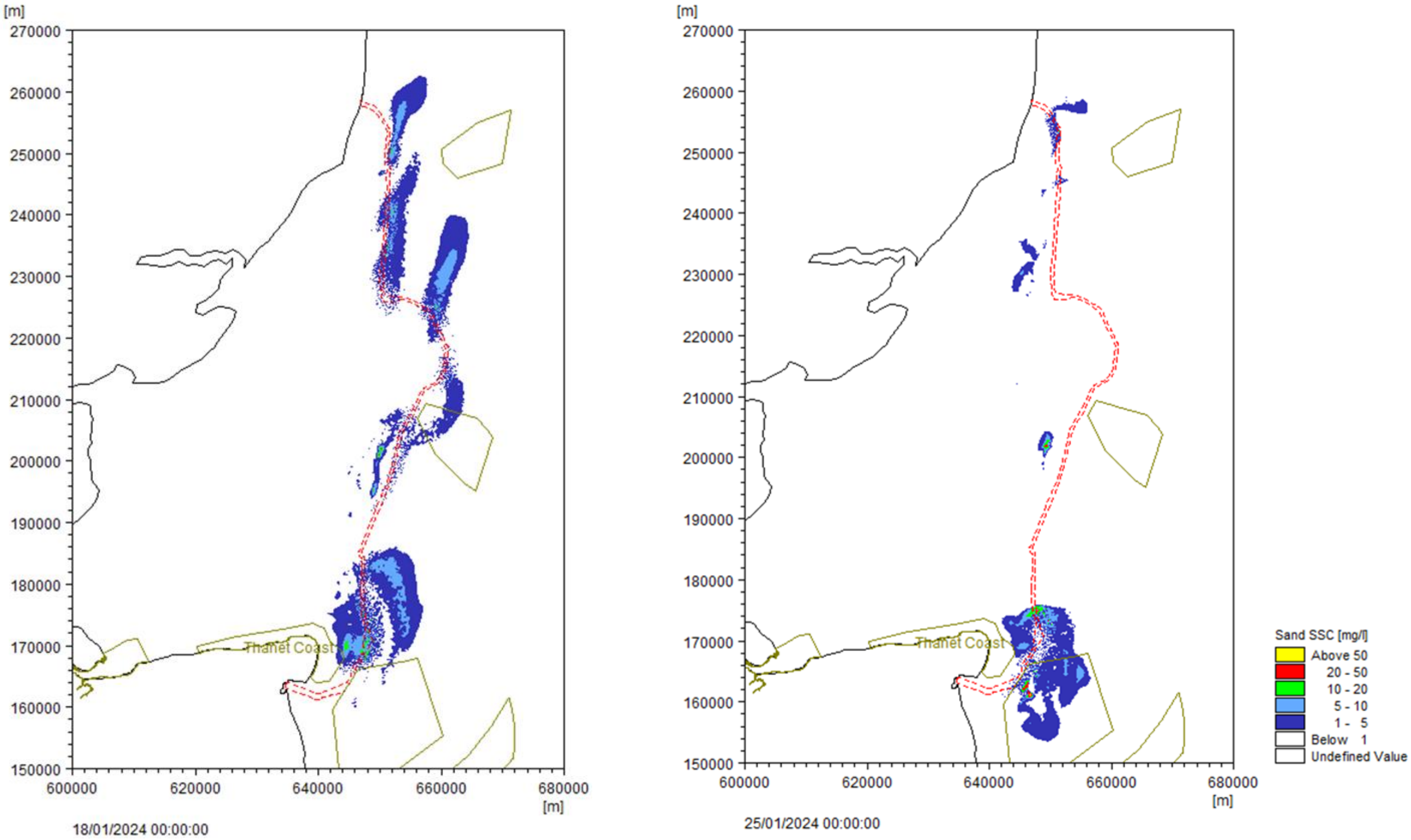

Plate 1-441.42. Fine sand SSC levels for jetting installation commencing on spring tides with output at +7 days (left) and +14 days (right) after start of activity.

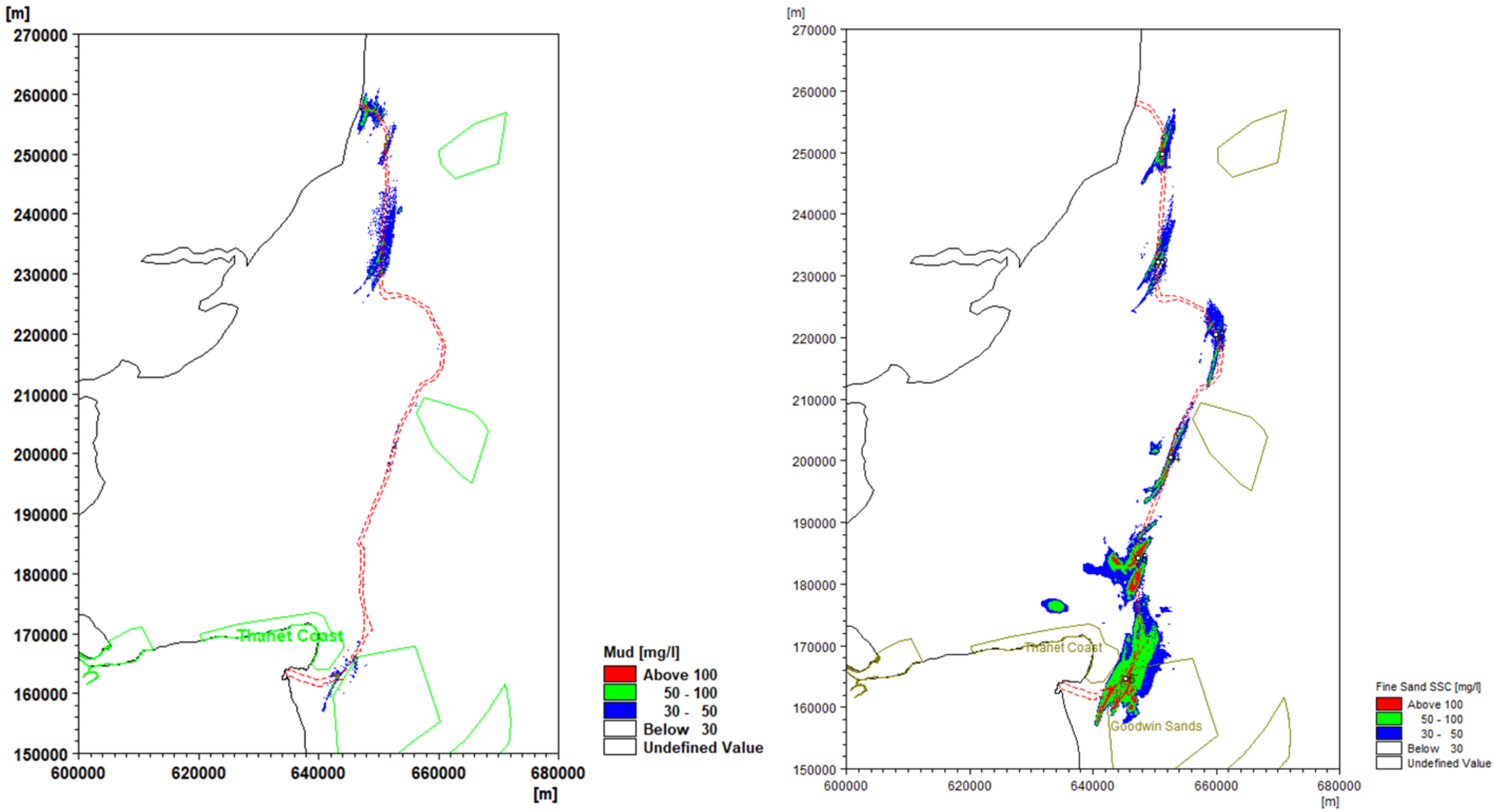

Plate 1-451.43. Maximum SSC levels over 14-day period for mud (left) and fine sand (right) for installation by jetting.

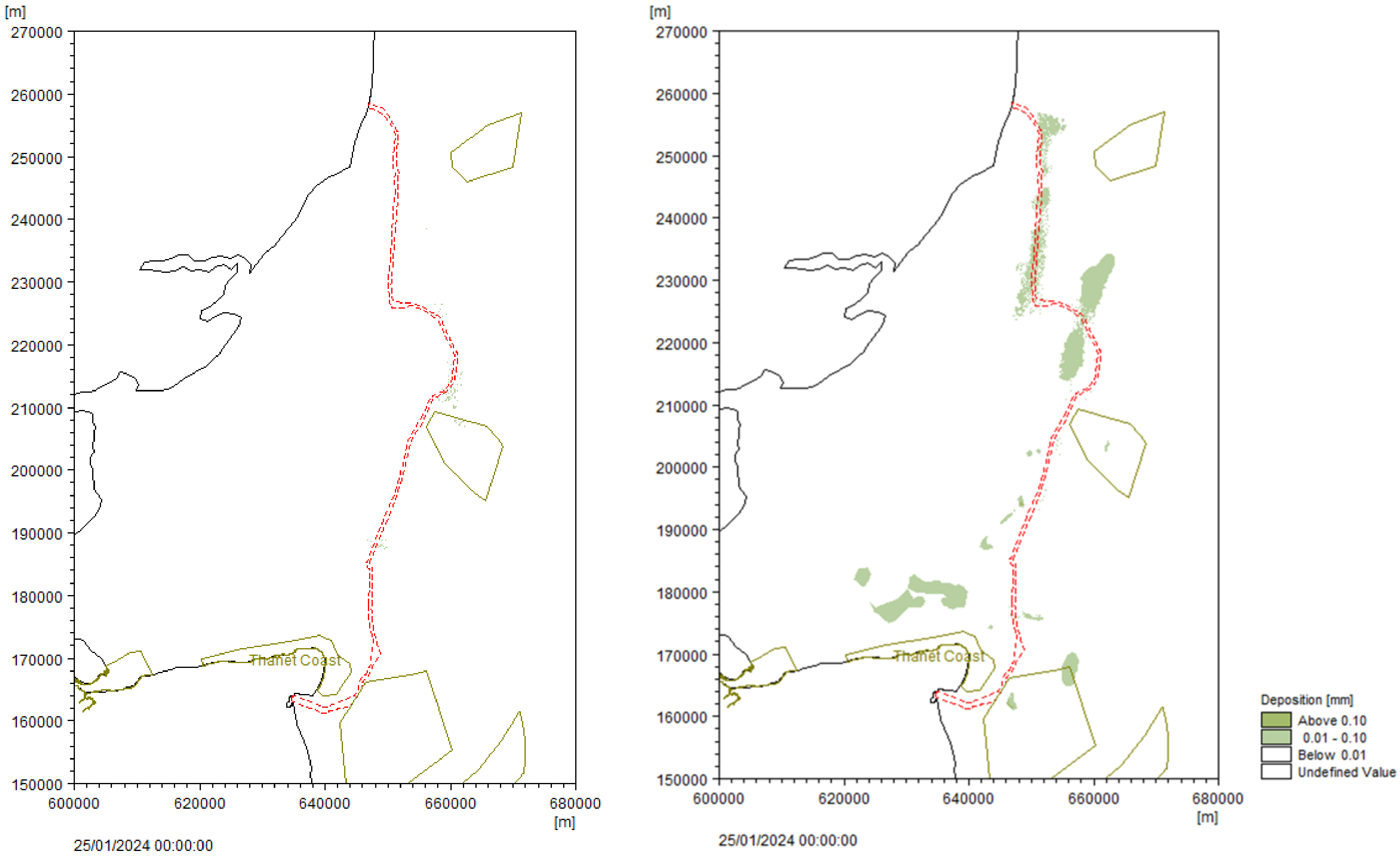

Plate 1-461.44 Instantaneous depth of deposition with jetting installation for mud (left) and fine sand (right) at end of 14-day period.

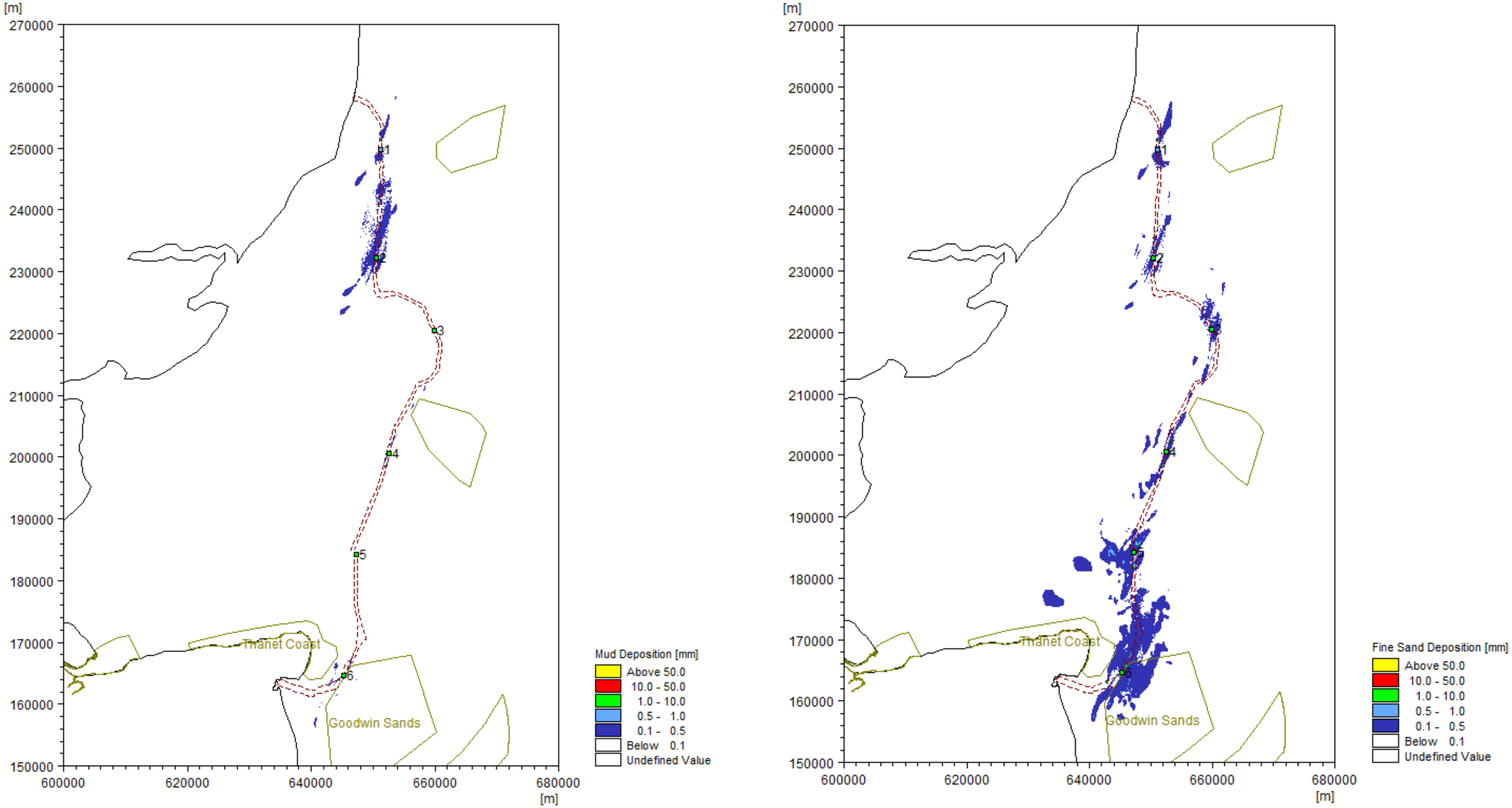

Plate 1-47~~1.45~~. Maximum deposition over 14-day period for mud (left) and fine sand (right) for installation by jetting.

Sediment dispersion in Pegwell Bay

1.9.75 Additional modelling was undertaken to assess sediment dispersion arising from construction-related disturbance following cable burial, as well as disturbance due to scouring at the cofferdam location within Pegwell Bay. The modelling was carried out using a detailed hydrodynamic and sediment transport model of Pegwell Bay, which was fully calibrated against measured tidal and current data. The model build and calibration report was subsequently reviewed and approved by the Environment Agency (**Application Document 9.144 Additional Sediment Dispersion Modelling - Technical Note).**

1.9.76 The modelling results (Plate 1-48~~Plate 1.46~~ and Plate 1-49 ~~Plate 1.47~~) indicate a progressive increase in sediment deposition at Points 1, 2 and 4, with the highest rate of accumulation occurring at Point 1 in the upper intertidal zone. In contrast, accumulated sediment at Point 3 is eroded during the spring flood tide, driven by peak flow velocities that exceed the threshold for sediment stability. Short-term peaks in suspended sediment concentration (SSC) are observed as sediment is released into shallow water depths; however, SSC reduces to zero as each point becomes exposed and dries. At mid to upper intertidal levels (Points 1 and 2), elevated SSC and associated deposition are highly localised, while lower intertidal levels experience a reduced rate of accumulation. Any wider dispersion of sediment is minimal, with SSC levels remaining below 1 mg/l.

1.9.77 The potential impact of increased SSC due to construction-related disturbance following cable burial, as well as disturbance due to scouring at the cofferdam location within Pegwell Bay and subsequent sediment deposition on habitats and species caused by increased turbidity and smothering is assessed in **Application Document 6.2.4.3 Part 4 Chapter 3 Benthic Ecology** and **Application Document 6.2.4.4 Part 4 Chapter 3 Fish and Shellfish.**

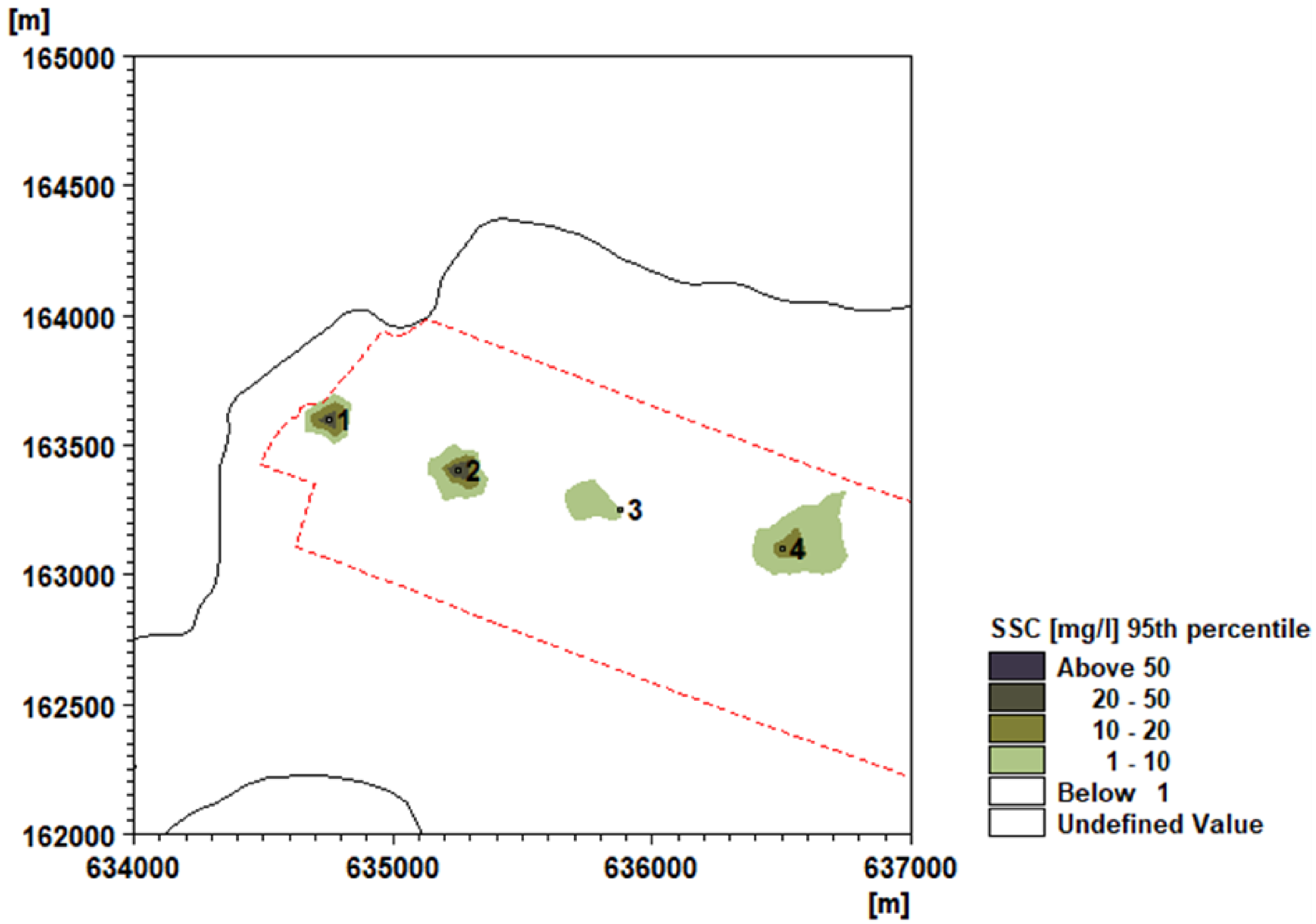

Plate 1-481.46 Pegwell Bay Model results for SSC distribution over 7-day period

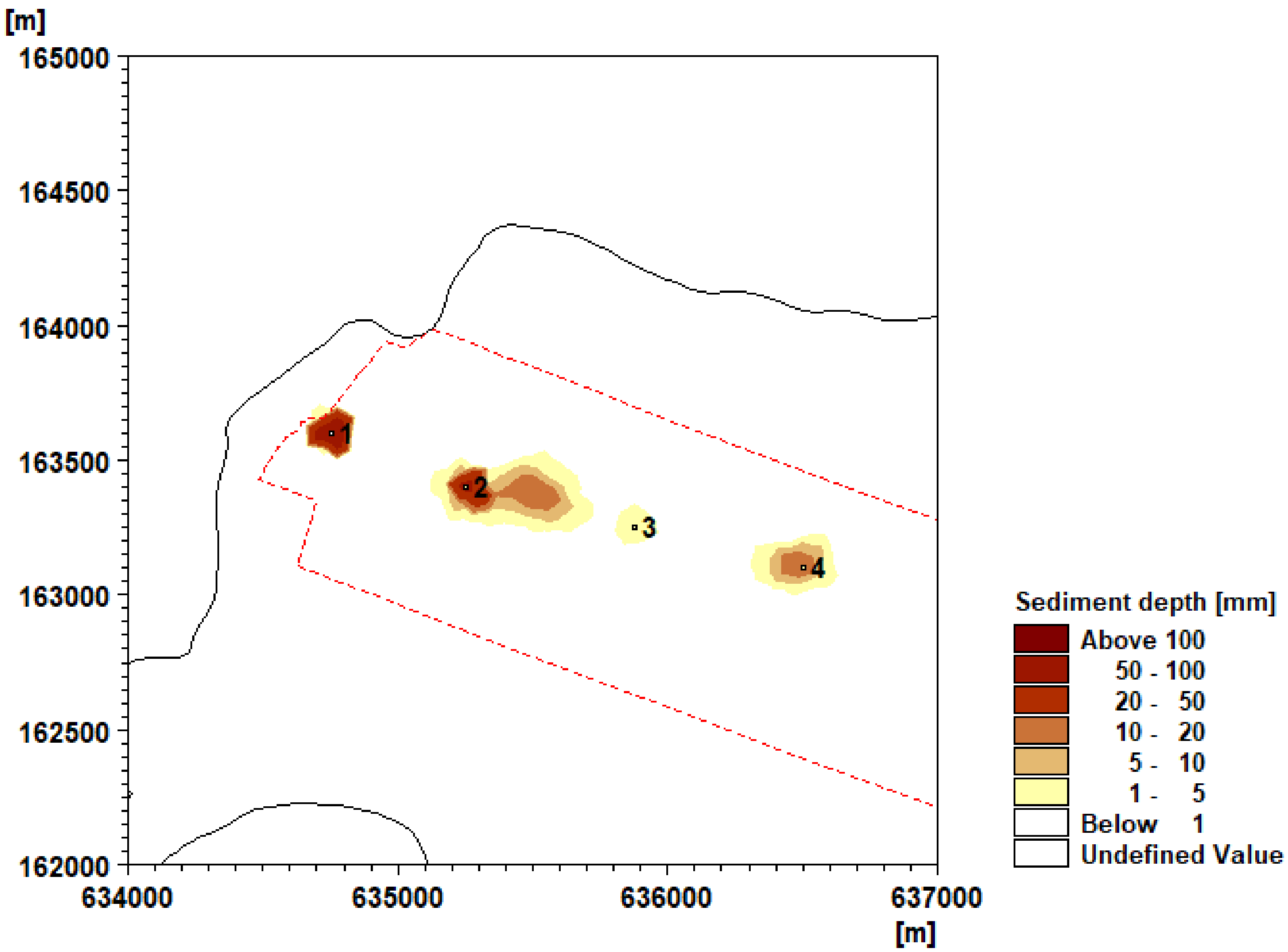

Plate 1-49~~1.47~~ Pegwell Bay model results for deposition over 7-day period

Reduction in water quality

Mobilisation of contaminants

1.9.78 Marine sediment quality can be affected by the deposition and subsequent accumulation of substances on the seabed. Historically, English nearshore and offshore waters have been heavily impacted by anthropogenic activities, such as dredging, which can result in sediment resuspension and the associated release of chemical pollution.

1.9.79 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 marine 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.

1.9.80 Areas of elevated heavy metals have been identified along the Offshore Scheme found to be typical of those found in the wider North Sea region. The concentrations of hydrocarbon and heavy metal encounters along the Offshore Scheme are not considered significant in the context of contaminants already present within the receiving environment and sensitivity is considered low.

1.9.81 Disturbance of seabed sediments associated with construction phase activities may result in the mobilisation of sediment-bound contaminants into the water column, with potential to cause indirect effects on water quality. Exceedances of Cefas Action Level 1 were recorded for several sampling stations along the Offshore Scheme. However, there will be a limited spatial extent of construction activities within the Offshore Scheme and so limiting the potential to disturb sediments. This, combined with the limited spatial extent of sediments with contaminants exceeding Cefas Action Level 1, along with the dominance of sand across the Offshore Scheme (**Application Document 6.3.4.2.A Appendix 4.2.A Benthic Characterisation Report (Original Report)**), and the potential for suspended sediments to be dispersed and diluted rapidly through natural hydrodynamic processes. The magnitude of the impact is assessed to be Negligible, as it is not expected that the potential disturbance of sediment bound contaminants will significantly affect the water quality. Therefore, the effect significance is assessed to be **negligible**, which is **not significant**.

Discharges, leaks and spills from vessels, including loss of oils

1.9.82 The Offshore Scheme will use a trenchless solution, such as HDD, at both landfall locations. At the Suffolk landfall, the exit points will be entirely in the subtidal environment. At the Kent landfall, the exit points will be located within the intertidal zone, characterised by intertidal mudflats. The use of HDD as a trenchless solution and therefore the discharge of drilling fluids at the breakout location has the potential to alter marine water quality.

1.9.83 Small amounts of fluid likely to be released, it is anticipated that only a temporary local reduction in water quality at the HDD breakout may occur. Therefore, only receptors in the immediate vicinity of the HDD breakouts have the potential to be in contact with drilling fluids if a leak or spill occurs.

1.9.84 At the Suffolk landfall, it has been estimated that up to 7,260 m^3 of drilling fluid will be discharged. Some particulates from the drilling muds may settle, but the presence of fine sediment habitats at the HDD exit points coupled with the generally dynamic nature of shallow coastal waters, there is likely to be natural resuspension distribution of sediments occurring due to tides and wave action.

1.9.85 At the Kent landfall, it has been estimated that up to 40 m^3 of drilling fluid will be discharged. The presence of intertidal mudflat at the HDD exit points indicate that the landfall location is comparatively more sheltered from wave action. However, the volume of HDD drilling fluid will be very limited and the regular tidal movement in the intertidal zone acting to disperse and dilute any drilling fluid released.

1.9.86 Additionally, drilling fluid discharges from the Proposed Project HDD operations will be single events over a short period of time. All drilling fluids used within the nearshore and intertidal environments associated with the HDD pits, such as bentonite, will be selected from the OSPAR List of Substances/Preparations Used and Discharged Offshore (2021) which are considered to 'Pose Little or No Risk to the Environment' (PLONOR). Additionally, where exit points are in the intertidal area (i.e. at the southern landfall) drilling fluid will be captured where possible (control measure LVS05 in **Application Document 7.5.2 Outline Offshore Construction Environmental Management Plan** and **Application Document 9.84 Register of Environmental Actions and Commitments (REAC)**).

1.9.87 The potential for accidental release of oils, lubricants, fuels and other chemicals exists for any of the vessels operating during installation, as does planned release of wastewater. Such materials are expected to generally be 'light' in nature and their potential to reach the seabed is low, with accidental and wastewater discharges expected to be rapidly dispersed by the tidal currents.

1.9.88 Embedded mitigation and control and management measures are detailed in Section 1.8. To ensure the risk of accidental spills is as low as reasonably practicable, relevant pollution prevention guidance will be followed. All vessels will follow the MARPOL regulations, and control measures and SOPEP will be followed. Ballast water discharges from all vessels will be managed under International Convention for the Control and Management of Ships' Ballast Water and Sediments.

1.9.89 Risk of an accidental spill is unlikely, and should such an accidental spill or leak occur, it would be limited in extent / volume and subject to immediate dilution and rapid dispersal within the marine environment, having a small magnitude. The physical environment has a low sensitivity to such discharges. This will result in a **negligible** effect that is **not significant**.

Operation and Maintenance Phase

Changes to seabed morphology and increased SSC

1.9.90 The Offshore Scheme is designed for a lifespan of approximately 40-60 years. The cable system installation is designed such that a regular maintenance regime is not required to maintain the integrity of the link. Potential impacts on seabed morphology, bedforms and changes to SSC caused by operational activities, are the same as those described for the construction activities, but on a much smaller scale.

1.9.91 Therefore, the magnitude of the impacts associated with repair works carried out during the Operation and Maintenance Phase are considered small. The sensitivity of the physical marine environment to these impacts is considered to be the same as outline for the Construction Phase. This will result in **negligible** effects that are not significant.

Coastal geomorphological change and associated changes to sediment transport regimes, with reference to climate change

1.9.92 The Offshore Scheme is designed for a lifespan of approximately 40-60 years. The cable system installation is designed such that a regular maintenance regime is not required to maintain the integrity of the link.

1.9.93 Throughout its operational lifetime, it is intended that most of the cable will be trenched into the seabed. Therefore, the presence of the cable will have no impact on bedload sediment transport processes and therefore will not impact coastal geomorphology.

1.9.94 The use of cable protection measures including rock berms, mattresses and rock backfill will alter the seabed morphology by artificially raising parts of the sea floor (**Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project**). In the offshore environment, the dimensions of the cable protection (rock berm with maximum height of 1 m and maximum width of 7 m (at the seabed)) are considered too small, sufficiently spread out along the Offshore Scheme Boundary route, and should be installed with a low enough profile to have no notable impact on the regional hydrodynamics and sediment transport patterns. Therefore, the magnitude of the impact of offshore cable protection measures is small and will not impact coastal morphology. This will result in a **negligible** effect that is **not significant.**

1.9.95 At the landfall sites, rock protection will be placed at the ducts after cable pull in and installation. The top of the duct will be approximately 1.1 m below the seafloor and the top of the rock bags/mattresses laid on top approximately 0.5 m below the seafloor. Therefore, they will not protrude from the seafloor. Evidence presented in **Application Document 9.144 Additional Sediment Dispersion Modelling - Technical Note** shows that there are no erosion processes likely to occur at the HDD exit locations, due to the low water movement in this location. Any exposure of the buried cable protection placed on the HDD duct ends during operation is therefore highly unlikely. This is also supported by the lack of any exposure of any other cables installed in Pegwell Bay.

1.9.96 The magnitude of the impact to coastal geomorphology and the morphological integrity of the designated sites associated with the landfall sites (Thanet Coast, Sandwich Bay, Hacklinge Marshes and Leiston to Aldeburgh SSSI) is assessed to be small.

1.9.97 As previously described, the sensitivity of the morphology of Pegwell Bay is Low, however due to its designated status, the sensitivity is assessed to be High. At the Suffolk landfall, the sensitivity of the coastal morphology is also assessed to be High.

1.9.98 At the Kent landfall, impacts on coastal morphology are **minor** which is **not significant**. At the Suffolk landfall, this results in a **minor** effect which is **not significant.**

1.9.99 The conservation sites at the landfalls are given a high sensitivity rating due to their designated status. This will result in a **minor** effect that is **not significant.**

1.9.100 The baseline assessment demonstrates that Pegwell Bay is a naturally low-energy, morphologically stable system. Climate change projections indicate only modest physical change in Pegwell Bay. For example, based on the most precautionary high-emissions scenario (UKCP18 RCP 8.5, 95th percentile), it is estimated that sea level will rise 0.24 m by 2050 at Pegwell Bay. A 24 cm rise by the mid-century is not sufficient to fundamentally reconfigure Pegwell Bay’s shallow, gently sloping intertidal morphology. Future wave and wind increase estimates also remain small, and given

Pegwell Bay's low baseline wave energy, this uplift is unlikely to result in meaningful geomorphological change over the lifetime of the Proposed Development. This is supported by ABPmer (2024) who explain that the geomorphology of the intertidal and sub-tidal areas of Pegwell Bay are expected to remain relatively stable over time with no notable change.

1.9.101 The most morphologically dynamic part of Pegwell Bay is the River Stour low water channel that meanders across the intertidal zone. ABPmer (2024b) considers it unlikely that the channel will migrate northwards to coincide with the buried cable alignment during the operational life of the Proposed Project. However, this cannot be guaranteed.

1.9.102 At the Suffolk landfall, the future baseline is likely to involve the continued erosion of the coast due to sea level rise and increased storminess. In response to future coastal change, East Suffolk Council in its Shoreline Management Plan (SMP) for Thorpeness Haven Beach deems it necessary in the future (2055 to 2015) to actively manage the coast which in some situations may mean it is not possible to continue to justify the current (2005 to 2055) 'hold the line' policy and a more adaptive management approach may be required.

1.9.103 A number of embedded design measures and commitments have been made to account for the potential effects of climate change and the inherent level of uncertainty in the future development and management of the landfall sites. This includes a commitment to the using trenchless techniques at the landfall to avoid the requirement for any infrastructure at the surface in the intertidal and coastal zones over the operational lifetime of the project.

1.9.104 Given that the trenchless ducts will be installed at depths between 17 m and 25 m (at its deepest point), this measure will ensure that there will be no interaction of the Proposed Development with coastal/ intertidal physical processes during the operational phase. Once buried at these depths, for the cable to become exposed in the nearshore/foreshore area, it is estimated that the coastline would need to retreat over 250 m landward including downward erosion that would not occur in reality due to the presence of the resistant Coralline Crag formation.

1.9.105 Current NCERM (2025) projections for an undefended coastline are for erosion of 118 m by 2105 for a location 1.7 km to north of landfall where the mechanism of erosion is quite different involving undercutting of soft cliff material. However, taking this as an indication of the maximum extent of the area at risk of coastal erosion under an extreme climate change scenario, this is significantly less than what would be required to expose cables at the HDD exit. Even allowing for uncertainty in future projections, the extent of erosion required to expose the conduits containing the cables is not therefore possible as a result of ongoing coastal processes at Aldeburgh.

1.9.106 Further, a series of commitments (MPE06 and MPE08) in **Application Document 7.5.2 Outline Offshore Construction Environmental Management Plan** and in **Application Document 9.94 Register of Environmental Actions and Commitments (REAC)** ensure that climate-driven changes do not go undetected and that additional mitigation can be implemented before the risk of exposure occurs and the project remains aligned with SMP policies and future coastal management decisions.

1.9.107 Commitment MPE09 in **Application Document 7.5.2 Outline Offshore Construction Environmental Management Plan** and **Application Document 9.84 Register of Environmental Actions and Commitments (REAC)** commits to the monitoring of the River Stour channel to detect any northerly migration towards the Sea Link cables (the frequency of ongoing monitoring will be subject to review after five years). The River

Stour Channel will be monitored throughout the operational life of the asset in line with a monitoring and contingency plan as secured in detail within Requirement 18 of the DCO. The plan will set out the frequency and methods for monitoring the location of the channel, contingency actions to be undertaken should the River Stour migrate to a location close to the cable and a 'trigger' point for when actions would be taken.

Shoreline evolution at the Suffolk landfall and associated discussion on cable burial depth

1.9.108 At the Suffolk landfall, the minimum depth of the landfall will be below elevation -10.5 m ODN (Ordnance Datum Newlyn) (which is equivalent to -9 m LAT) for the length installed beneath The Haven Local Nature Reserve (MPE04).

1.9.109 The baseline describes historic shoreline evolution at and near the Suffolk landfall site. Through the analysis of historical beach level changes covering the period 1991 to 2024. The maximum range of vertical variation at any given location along the beach profile coincident with the landfall site is 2.5 m although 1m would be a more typical range.

1.9.110 The closure depth can be used to estimate the lowest elevation which is affected by natural coastal erosion processes. The closure depth is the depth relative to low water below which coastal processes (waves) no longer influence longshore/cross-shore littoral transport processes. For the landfall location the closure depth has been estimated to be between -6 m LAT and -7 m LAT (ABPmer, 2024a). This is consistent with an independent estimate of -6 m LAT for the closure depth provided by HR Wallingford (HR Wallingford , 2016).

1.9.111 The estimated closure depth can be used to set a base level below which coastal processes have little or no influence on erosion of the beach, foreshore or seabed. The outcropping Coralline Crag formation in the nearshore area (-6 to -7 m LAT) is a relatively erosion resistant surface that would also affect or maintain the minimum level of the subtidal seabed between the coralline crag and the adjacent intertidal areas.

1.9.112 If the shingle ridge at the landfall site were to 'roll back' or retreat landwards, the calculated closure depth (in conjunction with the effect of the Coralline Crag) would still apply and can therefore be used to define a horizontal elevation along the HDD section of the cable route below which the cable is unlikely to be exposed due to natural coastal processes.

1.9.113 A minimum additional allowance of 2 m below the closure depth is recommended to allow for natural variability and climate change effects during the operation life of the proposed project which may affect calculation of the closure depth (i.e. due to future sea level rise and increased storminess).

1.9.114 Using the closure depth to determine a minimum depth for cable burial is likely to be conservative due to the presence of the Coralline Crag formation at -6 m LAT to -7 m LAT which will have a controlling influence reducing landward migration of the active profile relative to the seaward HDD exit.

1.9.115 This analysis is based on some assumptions and limitations:

- the SMP policies as defined in the baseline section will be implemented, as planned;
- the most recent beach profile data could not be accessed at the time the analysis was undertaken; and

- the approach used excludes consideration of more extreme events not captured within the available datasets, such as exceptional patterns of large storms causing cumulative damage to the coastline or a breach of the Orford Ness shingle spit to the south.

1.9.116 Sensitivity to exposure of the cable at the Suffolk landfall is considered to be **High**, primarily due to the requirement for remedial measures associated with re-burial. However, by installing the cable at or below the minimum depth referred to above, the presence of the cable will have **negligible effect** that is **not significant**

Cable protection measures and associated impact on the Goodwin Sands MCZ and the Cross Ledge Sandbanks

Goodwin Sands MCZ

~~1.9.107~~1.9.117 The Goodwin Sands are a naturally dynamic morphological feature that form part of a closed sedimentary system. Historical evidence shows that the system has been resilient to and capable of recovering from past disturbance, including dredging undertaken in 1998 (Goodwin Sands Conservation Trust, 2024). The Goodwin Sands sandbanks are a morphologically resilient feature which play a role as a natural sea defence of the Kent coast. The sandbanks from a large, dynamic and constantly changing feature consisting of sand and coarse sediments recognised as a "closed sediment system". This means the sandbanks are a largely self-contained and dynamic entity where little sand enters or leaves. Despite historical dredging, the total volume of sediment in the system has historically remained relatively stable. While considered "closed" regarding the input and output of sediments, the system is not static; it is characterised by active, shifting sandbanks and ongoing sediment migration.

~~1.9.108~~1.9.118 The Applicant has applied the mitigation hierarchy alongside Natural England’s advice at the pre-application stage and has avoided routing through the Goodwin Sands MCZ. The Goodwin Sands MCZ boundary is approximately 2.6 km from the cable crossing point at KP 113.1 (Nemo Link) and 260 m from the Thanet cable crossing point at KP 107.6.

~~1.9.109~~1.9.119 At the crossing points, external cable protection will be required with the following proposed maximum dimensions for each protection type which would be dependent on specific Crossing Agreements:

- Concrete mattressing: 0.3 m x 3.0 m x 6.0 m or 0.45 m x 3.0 m x 6.0 m;
- No pre-lay rock berm: 1.5 m[3] (height) x 1.0 m (top) x 7.0 m (base) with 1:3 slope.
- Includes pre-lay rock berm 1.5 m (height) x 1.0 m (top) 10.0 m (base) with 1:3 slope.

~~1.9.110~~1.9.120 In addition to cable crossings described above, the assessment also considers remedial rock protection:

[3] The change from 1.0 m to 1.5 m height is to correct a typographical error only. The amended height is consistent with the information presented in Table 1.19 and Application Document 6.4.1.4 ES Figures Introduction Description of the Proposed Project which has not changed. The change does not affect any of the conclusions of the assessment.

- Remedial rock protection: construction of a rock berm with dimensions 1.0 m (height) x 1.0 m (top) x 7.0 m (base) with 1:3 slope (where no cable lowering is achieved)

~~1.9.111~~1.9.121 However, it is noted that remedial rock protection will only be required in areas where natural backfill is too slow or target depth of lowering has not been achieved. **Application Document 9.21 Sea Link Cable Burial Risk Assessment Cable Burial Risk Assessment** and **Application Document 9.92 Outline Cable Specification and Installation Plan** for the Proposed Project provides for a high level of confidence that the ground conditions adjacent to the Goodwin Sands MCZ are sufficient to achieve target depth of lowering.

~~1.9.112~~1.9.122 The primary objective of the Proposed Project is to ensure that required burial depths are met without the need for cable external protection as identified within **Application Document 9.21 Sea Link Cable Burial Risk Assessment [PDA-039]**. Prior to cable lay and burial operations, further surveys will be completed to provide greater definition of the soils and seabed. This will enable the experienced cable lay contractor to select the most appropriate method of burial for achieving the required depth of lowering for the cable. This is the first and primary mitigator in avoiding external cable protection. If the required depth of lowering is not achieved, then first, further passes will be attempted to try to improve the depth of lowering. As such it is expected that there will be no requirements for any additional rock protection to be installed adjacent to the Goodwin Sands MCZ.

~~1.9.113~~1.9.123 Following installation of the cable an initial period of sediment accumulation would be expected to occur at the location of the cable crossings (and any areas of remedial rock protection berms where required noting that the use of rock protection is not planned), creating a smooth slope against the cable protection. The process of wedge formation may take place over a period of a few weeks to months, depending on rates of sediment transport.

~~1.9.114~~1.9.124 Following installation of the cable an initial period of sediment accumulation would be expected to occur at the location of the cable crossings (and any areas of remedial rock protection berms where required noting that the use of rock protection is not planned), creating a smooth slope against the cable protection. The process of wedge formation may take place over a period of a few weeks to months, depending on rates of sediment transport.

~~1.9.115~~1.9.125 Sandy sediments are transported in two modes: bedload and saltation. Saltation is the process by which sands are moved up into the water column. These suspended sands would be expected to move relatively freely over the top of the cable crossings/protection although to begin with would regularly be deposited upon it, filling void spaces. Once any void spaces have been infilled (which is expected to be in the order of a few months in areas of mobile sediment), saltation is expected to be largely unaffected by the presence of the cable crossings/protection such that existing transport process (including bed form migration) will remain unaffected.

~~1.9.116~~1.9.126 Bedload is the process by which sands move while still in contact with the seabed. Bedload will be temporarily affected up until such time that the cable crossing/protection is covered by sand and the slope gradient either side has been reduced in response to the accumulation of a sediment wedge with stable slope angles. Following this, bedload will continue because the slope angle presented by sections of protected cable would be within the natural range of bed slope angles associated with bed forms mapped within the Offshore Scheme.

~~1.9.117~~1.9.127 At the dimensions outline above, the protrusion of the cable crossings/protection above the sea floor will not cause any significant interference with flow dynamics or sediment transport patterns on a scale that would lead to the change in morphology of the Goodwin Sands MCZ (or indeed the Cross Ledge Sandbanks as detailed below). For all areas in which cable crossings are present or cable protection is used, it is not expected that the presence of the cable crossings/protection will continuously affect patterns of sediment transport following the initial period of accumulation. It follows that any changes on seabed morphology away from the cable crossings/protection will also be very small. The extent of the cable crossings/protection measures does not constitute a continuous blockage along the Order Limits.

~~1.9.118~~1.9.128 The hydrodynamic and sediment transport regimes that are associated with development and maintenance of the Goodwin Sands MCZ complex, occur on a regional scale that would not be altered by the presence of low-lying protection at the Thanet South crossing situated 260 m away from the Goodwin Sands MCZ (**Application Document 6.4.4.1 (D) Environmental Statement Figures Marine Physical Environment [REP4-049]**) or through any unplanned localised remediation.

~~1.9.119~~1.9.129 **Figure 6.4.4.1.16 Bedload transport at the Goodwin Sands MCZ** shows that the cable and therefore the long axis of the protection associated with the cable crossing points shown in the figure, is aligned to the direction of sediment transport and bedform migration, thus further reducing any potential blockage effect. The sediment transport directions arrows in **Figure 6.4.4.1.16 Bedload transport at the Goodwin Sands MCZ** are based on Kenyon & Cooper (2005). The crest alignment lines were traced from the visible sand waves crests visible in bathymetry data.

~~1.9.120~~1.9.130 To aid the above, a report for the High Court of Justice (2019) (Thomson v Marine Management Organisation & Others, 2019 EWHC 2368 (Admin).) presents extensive technical evidence, modelling outputs, and expert advice demonstrating that the Goodwin Sands sandbank system is self-maintaining, highly resilient, and capable of natural recovery, in response to assessing the potential effects of dredging 2 million m^3 of sand from Goodwin Sands involving lowering of up to 2-4 m in places. The modelling indicates that, although localised disturbance may occur, the overall form and behaviour of the sandbank remain stable due to ongoing natural sediment transport processes. The report concludes that the Goodwin Sands possess a high degree of morphological resilience, enabling them to absorb small-scale impacts without affecting their wider structure or long-term evolution (Thomson v Marine Management Organisation & Others, 2019 EWHC 2368 (Admin).).

~~1.9.121~~1.9.131 The evidence therefore demonstrates that the Goodwin Sands function as a high-energy, constantly shifting sediment system driven by strong tidal flows and wave action. Expert modelling and regulatory assessments show that any changes resulting from human activity are minor, temporary, and confined to the immediate vicinity, with no potential to alter large-scale currents or sediment pathways. The ecology of the sandbank also reflects this dynamic setting, comprising species that recover rapidly following disturbance. Collectively, these assessments confirm that the Goodwin Sands possess substantial morphological and ecological resilience, allowing them to accommodate small-scale impacts without affecting their overall form or long-term development (Thomson v Marine Management Organisation & Others, 2019 EWHC 2368 (Admin).).

1.9.132 Therefore, the magnitude of the impact of any works associated with the Proposed Development on the Goodwin Sands MCZ, is assessed to be small. While the Goodwin Sand Banks are a morphologically resilient feature, the role it plays as a natural sea defense of the Kent coast increases its sensitivity to medium. This results in a **minor** effect which is **not significant**.

1.9.133 To further support the assessment of potential impacts of rock protection adjacent to the Goodwin Sands MCZ boundary, a quantitative analysis was carried out: the volume of mobile sand within a sample area of the seabed has been estimated using high resolution seabed mapping data from the MMT (2022) Environment & Geophysical Survey Report. Plate 1-36~~Plate 1.34~~ shows Section A-B which is approximately perpendicular to the sandwave crests roughly aligned with the proposed cable route at KP108. This is therefore representative of the 3.2 km long section of the cable route between KP107.3 and KP110.5 which may require rock protection at cable crossings and/or cable joints.

1.9.134 The dimensioned profile along Section A-B shown in Plate 1-36~~Plate 1.34~~ was used to take off the elevation of the seabed at intervals of 50m. A reference base level was assumed at the level of the sandwave troughs allowing the height of mobile sediment above this to be determined. For the calculation of a volume, the profile was assumed to be representative of a 500m wide swathe along the cable route.

1.9.135 Note that the KP values shown on Figure 2 are based on a previous cable route alignment which relate to approx. KP108 of the final alignment as defined in the DCO. Calculation of the mobile sand volume at KP108 covers an 800 m long section of the cable route. The calculated volume was therefore scaled by a factor of 4 to provide a volume representative of a 3.2 km length of the cable route.

1.9.136 At this stage it is uncertain whether rock protection will be required and if it is, over what length of the 3.2 km section it will be applied. NG engineers have advised that the maximum combined length of rock protection would cover 50% of the 3.2 km section. Due to uncertainties in terms of achievable burial depths, a range for the combined length of rock protection from 30% to 50% has been considered.

1.9.137 Further calculations to estimate the volume of rock required to protect 30%, 40% and 50% of the 3.2 km section have also been undertaken. These were based on the proposed design of the protective mound having a height of 1 m above the seabed, a 1 m top width and 1 on 3 side slopes.

1.9.138 Results of the volume calculations are summarised in Table 1-20 which includes a relative comparison of rock volumes for different lengths of protection against the total volume of mobile sand for the area adjacent to the Goodwin Sands MCZ. This comparison provides a measure of the space occupied by rock relative to mobile sand which can be used as an indicator of the effect the presence of the static rock will have on regional sediment transport processes.

Table 1-20. Summary of metrics for alternative rock protection scenarios

Description of metric	Rock protection scenario (% of 3.2 km section)		
	30%	40%	50%
Length of rock protection	960 m	1280 m	1600 m
Volume of rock protection	2304 m^3	3072 m^3	3840 m^3
Volume of mobile sand	1,665,000 m3	1,665,000 m^3	1,665,000 m^3

Proportion of rock rel. to mobile sand	0.14%	0.18%	0.23%

~~1.9.122~~1.9.139 The results show that the 'blockage' effect of sediment transport associated with sandwave migration is less than 0.25% for the worst-case scenario in which 50% of the 3.2 km cable requires protection. This supports the assessment findings outlined above, that ~~there would be no significant~~any potential effects of rock protection on regional scale sediment transport processes are considered to be **not significant**.

Cross Ledge Sandbanks

~~1.9.123~~1.9.140 The Cross Ledge Sandbanks are approximately 3 km and 8 km from the crossing points at KP 113.1 and KP 107.6, respectively (**Figure 6.4.4.1.11 Offshore Seabed Surficial Geology**).

~~1.9.124~~ The Cross Ledge Sandbanks are situated in the dynamic entrance to Pegwell Bay where wave shoaling and wave breaking occur in the shallower near-shore environment. (Vattenfall Wind Power Ltd, 2018). These conditions result in a morphologically dynamic and resilient geomorphological feature with lower sensitivity; however, due to its role in protecting Pegwell Bay from wave attack, its sensitivity increases to medium. The crests of the mapped bedforms in Pegwell Bay are mainly aligned north/northwest to southeast, indicating the direction of bedload transport at the time of the survey is east-southeast – west-northwest. The long axis of the cable is aligned to the direction of sediment transport and bedform migration (east-southeast – west-northwest). Should cable protection measures be needed, this alignment further reduces any potential blockage effect of bedload sediment transport. This results in a **minor** effect which is **not significant.**

1.9.141

Proximity of North Farland cable crossing to the Aldeburgh Napes sandbank

~~1.9.125~~1.9.142 The Aldeburgh Napes are classified as an Annex I feature and are located east of the North Farland cable crossing (**Figure 6.4.4.1.17 Suffolk offshore bedforms, including the Aldeburgh Napes and Aldeburgh Ridge**). It is recognised that the Aldeburgh Napes sandbanks have exhibited a long-term trend of lowering in recent years, reducing their effectiveness in protecting the Aldeburgh coastline. As with the assessment of cable protection near the Goodwin Sands MCZ, the scale of the proposed cable protection is small relative to the size and function of the sandbank system, characterised by its low berm height, narrow crest width, shallow side slopes, and overall limited footprint when compared with the width of the active sediment transport pathway. The magnitude of any effect will depend on the alignment of the scour protection relative to prevailing sediment transport directions. Sediment transported as bedload may temporarily accumulate on the updrift side of the cable protection; however, under worst-case alignment, sediment is expected to pass over the berm crest and normal transport processes will be re-established. The seabed is anticipated to recover within a relatively short timescale, with no long-term effects on future sediment transport following recovery, as the marine environment is dynamic driven by the tidal currents and wave action. The presence of sandwaves is indicative of the influence of strong tidal currents.

~~1.9.126~~1.9.143 The sensitivity of the Aldeburgh Napes is considered High due to its designation as an Annex 1 feature. This will result in a **minor** effect that is **not significant**.

Offshore scour of the seabed

~~1.9.127~~1.9.144 Rock berms (maximum rock berm dimensions: 1.0 m (H) x 1.0 m (top) 7.0 m (base) with 1:3 slope), rock bags and mattresses used to protect the cable where it cannot be buried, or cable crossings (maximum dimensions: 1.5 m (height) x (1.0 m (top) 10 m (base), may act as an obstacle to the flow, altering local hydrodynamic patterns causing local scouring of the mobile seabed about the obstacle. As a result, some sediment will be eroded from the seabed. The tidal current speeds across the Offshore Scheme Boundary do not exceed 1.2 m/s (Section 1.7) and will be even lower close to the bed due to frictional effect, suggesting that scour is unlikely to be a significant issue.

~~1.9.128~~1.9.145 In less energetic environments it is also possible that some increased deposition of sediment may occur over the rock berms. Whilst this may make it more difficult to undertake maintenance inspections, such deposition would effectively provide a reduction to the direct impact of the rock berm on the seabed returning to a more natural state. Where such deposition as described occurs, this would therefore have a moderate beneficial impact.

~~1.9.129~~1.9.146 Due to the dynamic nature of the seabed driven by natural wave and tidal action and associated sediment transport processes, it can be expected that the seabed will establish new equilibrium conditions even if obstructions, such as exposed sections of the cable and protection measures, remain on the seabed. Therefore, the sensitivity of the seabed to sediment disturbance due to scour is considered low.

~~1.9.130~~1.9.147 The magnitude of the impact of scour on the seabed is assessed to be small, 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 or on local sediment transport. Further, over time the rock berms or exposed sections of cable may become buried by the eventual build-up of sediment or migration of bedforms, thus re-establishing direct sediment pathways over the obstacle. This will therefore result in a **minor** effect that is **not significant**.

Changes to the Coralline Crags due to repairs and cable replacement activities

~~1.9.131~~1.9.148 In the unlikely event of cable replacement within the HDD near the Coralline Crag, the works at the HDD exit site are 45 m beyond the nearest coralline crag outcrop and will be conducted in a similar manner to the HDD construction, as such the positioning of jack up platforms will not affect the Coralline Crag and any vessel anchoring will be designed to avoid the feature. Therefore, during operational phase, there is no impact on the Coralline Crag expected.

~~1.9.132~~1.9.149 As set out in **Application Document 6.2.1.4 (D) Part 1 Introduction Chapter 4 Description of the Proposed Project ~~(Clean)~~ [REP1A-003]**, four HDD ducts will be installed at each landfall during construction. This will ensure that there is a spare duct available that can be used during operation, should there be a requirement to repair or replace any section of cable at the landfall. Installation of the spare duct during construction will minimise the risk of any potential impacts on the Coralline Crag due to cable repair/replacement through the lifetime of the Proposed Project.

Discharges, leaks and spills from vessels, including loss of oils

~~1.9.133~~1.9.150 Potential for accidental discharges and losses from vessels undertaking emergency works during the operational phase will be the same as for the construction phase, although the frequency and intensity of works will be lower, and risk of incident also lower. The sensitivity of changes to water quality is considered low and the magnitude of the impact is also considered negligible. This will result in a **negligible** effect that is **not significant.**

Decommissioning Phase

~~1.9.134~~1.9.151 Following the completion of the Operational phase, the Decommissioning phase will take place. As this work is planned decades into the future, it is unknown what the exact methodology will be for decommissioning, as this will be based on the best available technology available at the time of decommissioning (**Application Document 6.2.1.4 Part 1 Introduction Chapter 4 Description of the Proposed Project**).

~~1.9.135~~1.9.152 In the years leading up to the end of the Proposed Project's operational life, options for decommissioning will be evaluated through integrated environmental, technical, and economic assessments. The objective in undertaking these assessments will be to minimise the short- and long-term effects on the environment, whilst ensuring that the sea is safe for other users to navigate. The level of decommissioning will be based upon the regulations, best practices, and available technology at the time of decommissioning.

~~1.9.136~~1.9.153 The techniques for decommissioning are often simpler than for installation prioritising minimising seabed disturbance over cable integrity. The principal options for decommissioning include:

- In areas where the cable is shallow buried it may be possible to pull the cable out of the seabed without the use of other equipment.
- In areas where the cable is more deeply buried, under-running the cable can help free it from the seabed.
- In areas of deeper burial, or mobile seabed, the use of jetting or controlled flow excavation to release the cable from the seabed may be considered.
- Any active crossings, at the time of decommissioning, would normally be left in place with a section of decommissioned cable left in-situ.
- Removal of the trenchless solutions from the transition joint bay passing under the beach landfalls to the bellmouth exits should be reviewed at the time of decommissioning as it may be less damaging to leave in-situ with stabilisation, rather than to excavate and remove, especially given the sensitivity of both landfall sites.

~~1.9.137~~1.9.154 Any impacts from the Decommissioning phase activities involved in cable removal, will be the same as those carried out during the Construction phase. The effects of these impacts are predicted be either the same or less than the impacts associated with the installation and operation phase.

1.10 Additional Mitigation

1.10.1 The embedded and control and management measures, applicable to Physical Environment are outlined in **Application Document 7.5.2 Outline Offshore Construction Environmental Management Plan** and **Application Document 9.84 Register of Environmental Actions and Commitments (REAC)**.

1.11 Residual Effects and Conclusions

1.11.1 The future impact of climate change associated sea level rise and increased storminess may alter the baseline conditions associated with specifically the coastal environment. For example, accelerated erosion rates may occur at the landfall sites between now and commencement of the construction phase which will be captured by the ongoing coastal monitoring programmes.

1.11.2 Important morphological features such as the Coralline Crag Ridges that play an important role in stabilizing the Suffolk coast is likely to become increasingly at risk from climate change driven sea level rise and increased storminess which may as a result increase its sensitivity.

1.12 Transboundary Effects

1.12.1 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.

1.12.2 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 Environment receptors outside UK waters and subsequently cause transboundary effects.

Table 1-21~~1.20~~ Summary of Physical Environment effects

Phase	Receptor	Sensitivity	Impact	Effect		Additional Mitigation Measures	Residual Effect	
				Magnitude	Significance		Magnitude	Significance
Construction – Route preparation activities	Bedforms (decimetre-scale sized bedforms)	Low	Damage to/removal of existing bed features	Small	Negligible effect - Not significant	MPE03 MPE04 MPE05	Negligible	Negligible effect - Not significant
	Sandwaves (large-scale bedforms)	Medium	Damage to/removal of existing bed features and change to bathymetry	Medium	Minor effect – Not significant	MPE03 MPE04 MPE05	Negligible	Negligible effect - Not significant
	Local hydrodynamic, wave and sediment transport regimes	Low	Changes to hydrodynamic, wave and sediment transport regimes	Small	Minor effect - Not significant	MPE03 MPE04 MPE05	Small	Minor effect - Not significant
	Water column	Very Low	Increased turbidity/SSC	Small	Negligible effect - Not significant	Use of cofferdam at Kent landfall	Small	Negligible effect - Not significant

Phase	Receptor	Sensitivity	Impact	Effect		Additional Mitigation Measures	Residual Effect	
				Magnitude	Significance		Magnitude	Significance
Construction – Cable installation	Nearshore seabed and beach morphology	~~Low~~High	Changes to nearshore and beach morphology at the landfalls, including Pegwell Bay to Hacklinge Marshes SSSI and The Haven (Local Nature Reserve and SSSI) by use of nearshore vessels and equipment	Small	~~Negligible~~ Minor effect - Not significant	MPE03 MPE04 MPE05 MPE06 MPE08 MPE10 MPE11	Negligible	Negligible effect - Not significant
		~~Low~~High	Changes to nearshore seabed and beach morphology at the landfalls, including Pegwell Bay to Hacklinge Marshes SSSI by the cofferdam at Kent landfall	Small	Minor effect - Not significant	MPE03 MPE04 MPE05 MPE06 MPE08 MPE09 MPE10	Negligible	Negligible effect -Not significant

Phase	Receptor	Sensitivity	Impact	Effect		Additional Mitigation Measures	Residual Effect	
				Magnitude	Significance		Magnitude	Significance
	Aldeburgh Napes	~~Low~~High	Morphological change to the Aldeburgh Napes and their associated role in the regional coastline morphology	Small	Minor effect - Not significant	MPE03 MPE04 MPE05 MPE06 MPE08	Negligible	Negligible effect -Not significant
	Kent and Suffolk landfall	~~Low~~ High (Kent), High (Suffolk)	Changes to nearshore seabed and beach morphology at the landfalls due to excavation of HDD exit pits and the presence of temporary rock protection at the HDD exit pits.	Small	Minor effect - Not significant	MPE04 MPE05	Negligible	Negligible effect - Not significant
	Coralline Crag Ridges	Medium – High	Changes to the Coralline Crag Ridges and its associated role in the regional coastline morphology	Small	Minor effect - Not significant	MPE04 MPE05 MPE07	Small	Minor effect - Not significant
	Offshore seabed	Low	Changes to offshore seabed bathymetry and	Small	Negligible effect - Not significant	MPE04 MPE05	Small	Negligible effect - Not significant

Phase	Receptor	Sensitivity	Impact	Effect		Additional Mitigation Measures	Residual Effect	
				Magnitude	Significance		Magnitude	Significance
	bathymetry and morphology		morphology, due to cable installation.					
	All seabed morphology	Low	Alteration to seabed morphology due to increased sediment deposition following the suspension of sediment into the water column	Small	Negligible effect - Not significant	MPE04 MPE05	Small	Negligible effect - Not significant
	Water column	Low	Increased turbidity/SSC from construction activities.	Negligible	Negligible effect - Not significant	No	Negligible	Negligible effect - Not significant
	Water quality	Low	Accidental release of oils, lubricants, fuels and other chemicals from any of the vessels into the water column reducing water quality. Mobilisation of contaminated sediments.	Negligible	Negligible effect - Not significant	No	Negligible	Negligible effect - Not significant

Phase	Receptor	Sensitivity	Impact	Effect		Additional Mitigation Measures	Residual Effect	
				Magnitude	Significance		Magnitude	Significance
Operation and Maintenance Phase	Coastal geomorphology and associated sediment transport regimes	Suffolk coast – High. Pegwell Bay Landfall - ~~Low~~High.	Changes to sediment transport regimes leading to change to coastal geomorphology due to the presence of buried rock protection at the HDD exit pits.	Small	Minor effect - Not significant	MPE06 MPE08	Small	Minor effect - Not significant
	Goodwin Sands MCZ	Medium	Changes to the Goodwin Sands MCZ due to the presence of Cable protection measures	Negligible	Minor effect - Not significant	MPE04 MPE05 MPE13	Negligible	Negligible effect - Not significant

Phase	Receptor	Sensitivity	Impact	Effect		Additional Mitigation Measures	Residual Effect	
				Magnitude	Significance		Magnitude	Significance
	Cross Ledge Sandbanks	Medium	Changes to the Sandbanks due to the presence of Cable protection measures	Negligible	Minor effect - Not significant	MPE04 MPE05	Negligible	Negligible effect - Not significant
	Coastal geomorphology	Kent – High Suffolk - High	Coastal geomorphological change and associated changes to sediment transport regimes, with reference to climate change	Small	Minor effect - Not significant	MPE06 MPE08 MPE09	Small	Negligible effect - Not significant
	Offshore seabed morphology	Low	Offshore scour of the seabed due to presence of rock protection measures.	Negligible	Negligible effect - Not significant	MPE04 MPE05	Negligible	Negligible effect - Not significant
	Water column	Low	Increased turbidity/SSC from maintenance activities.	Small	Negligible effect - Not significant	No	Negligible	Negligible effect - Not significant

Phase	Receptor	Sensitivity	Impact	Effect		Additional Mitigation Measures	Residual Effect	
				Magnitude	Significance		Magnitude	Significance
	Water quality	Low	Accidental release of oils, lubricants, fuels and other chemicals from any of the vessels into the water column reducing water quality. Mobilisation of contaminated sediments.	Negligible	Negligible effect - Not significant	No	Negligible	Negligible effect - Not significant
Decommissioning	As for construction phase		As for construction phase	Negligible-Minor (As for construction phase)	Not significant	MPE04 MPE05	Negligible - (As for construction phase)	Negligible effect - Not significant

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