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Rampion 2 WIND FARM

Volume 2, Chapter 6:

Coastal processes

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6. Coastal processes

6.1 Introduction

6.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the preliminary results of the assessment of the likely significant effects of Rampion 2 with respect to coastal processes, including waves, tides, sediments and morphology during the construction, operation and maintenance and decommissioning phases of the Proposed Development. More detail on the coastal processes baseline and technical assessments is provided in the following Appendices:

- **Appendix 6.1: Coastal Processes Technical Report: Baseline description, Volume 4;**
- **Appendix 6.2: Coastal Processes Model Design and Validation, Volume 4**; and
- **Appendix 6.3: Coastal Processes Technical Report: Impact Assessment, Volume 4.**

6.1.2 This chapter should be read in conjunction with the project description provided in **Chapter 3: Alternatives**, **Chapter 4: The Proposed Development** and the relevant parts of the following chapters (due to the potential for pathways of coastal processes effects to impact sensitive receptors considered by other aspects):

- **Chapter 8: Fish and shellfish ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 9: Benthic subtidal and intertidal ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 10: Commercial fisheries** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 11: Marine mammals** (due to potential changes in seabed morphology, smothering and suspended sediments, affecting prey species and other indirect effects);
- **Chapter 12: Offshore ornithology** (due to potential changes in seabed morphology, smothering and suspended sediments, affecting prey species and other indirect effects);
- **Chapter 14: Shipping and navigation** (due to potential changes in hydrodynamic and wave regime, seabed and coastal morphology);
- **Chapter 15: Nature conservation** (due to potential changes in flow and wave regime, seabed and coastal morphology); and
- **Chapter 28: Water environment** (due to suspended sediments).

6.1.3 This chapter describes:

- the legislation, planning policy and other documentation that has informed the assessment (**Section 6.2: Relevant legislation, planning policy, and other documentation**);
- the outcome of consultation engagement that has been undertaken to date, including how matters relating to coastal processes within the Scoping Opinion received in August 2020 have been addressed (**Section 6.3: Consultation and engagement**);
- the scope of the assessment for coastal processes (**Section 6.4: Scope of the assessment**);
- the methods used for the baseline data gathering (**Section 6.5: Methodology for baseline data gathering**);
- the overall baseline (**Section 6.6: Baseline conditions**)
- embedded environmental measures relevant to coastal processes and the relevant maximum design scenario (**Section 6.7: Basis for PEIR assessment**);
- the assessment methods used for the PEIR (**Section 6.8: Methodology for PEIR assessment**);
- the assessment of coastal processes effects (**Section 6.9 – 6.11: Preliminary assessment** and **Section 6.12: Preliminary assessment: Cumulative effects**);
- consideration of transboundary effects (**Section 6.13: Transboundary effects**);
- consideration of Inter-related effects (**Section 6.14: Inter-related effects**);
- a summary of residual effects for coastal processes (**Section 6.15: Summary of residual effects**);
- an outline of further work to be undertaken for the Environmental Statement (ES) **(Section 6.16: Further work to be undertaken for ES**);
- a glossary of terms and abbreviations is provided in **Section 6.17: Glossary of terms and abbreviations**; and
- a references list is provided in **Section 6.18: References**.

6.2 Relevant legislation, policy and other information and guidance

Introduction

6.2.1 This section identifies the legislation, policy and other documentation that has informed the assessment of effects with respect to coastal processes. Further information on policies relevant to the EIA and their status is provided in **Chapter 2: Policy and legislative context** of this PEIR.

Legislation and national planning policy

6.2.2 Coastal processes are not subject to specific aspect legislation but are relevant to legislative requirements of other aspects, including the Birds and Habitats Directives and associated regulations, Water Framework Directive (WFD) and so on, due to the potential for pathways of coastal processes effects to impact other aspects. Refer to the following aspect chapters for relevant legislation:

- **Chapter 8: Fish and shellfish ecology;**
- **Chapter 9: Benthic subtidal and intertidal ecology;**
- **Chapter 12: Offshore ornithology;**
- **Chapter 15: Nature conservation;**
- **Chapter 28: Water environment;** and
- **Appendix 27.3: Preliminary WFD assessment, Volume 4.**

6.2.3 **Table 6-1** lists the national planning policy relevant to the assessment of the effects on coastal processes receptors.

Table 6-1 National planning policy relevant to coastal processes

Policy description	Relevance to assessment
Overarching National Policy Statement for Energy (EN1) (July 2011)	
(Paragraph 5.5.7 of NPS EN-1). The Environmental Statement should include an assessment of the effects on the coast. In particular, applicants should assess: • The impact of the proposed project on coastal processes and geomorphology, including by taking account of potential impacts from climate change. If the development will have an impact on coastal processes the applicant must demonstrate how the impacts will be managed to minimise adverse impacts on other parts of the coast; • The implications of the proposed project on strategies for managing the coast as set out in Shoreline Management Plans (SMPs)…any relevant Marine Plans…and capital programmes for maintaining flood and coastal defences; • The effects of the proposed project on marine ecology, biodiversity and protected sites;	Changes to coastal processes receptors and 'pathways' (for example, elevations in Suspended Sediment Concentration (SSC), scour around foundations etc.) are the basis for this chapter and are assessed for the construction phase in **Section 6.9**, **Section 6.10** for the operation and maintenance phase and **Section 6.11** for the decommissioning phase. **Section 6.12** assesses the potential cumulative effects**.** More detailed supporting assessments are provided in **Appendix 6.3, Volume 4**. The vulnerability of Rampion 2 to coastal change (taking account of climate change) is also considered in these sections. The implications of the Proposed Development on strategies for managing the coast is considered within the nearshore area assessment, presented in **paragraphs 6.9.45** to **6.9.74** (for the construction phase), **paragraphs 6.10.32** to **6.10.35** (for the operation and maintenance phase) and **paragraphs**

Policy description	Relevance to assessment
• The effects of the proposed project on maintaining coastal recreation sites and features; and • The vulnerability of the proposed development to coastal change, taking account of climate change, during the project's operational life and any decommissioning period.	**6.11.9** to **6.11.16** for the decommissioning phase). The effects of Rampion 2 on marine ecology, biodiversity and protected sites is set out in **Chapter 9: Benthic subtidal and intertidal ecology**. The effects of the Proposed Development on maintaining coastal recreation sites and features is set out in **Chapter 7: Other marine users**.
(Paragraph 5.5.9 of NPS EN-1).The applicant should be particularly careful to identify any effects of physical changes on the integrity and special features of Marine Conservation Zones (MCZs), candidate marine Special Areas of Conservation (cSACs), coastal SACs and candidate coastal SACs, coastal Special Protection Areas (SPAs) and potential Sites of Community Importance (SCIs) and Sites of Special Scientific Interest (SSSI)	Designated nature conservation sites within the Rampion 2 coastal processes study area are listed as receptors in **Table 6-4** and illustrated in **Figure 6.2, Volume 3** and are assessed for the construction phase in **Section 6.9**, **Section 6.10** for the operation and maintenance (operation and maintenance) phase and **Section 6.11** for the decommissioning phase. The predicted changes to coastal processes have been considered in relation to indirect effects on other receptors elsewhere in the PEIR, in particular **Chapter 8: Fish and shellfish ecology**, **Chapter 9: Benthic subtidal and intertidal ecology**, **Chapter 11: Marine mammals**, and **Chapter 15: Nature conservation**.
(Paragraph 5.5.11 of NPS EN-1). 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	Local and regional coastal morphology is defined as a coastal process receptor (**Table 6-4**). This assessment considers the nature of ongoing shoreline change at the nearshore area and the potential for cables and other project infrastructure to impact coastal processes as presented in **Section 6.9** (construction phase), **Section 6.10** (operation and maintenance phase) and **Section 6.11** for the decommissioning phase.

Policy description	Relevance to assessment
development outweigh the adverse impacts.	
(Section 4.8 of NPS EN-1). The resilience of the project to climate change (such as increased storminess) should be assessed in the Environmental Statement accompanying an application.	Potential changes in climate are described in **paragraph 6.6.9** and are taken into consideration within the assessments presented in **Sections 6.9, 6.10** and **6.11**.
National Policy Statement for Renewable Energy Infrastructure (EN-3) (July 2011)	
(Paragraph 2.6.81 of NPS EN-3). An assessment of the effects of installing cable across the intertidal zone should 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 and removal (decommissioning); • Increased suspended sediment loads in the intertidal zone during installation; and • Predicted rates at which the intertidal zone might recover from temporary effects.	Effects of the cable installation in the nearshore area (including seabed disturbance, increased SSC and coastal morphology) are presented in **paragraphs 6.9.21** to **6.9.79**, whilst effects associated with decommissioning activities are presented in **paragraphs 6.11.1** to **6.11.16**. Where possible, the assessment includes estimates of the rates which the intertidal area might recover from temporary effects. A cable nearshore assessment is also presented in **Appendix 6.3, Volume 4, Section 5.4**. This assessment considers the nature of ongoing shoreline change at the nearshore area and the potential for cables and other project infrastructure to impact coastal processes. Details regarding Proposed Development design at the nearshore area are set out in **Chapter 3: Alternatives**. Details regarding alternative nearshore areas that have been considered during the design phase and an explanation for the final choice is provided in **Chapter 3**. The potential for habitat loss is discussed within **Chapter 9: Benthic subtidal and intertidal ecology**.
(Paragraph 2.6.113 of NPS EN-3). Where necessary, assessment of the effects on the subtidal environment should include:	Changes to the subtidal environment (including elevations in SSC) are described in **paragraphs 6.9.1** to **6.9.32**. Where possible, the assessment includes

Policy description	Relevance to assessment
• Loss of habitat due to foundation type including associated seabed preparation, predicted scour, scour protection and altered sedimentary processes; • Environmental appraisal of array and cable routes and installation methods; • Habitat disturbance from construction vessels' extendible legs and anchors; • Increased suspended sediment loads during construction; and • Predicted rates at which the subtidal zone might recover from temporary effects.	estimates of the rates which the subtidal zone might recover from temporary effects. The impact of Rampion 2 on identified coastal processes receptors is considered in **Section 6.9** (construction phase), **Section 6.10** (operation and maintenance phase) and **Section 6.11** for the decommissioning phase. **Section 6.12** assesses the potential cumulative effects. The potential for habitat loss/change is discussed within **Chapter 9: Benthic subtidal and intertidal ecology**.
(Paragraph 2.6.190 of NPS EN-3). Assessment should be undertaken for all stages of the lifespan of the proposed wind farm in accordance with the appropriate policy for offshore wind farm EIAs	The impact of Rampion 2 on identified coastal processes receptors is considered in **Section 6.9**, **Section 6.10** and **Section 6.11. Section 6.12** assesses the potential cumulative effects.
(Paragraph 2.6.191 and 2.6.192 of NPS EN-3). The Applicant should consult the Environment Agency, Marine Management Organisation (MMO) and Centre for Environment, Fisheries and Aquaculture Science (Cefas) on methods for assessment of impacts on physical processes	Consultation on approach to assessment for coastal processes has been carried out with the Environment Agency, MMO, Natural England and Cefas. Details of the issues raised and responses to consultation are provided in **Table 6-3**.
(Paragraph 2.6.193 of NPS EN-3). Geotechnical investigations should form part of the assessment as this will enable the design of appropriate construction techniques to minimise any adverse effects	Geotechnical data has informed the assessment and Proposed Development design of Rampion 2. Details are provided in **Table 6-8**.
(Paragraph 2.6.194 of NPS EN-3). The assessment should include predictions of the physical effect that will result from the construction and operation of the required infrastructure and include effects such as the scouring that may result from the proposed development.	The assessment of the effects that will result from the construction and operation are assessed in **Section 6.9** and **Section 6.10**. More detailed supporting assessments are provided in **Appendix 6.3, Volume 4.** A scour assessment is presented in **Appendix 6.3, Volume 4**, **Section 6**. Results are summarised in **paragraphs 6.10.36** to **6.10.42**.

Policy description	Relevance to assessment
(Paragraph 2.6.197 of NPS EN-3). Mitigation measures which the Secretary of State should expect the applicants to have considered include the burying of cables to a necessary depth and using scour protection techniques around offshore structures to prevent scour effects around them. Applicants should consult the statutory consultees on appropriate mitigation.	The embedded environmental measures relating to cable burial and scour are set out in **Chapter 3: Alternatives**, and in **Table 6-10** of this chapter.

Local planning policy

6.2.4 **Table 6-2** lists the local planning policy relevant to the assessment of the effects on coastal processes receptors.

Table 6-2 Local planning policy relevant to coastal processes

Policy description	Relevance to assessment
South Inshore and South Offshore Marine Plan (July 2018)	
(Policy 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.	Cables will be buried where possible and cable protection will be applied as and where appropriate according to the cable burial design plan. Indicative design options for cable burial and protection are set out in **Chapter 4: The proposed development**.
(Policy S-CAB-2) Proposals that have a significant adverse impact on new and existing landfall sites for subsea cables (telecoms, power and interconnectors) should demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts, d) if it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.	Indicative design options for cable landfall are set out in **Chapter 4: The proposed development**.

Policy description	Relevance to assessment
(Policy S-CC-2) Proposals should demonstrate for the lifetime of the proposal that: 1) they are resilient to the effects of climate change 2) they will not have a significant adverse impact upon climate change adaptation measures elsewhere. In respect of 2) proposals should demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate the significant adverse impacts upon these climate change adaptation measures.	Indicative design options for cable landfall are set out in **Chapter 4: The proposed development**. Baseline conditions are described in detail within **Appendix 6.1**, Volume 4 and include for the potential effects of climate change**.**
(Policy S-CC-3) Proposals in the south marine plan area and adjacent marine plan areas that are likely to have a significant adverse impact on coastal change should not be supported.	Potential impacts on the coastline in the south marine plan area are described in **Section 6.9** (construction), **Section 6.10** (operation and maintenance) and **Section 6.11** (decommissioning)**. Section 6.12** assesses the potential cumulative effects.
Policy (S-WQ-1) Proposals that may have significant adverse impacts upon water environment, including upon habitats and species that can be of benefit to water quality must demonstrate that they will, in order of preference: a) avoid, b) minimise, c) mitigate significant adverse impacts.	Changes in SSC are assessed in **paragraphs 6.9.1** to **6.9.32** for the construction phase and **paragraphs 6.11.1** to **6.11.8** for the decommissioning phase. Potential impacts on the water environment are discussed in **Chapter 28: Water environment**.
Arun Local Plan 2011-2031 (Adopted July 2018)	
Section 18.5.8 highlights the importance of vegetated shingle habitat and that "*new development should take into consideration impacts on vegetated shingle to ensure that it does not exacerbate the situation [of 'coastal squeeze' caused by urban development on the landward side and rising sea levels on the seaward side].*" (Policy W DM4). In particular "*proposals for development in coastal locations, including for example, sea defence works, will be permitted providing they protect and enhance coastal habitats such as vegetated shingle. Where habitats are lost through the provision of*	Potential pathways of impact on vegetated shingle habitats are described in **paragraphs 6.9.45** to **6.9.79** (for the construction phase), **paragraphs 6.10.19** to **6.10.35** (for the operation phase), and **paragraphs 6.11.9** to **6.11.16** (for the decommissioning phase). Potential impacts on vegetated shingle habitats are discussed in **Chapter 23: Terrestrial ecology and nature conservation.**

Policy description	Relevance to assessment
sea defence works, replacement habitats must be provided in a suitable location".	

Other relevant information and guidance

6.2.5 The following information and guidance relevant to the coastal processes assessment has also been considered along with knowledge gained from Rampion 1:

- Environmental impact assessment for offshore renewable energy projects. (BSI, 2015);
- review of environmental data associated with post-consent monitoring of licence conditions of offshore wind farms.' MMO Project No: 1031. (Fugro-Emu, 2014);
- general advice on assessing potential impacts of and mitigation for human activities on Marine Conservation Zone (MCZ) features, using existing regulation and legislation (JNCC and Natural England, 2011);
- guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects. (Cefas, 2011);
- Coastal Process Modelling for Offshore Wind farm Environmental Impact Assessment: Best Practice Guide. ABPmer and HR Wallingford for COWRIE, 2009, [http://www.offshorewindfarms.co.uk];
- Advice Note Nine: Using the Rochdale Envelope' (The Planning Inspectorate (PINS), 2012);
- guidelines in the use of metocean data through the lifecycle of a marine renewables development' (ABPmer et al., 2008);
- review of Cabling Techniques and Environmental Effects applicable to the Offshore Wind farm Industry. Department for Business Enterprise and Regulatory Reform in association with Defra. (BERR, 2008); and
- potential effects of offshore wind developments on coastal processes. (ABPmer and METOC, 2002).

6.3 Consultation and engagement

Overview

6.3.1 This section describes the outcome of, and response to, the Scoping Opinion in relation to coastal processes assessment. An overview of engagement undertaken can be found in **Section 1.5** of **Chapter 1: Introduction**.

6.3.2 Given the restrictions which have been in place due to the COVID-19 pandemic during this period, all consultation has taken the form of conference calls using online video conferencing software.

Scoping opinion

6.3.3 Rampion Extension Development Limited (RED) submitted a Scoping Report (RED, 2020) and request for a Scoping Opinion to the Secretary of State (administered by PINS) on 2 July 2020. A Scoping Opinion was received on 11 August 2020. The Scoping Report set out the proposed coastal processes assessment methodologies, outline of the baseline data collected to date and proposed, and the scope of the assessment. **Table 6-3** sets out the comments received in Section 4 of the PINS Scoping Opinion 'Aspect based scoping tables – Offshore' and how these have been addressed in this PEIR. A full list of the PINS Scoping Opinion comments and responses is provided in **Appendix 5.1: Response to the Scoping Opinion**. Regard has also been given to other stakeholder comments that were received in relation to the Scoping Report.

6.3.4 The information provided in the PEIR is preliminary and therefore not all the Scoping Opinion comments have been able to be addressed at this stage, however all comments will be addressed within the ES.

Table 6-3 PINS Scoping Opinion responses – coastal processes

PINS ID number	Scoping Opinion comment	How this is addressed in this PEIR
4.1.2	The Scoping Report states that the potential impact of the potential impact of the design of the Proposed Development will be assessed "*both alone and in conjunction with the built design of the existing Rampion project". It is* unclear why the Proposed Development would be assessed alone given that Rampion 1 is now entirely completed. The ES should assess the impacts of the Proposed Development in the context of the relevant baseline environment.	Potential changes to waves and currents caused by maximum design scenario (MDS) foundations in Rampion 2 are assessed in **paragraphs 6.10.10** to **6.10.16** against a baseline environmental condition that includes the number, type, dimensions and locations of foundations built in Rampion 1.
4.1.3	The Scoping Report states that the assessment for Rampion 1 was overly conservative and overestimated the number of structures built, yet it asserts that the results of the previous modelling remain valid and can reliably support the ES for the Proposed Development. The ES should ensure that potential changes to the wave and hydrodynamic regime are assessed against an accurately described baseline so as not to	Potential changes to waves caused by MDS foundations in Rampion 2 are assessed in **paragraphs 6.10.10** to **6.10.18** using a new numerical model which includes Rampion 1 in the baseline. Potential changes to currents caused by MDS foundations in Rampion 2 are assessed in **paragraphs 6.10.1** to **6.10.9** using a desktop assessment that uses previous conservative modelling

PINS ID number	Scoping Opinion comment	How this is addressed in this PEIR
	underestimate the scale and significance of effects.	results (based on a greater total number of larger foundations) to realistically account for the maximum likely effect of the smaller number, type, dimensions and locations of foundations subsequently built in Rampion 1.
4.1.4	The Scoping Report does not address impacts on tidal, wave and sediment transport regime to seabed scour during construction and decommissioning of the Proposed Development. The ES should include as assessment of the impacts associated with changes to tidal, wave and sediment transport regime and seabed scour where significant effects are likely to occur. The Applicant should make effort to agree the approach with relevant consultation bodies including NE and the MMO.	Potential changes to waves, currents and sediment transport, and scour caused by all MDS infrastructure (foundations and cable protection) in Rampion 2 during the operation and maintenance phase is assessed in **paragraphs 6.10.36** to **6.10.42**. Potential changes of similar or lesser magnitude and extent caused by any less than all MDS infrastructure during the construction and decommissioning phases are separately assessed in **paragraphs 6.9.80** to **6.9.84**, and in **paragraphs 6.11.17** to **6.11.22**, respectively (using the same MDS as for all infrastructure present). A number of Expert Topic Group meetings, described in **paragraph 6.3.5**, were held to discuss and agree the approach with relevant consultation bodies including NE, Cefas and the MMO.
4.1.5	SSSIs along the coastline have not been listed as sensitive receptors in this regard. The ES should present a full list of designated sites that have the potential to be impacted in terms of coastal processes, including any effects on Climping Beach SSSI (in relation to changes to landfall morphology) and Beachy Head East MCZ and the Bembridge MCZ.	A full list of designated sites that have the potential to be impacted in terms of coastal processes is provided in **Table 6-4**.
4.1.6	The Scoping Report does not address the likelihood of the	Potential cumulative changes and impacts on the sediment transport

PINS ID number	Scoping Opinion comment	How this is addressed in this PEIR
	potential impacts to the sediment transport regime to act cumulatively with other developments and/or infrastructure (including the Aquind interconnector). The ES should include an assessment of the cumulative impacts on the sediment transport regime where significant effects are likely to occur.	regime are assessed in **Section 6.12** including the Aquind interconnector.

Evidence Plan Process (EPP)

6.3.5 The EPP has been set up to provide a formal, non-legally binding, independently chaired forum to agree the scope of the EIA and HRA, and the evidence required to support the DCO Application. For coastal processes, formal updates on progress in relation to coastal processes were provided to stakeholders during two Expert Technical Group (ETG) Meetings for Physical Processes (including water quality), Benthic Ecology and Fish Ecology. Meetings were held on 17 September 2020 and 24 March 2021. Of relevance to coastal processes, stakeholder attendees included representatives from the Marine Management Organisation, Cefas, Natural England and the Environment Agency.

6.3.6 During the meetings, presentations were made in relation to coastal processes to describe the spatial scope of the coastal processes assessment, the data being collected and used to inform the assessments, the potential impact types to be assessed, the methods to be used for each assessment, and the scope of the new wave modelling. As recorded in the minutes of those meetings, the questions and answers show general agreement in the proposed approaches.

Informal consultation and engagement

6.3.7 Informal consultation has been ongoing with a number of prescribed and non-prescribed consultation bodies and local authorities in relation to the wider project, including aspects of coastal processes.

6.3.8 RED carried out an Informal Consultation exercise for a period of four weeks from 14 January 2021 to 11 February 2021. This Informal Consultation exercise aimed to engage with a range of stakeholders including the prescribed and non-prescribed consultation bodies, local authorities, Parish Councils and general public with a view to introducing the Proposed Development and seeking early feedback on the emerging designs.

6.4 Scope of the assessment

Overview

6.4.1 This section sets out the scope of the PEIR assessment for coastal processes. The scope has been developed as the Rampion 2 design has evolved and responds to feedback received to date as set out in **Section 6.3**. As outlined in the PINS Advice Note Seven: Environmental Impact Assessment: Process, Preliminary Environmental Information and Environmental Statements (Version 7, PINS, 2020, information presented in the PEIR is preliminary, therefore this scope will be reviewed and may be refined as Rampion 2 evolves and as a result of ongoing consultation.

Spatial scope and study area

6.4.2 The spatial scope of the coastal processes assessment is the PEIR Boundary together with the Zone of Influence (ZOI) as illustrated in **Figure 6.1, Volume 3.** The spatial scope has been derived from combining the following:

- the spatial extent of potential impact on waves at adjacent coastlines between Beachy Head and Selsey Bill; and
- the likely extent of potential sediment plume impacts described by the tidal excursion buffer. The tidal excursion describes the greatest distance and direction that water carrying an impact may travel during one mean spring tide, from any part of the Scoping Boundary.

Temporal scope

6.4.3 The temporal scope of the assessment of coastal processes is the entire lifetime of Rampion 2, which therefore covers the construction, operation and maintenance and decommissioning periods.

Potential receptors

6.4.4 The spatial and temporal scope of the assessment enables the identification of receptors which may experience a change as a result of Rampion 2.

6.4.5 Whilst coastal processes can largely be considered as pathways, a number of features have been identified as potentially sensitive coastal processes receptors. The receptors identified that may experience likely significant effects for coastal processes are outlined in **Table 6-4** with locations shown in **Figure 6.1** and **Figure 6.2, Volume 3**.

Table 6-4 Receptors requiring assessment for coastal processes

Receptor group	Receptors included within group
Nationally or internationally designated sites	The following nature conservation designations include geological and

Receptor group	Receptors included within group
	geomorphological features within the spatial scope of the EIA: Solent and Dorset Coast SPA, Selsey Bill and the Hounds MCZ, Offshore Overfalls MCZ, Kingmere MCZ, Selsey East Beach SSSI, Bognor Reef SSSI, Felpham SSSI, Climping Beach SSSI, Brighton to Newhaven Cliffs SSSI, Seaford to Beachy Head SSSI
Local coastline morphology	Coastal morphology in the landfall area at Climping
Regional coastline morphology	Coastlines between Selsey Bill and Beachy Head
Nearby offshore sandbanks	Important geomorphological features including East Bank and Outer Owers Bank
Recreational surfing wave resource	Surfing venues on coastlines between Selsey Bill and Beachy Head[1]

[1] Identified using Magicseaweed surf beach spot guide (https://magicseaweed.com/)

6.4.6 The list of receptors will be kept under review during the EIA as more detailed information is obtained during baseline surveys and other forms of data collection by other aspects and will be reflected in the final ES.

Potential effects

6.4.7 For the most part coastal processes are not in themselves receptors but are instead 'pathways'. However, changes to coastal processes have the potential to indirectly impact other environmental receptors (Lambkin *et al*., 2009). For instance, the creation of sediment plumes (which is considered in the coastal processes assessment) may lead to settling of material onto benthic habitats. The potential significance of this change is assessed in **Chapter 9: Benthic subtidal and intertidal ecology**.

6.4.8 Potential effects on coastal processes pathways and receptors that have been scoped in for assessment are summarised in **Table 6-5**.

Table 6-5 Potential effects on costal processes receptors scoped in for further assessment

Receptor	Activity or impact	Potential effect
Construction phase		

Receptor	Activity or impact	Potential effect
Water column and seabed environment.	Changes in suspended sediment concentrations (SSC) and deposition of disturbed sediments to the seabed due to drilling for foundation installation.	Potential pathway of effect for other aspects.
Water column and seabed environment.	Changes in SSC and deposition of disturbed sediments to the seabed due to dredging for seabed preparation prior to installing jacket foundations.	Potential pathway of effect for other aspects.
Water column and seabed environment.	Increases in SSC and deposition of disturbed sediments to the seabed due to cable installation.	Potential pathway of effect for other aspects.
Water column and seabed environment.	Increases in SSC and deposition of sediment to the seabed due to HDD drilling fluid release.	Potential pathway of effect for other aspects.
Nationally or internationally designated sites Local coastal morphology at the Climping landfall.	Changes to landfall morphology due to installation of export cable at the landfall.	Morphological change.
Nationally or internationally designated sites Regional coastline morphology Nearby offshore sandbanks Recreational surfing venues	Changes to the tidal, wave, sediment transport regimes and seabed scour as a result of the presence of less than all windfarm infrastructure.	Morphological change. Change in the wave regime at surfing venues. Potential pathway of effect for other aspects.
Operation and maintenance phase		

Receptor	Activity or impact	Potential effect
Water column and seabed environment.	Changes to the tidal regime due to presence of windfarm infrastructure.	Potential pathway of effect for other aspects.
Recreational surfing venues	Changes to the wave regime (presence of wind farm infrastructure).	Change in the wave regime at surfing venues. Potential pathway of effect for other aspects.
Nationally or internationally designated sites Regional coastline morphology Nearby offshore sandbanks	Changes to the sediment transport regime due to presence of wind farm infrastructure.	Morphological change. Potential pathway of effect for other aspects.
Water column and seabed environment.	Seabed scour due to the presence of windfarm infrastructure.	Potential pathway of effect for other aspects.
Decommissioning phase		
Water column and seabed environment.	Changes to SSC, bed levels and sediment type due to removal of foundations.	Potential pathway of effect for other aspects.
Nationally or internationally designated sites Local coastal morphology at the Climping landfall.	Changes to landfall morphology due to removal of export cable at the landfall.	Potential pathway of effect for other aspects.
Nationally or internationally designated sites Regional coastline morphology Nearby offshore sandbanks Recreational surfing venues	Changes to the tidal, wave, sediment transport regimes and seabed scour due to removal/presence of less than all windfarm infrastructure.	Morphological change. Change in the wave regime at surfing venues. Potential pathway of effect for other aspects Potential pathway of effect for other aspects.

Activities or impacts scoped out of assessment

6.4.9 All likely significant effects identified will be considered at further stages of the assessment as more detail regarding the design becomes available and greater levels of baseline data are collected and analysed. No matters or aspects are being scoped out at this stage. This is mainly due to the potential for pathway changes to coastal processes to impact on other aspect receptors and the requirement for informing those assessments.

Table 6-6 Activities or impacts scoped out of assessment

Activity or impact	Rationale for scoping out
No activities have been scoped out of the assessment.	Potential for pathway changes to impact other aspect receptors and the requirement for informing those assessments.

6.5 Methodology for baseline data gathering

Overview

6.5.1 Baseline data collection has been undertaken to obtain information over the study areas described in **Section 6.4**. This section sets out the data currently available information from the study area/s. Using these data, the baseline environmental conditions in the ZOI are summarised and presented in **Section 6.6.**

Desk study

6.5.2 The data sources that have been collected and used to inform the coastal processes assessment are summarised in **Table 6-7**.

Table 6-7 Data sources used to inform the coastal processes PEIR assessment

Source	Date	Summary	Coverage of study area
Navigation Charts (UKHO)	Accessed March 2021	Description of bathymetry and general seabed type at a regional scale.	Full coverage of the study area.
UK Atlas of Marine Renewable Energy	Accessed March 2021	Mapped summary statistics for wind and wave climate and tidal regime (available online www.renewables-atlas.info/).	Full coverage of the study area.
ABPmer SEASTATES Wave	Accessed March 2021	Hindcast database of wave height, period and direction (~40 years, 1979 to near present) approximately 5km resolution (for	Full coverage of the study area.

Source	Date	Summary	Coverage of study area
Hindcast Database		more information see www.seastates.net/downloads/).	
ABPmer SEASTATES Tide and Surge Hindcast Database	Accessed March 2021	Hindcast database of water levels, current speed and direction (~40 years, 1979 to near present) approximately 2km resolution (for more information see www.seastates.net/downloads/).	Full coverage of the study area.
NOAA Climate Forecast System Reanalysis (CFSR)	Accessed March 2021	Hindcast database of wind speed and direction (~40 years, 1979 to near present) approximately 2km resolution (available online rda.ucar.edu/datasets/ds093.1/).	Full coverage of the study area.
Rustington Wave Buoy (Channel Coastal Observatory)	Accessed March 2021	Observations of wave height, period and direction (~10 years used, January 2010 to near present) (available online www.channelcoast.org/).	Point location 4nm SSE of Littlehampton Harbour, inside the study area.
Geophysical survey of Zone 6 (Osiris Projects Ltd)	2010 to 2011	High resolution geophysical survey of the Round 3 Zone 6 area, including the present extent of Rampion 1 and parts of the Rampion 2 Scoping Boundary.	Partial coverage of the study area.
Geotechnical survey of Zone 6 (Fugro Geoconsulting Ltd)	2011	Geotechnical survey of the Round 3 Zone 6 area, including the present extent of Rampion 1 and parts of the Rampion 2 Scoping Boundary.	Partial coverage of the study area.
Metocean survey (EMU Ltd)	2011	Measurements of water levels, currents and waves at three locations (2 over a period of 3 months and 1 for 6 months) in the Round 3 Zone 6 area, including the present extent of Rampion 1 and parts of the Rampion 2 Scoping Boundary.	Partial coverage of the study area.
Benthic Survey (EMU Ltd)	2011	Benthic survey including sediment grab samples at 59 locations in the Round 3 Zone 6 area,	Partial coverage of

Source	Date	Summary	Coverage of study area
		including the present extent of Rampion 1 and parts of the Rampion 2 Scoping Boundary.	the study area.
Environment Agency	2017	Regional Beach Management Plan 2017: Selsey Bill to Climping	Partial coverage of the study area.

Site surveys

6.5.3 Additional site-specific survey data sources that have been collected and used to inform the coastal processes assessment are summarised in **Table 6-8**.

Table 6-8 Site surveys undertaken

Survey type	Scope of survey	Coverage of study area	Survey status
Geophysical and geotechnical survey of Rampion 2	High resolution bathymetry, side scan sonar and sub-bottom geophysical data collection.	Full coverage of the PEIR boundary offshore array area and export cable corridor	Complete
Benthic survey of Rampion 2	Including collection of seabed sediment samples and characterisation of sediment grain size distribution	Full (discrete) coverage of the PEIR boundary offshore array area and export cable corridor	Complete

Data limitations

6.5.4 There are no specific data limitations relating to coastal processes that affect the robustness of the assessment of this PEIR.

6.6 Baseline conditions

Overview

6.6.1 The baseline physical environment within the ZOI is described in detail in **Appendix 6.1, Volume 4**. This section provides a summary of that information for the current (recent historical and present day) timeframe, and for a future period including the operational lifetime of Rampion 2 (a minimum of approximately 30 years). The baseline conditions describe the relevant conditions and ranges of variability for aspects of the physical environment that are relevant to the assessment of potential effects in the array, export cable corridor, landfall and surrounding areas, within the wider ZOI. This characterisation of the receiving environment is presented as the baseline against which potential changes or impacts arising from the Proposed Development can be assessed.

6.6.2 The baseline description has been achieved through the combined analysis of the project specific survey data, information previously collected to inform the construction and operation of the adjacent Rampion 1, as well as data collected as part of regional coastal monitoring programmes, listed in **Section 6.6**.

6.6.3 It is noted that many of the datasets used to inform the baseline were collected all or in part during and after the construction of Rampion 1 and therefore any localised changes associated with the operation of Rampion 1 are also captured within the baseline for Rampion 2. Longer term statistics will include periods of data from before, during and after the construction of Rampion 1.

6.6.4 The conclusions of the assessment of changes to currents and waves (**paragraphs 6.10.1** to **6.10.8** and **paragraphs 6.10.10** to **6.10.16**, respectively) show that Rampion 1 causes only very small absolute or relative changes to these parameters, in a limited spatial extent mainly downstream or downwind of the individual foundations. The regional baseline description in this section is therefore equally valid in the presence or absence of Rampion 1 (i.e. the periods of time pre-, during- and post-construction). A summary of key findings is set out below.

6.6.5 A technical report and Environmental Statement (ES) chapter were produced for the area of the Rampion 1 array (E.ON Climate & Renewables, 2012). A review of the key data and findings from that study has been incorporated into the description of the existing baseline environment.

Current baseline

Hydrodynamic regime

6.6.6 A summary of key findings of the baseline hydrodynamic regime is as follows.

- The array and export cable corridor are situated within a macro-tidal setting, with the mean spring tidal range increasing gradually from 4m at the western boundary of the study area (around Selsey Bill), to 6.5m at the eastern boundary (around Beachy Head).
- Storm surges may cause short term modification to predicted water levels and under an extreme (1:50 year return period) storm surge, water levels at the landfall are expected to reach 3.76m ODN, approximately 1m above mean high water springs.
- The tidal currents within the study area are generally energetic with peak spring current speeds between 0.75 and 1.1m/s in the offshore array areas, reducing gradually from 0.9m/s at the offshore end of the export cable corridor to 0.5m/s at the landfall. There is a general southwest to northeast reduction in current speeds and from offshore to onshore generally.

- The flood tide (to the east-northeast) is marginally stronger than the ebb tide (to the west-southwest) and this leads to a general net residual flow to the northeast, especially on spring tides.
- The wave regime in the English Channel is the outcome of locally generated wind waves and swell waves. Analysis of long-term wave records from the study area show that the most frequent wave direction is from the southwest to south-southwest, with waves occurring from this direction approximately 60 percent of the time.
- Extremes analysis of available long-term wave hindcast data shows a clear increase in wave height with distance offshore. Within the array, significant wave heights associated with a 1:2 year return period event are expected to be approximately 4.8m, whereas for the 1:10 year event this value increases to approximately 5.3m.

Morphological regime

6.6.7 A summary of key findings of the baseline morphological regime is as follows.

- Water depths across the array area vary from approximately 13mLAT (on a rocky outcrop in the northwest of the site) to 65mLAT (within a broad depression) in the southeast on the array. Sandwaves are prevalent over much of the central and eastern array area, trending northwest to southeast, with wave heights of up to 2m relative to the surrounding seabed.
- The seabed undulates across much of the export cable corridor, influenced by the underlying geology. Water depths within the export cable corridor are greatest at the southern end where they reach 28mLAT within a significant seabed depression. Megaripples are present towards the southern end of the export cable corridor with heights of 0.2m and wavelengths reaching 7m.
- The sandwaves and megaripples mapped within the array and export cable corridor have axes broadly aligned perpendicular to the direction of flow. Given known relationships between sediment availability, flow speeds and bedform development, it is expected that these bedforms are active. This has been confirmed to be the case through a comparison in the area of partial overlap between the 2020 survey of the PEIR boundary array area and the earlier Rampion Zone survey (undertaken in 2010).
- The asymmetry of the sandwaves along with the easterly displacement of the features between the 2010 and 2020 bathymetric surveys points to a general easterly direction for sediment transport. This is entirely consistent with known sediment transport pathways across the wider study area.
- The Rampion 2 landfall is located at Climping. The beach frontage here consists of mixed sand and shingle sediment with a 1:7.5 slope to the sand foreshore and sediment transport in an easterly direction. A failed seawall and groynes are also present. The Southeast Regional Coastal Monitoring Programme (Channel Coastal Observatory, 2021) shows that the central and western part of the landfall frontage has experienced long-term erosion (in the period 2007 to 2020), mainly at the back of the beach, in the order of up to 2m. the eastern part of the landfall frontage has conversely experienced long-term accretion in the same period, mainly in the lower beach and intertidal area.

- The landfall at Climping is located within Shoreline Management Plan (SMP) Policy Unit 4D20 (Littlehampton to Poole Place) with the Environment Agency being responsible for coastal management along this section of coastline. The original SMP policy was for ‘Managed Realignment’ but this has now evolved to ‘Withdraw Management’ and more recently, ‘Do Minimum’. There is currently ongoing discussion regarding the most appropriate management policy for this stretch of coast.

Sedimentary regime

6.6.8 A summary of key findings of the baseline sedimentary regime is as follows.

- The seabed across the array and export cable corridor is dominated by the presence of coarse-grained sediments (sands and gravels) with outcropping bedrock in places. Holocene deposits are widespread across central and eastern areas of the Rampion 2 array area whereas in western areas hard substrate is at or close to the surface in most areas. Bedrock is found throughout the seafloor within the export cable corridor, except when cut through by palaeochannel systems.
- Sediments across the Rampion 2 array and export cable corridor are characteristics of two very different depositional environments. The Holocene seabed sediments generally consist of sand, gravelly sand and sandy gravel and have been reworked and deposited by marine processes. The sediments associated with the palaeochannels are also sands and gravels but have a fluvial origin, deposited in a terrestrial setting.
- The available evidence suggests that net sediment transport as bedload is directed east-northeast towards the eastern English Channel. In the offshore environment, tidal currents are the primary agent for mobilising sediment through bedload and suspended load transport. Wave action during larger storms will occasionally increase the rate of transport, but is not a primary factor in the patterns of transport in offshore areas.
- Within the array area, suspended sediment concentrations (SSC) are typically between 5 to 10mg/l. However, during stormier conditions, near bed SSC can be temporarily much higher (order of hundreds of mg/l) due to the influence of waves stirring of the seabed. Coarser sediments disturbed by waves may be transported a short distance in the direction of ambient currents or down-slope under gravity before being deposited. Finer material that persists in suspension will eventually be transported in the direction of net tidal residual flow, that is, to the east-northeast.

Future baseline

6.6.9 The baseline is expected to evolve in response to natural variation (for example, lunar nodal cycle, North Atlantic Oscillation etc), wider changes in climate expected over the lifetime of the development, and anthropogenic management of the coast. These are discussed below.

- Mean sea level in the PEIR Assessment Boundary is likely to rise slightly over the lifetime of the wind farm (expected approximately 30-year minimum operational period). This change is generally accepted to include contributions from global eustatic changes in mean sea level and as a result of regionally varying vertical (isostatic) adjustments of the land.

- Information on the rate and magnitude of anticipated relative sea level change in the English Channel during the 21st Century is available from UKCP18 (Palmer *et al*. 2018). It is predicted that by 2060, relative sea level could have risen by approximately 0.35 to 0.4m above present day (2021) levels (Representative Concentration Pathway (RCP) 8.5; 95th percentile) at the landfall with rates of change increasing over time.
- A rise in sea level would potentially allow larger waves, and therefore more wave energy, to reach the coast in certain conditions and consequently result in an increase in local rates or patterns of erosion and the equilibrium position of coastal features. Sea level rise may also result in a loss of intertidal habitat through the process of 'coastal squeeze' caused by the presence of coastal defences preventing natural roll back of the coast.
- UKCP18 also includes projections of changes to storm surge magnitude in the future as a result of climate change. However, it is found that UKCP18 projections of change in extreme coastal water levels are dominated by the increases in mean sea level with only a minor (less than ten percent) additional contribution due to atmospheric storminess changes over the 21st century (Palmer *et al*. 2018).
- Modification of the wave regime may also occur in response to changing patterns of atmospheric circulation, although this is associated with much uncertainty (Palmer *et al*., 2018).
- There is currently ongoing discussion regarding the most appropriate management policy for the stretch of coast at the landfall. Should the coastline no longer be defended going forward, it is reasonable to assume the morphology of the coast could change quiet substantially here over the lifetime of the Proposed Development.

6.7 Basis for PEIR assessment

Maximum design scenario

6.7.1 Assessing using a parameter-based design envelope approach means that the assessment considers a maximum design scenario (MDS) whilst allowing the flexibility to make improvements in the future in ways that cannot be predicted at the time of submission of the DCO Application. The assessment of the maximum adverse scenario for each receptor establishes the maximum potential adverse impact and as a result impacts of greater adverse significance would not arise should any other development scenario (as described in **Chapter 4: The Proposed Development**) to that assessed within this Chapter be taken forward in the final scheme design.

6.7.2 The maximum assessment assumptions that have been identified to be relevant to coastal processes are outlined in **Table 6-9** below and are in line with the Project Design Envelope (**Chapter 4**).

Table 6-9 Maximum assessment assumptions for impacts on coastal processes

Project phase and activity/impact	Maximum assessment assumptions	Justification
Construction: Changes in suspended sediment concentrations (SSC) and deposition of disturbed sediments to the seabed due to drilling for foundation installation	Maximum % of locations using drilling: 50% Maximum number of larger turbine type wind turbine generator (WTG) foundations requiring drilling: 50% of 75 = 38. Assumed representative drilling rate: 5m/hr Maximum volume of sediment released per WTG foundation: 8,588m^3 (based on larger turbine type WTG; drilling to 60m with drill diameter of 13.5m) Maximum volume of sediment released in the array from WTG foundations: 326,344m^3 (based on array comprising 38 x larger turbine type WTGs; drilling to 60m with drill diameter of 13.5m)	MDS represents the greatest likely local and total volume, and local rate of sediment disturbed by drilling and released into suspension in the water column. Other details and justification for the MDS is set out in **Appendix 6.3, Volume 4.**
Construction: Changes in SSC and deposition of disturbed sediments to the seabed due to dredging for seabed preparation prior to installing jacket foundations	**Seabed preparation** Maximum number of smaller turbine type WTG foundations requiring seabed preparation: 116 Total dredge/ disposal volume of 417,600m^3 (for WTG foundation bed preparation; 1m seabed preparation; seabed preparation area of 60 x 60m) Maximum number of Offshore Substation (OSS)	MDS represents the greatest likely local and total volume, and local rate of sediment disturbed by dredging (and associated spoil disposal) and released into suspension in the water column. Other details and justification for the MDS is set out in **Appendix 6.3, Volume 4.**

Project phase and activity/impact	Maximum assessment assumptions	Justification
	foundations requiring seabed preparation: 3 Total dredge/ disposal volume of 19,500m^3 (for OSS foundation bed preparation; 1 m seabed preparation; seabed preparation area of 100 x 60m). **Dredge spoil disposal** Disposal technique: carried out using a representative Trailing Suction Hopper Dredger (THSD) (11,000m^3 hopper capacity with split bottom for spoil disposal). Multiple dredgers to be working simultaneously. Disposal location: 'close' to the installation works. Maximum volume of sediment released in the array from WTG and OSS foundations: 437,100m^3 (foundation details as above for seabed preparation).	
Construction: Increases in SSC and deposition of disturbed sediments to the seabed due to cable installation	**Pre-lay trenching** 4 export cables x 19km in offshore cable corridor 2 interconnector cables x 25km in offshore array area Total length of all inter-array cables: 250km in offshore array area Trench up to 2 m wide with a 'U' shaped profile.	MDS represents the greatest likely local and total volume, and local rate of sediment disturbed by cable installation and released into suspension in the water column. Jetting and mass flow excavators are considered to have the greatest (similar) potential to cause energetic resuspension of sediment at the seabed, at a rate described by the

Project phase and activity/impact	Maximum assessment assumptions	Justification
	1.5 m deep in the export cable corridor. 1.0m deep in the offshore array area. Maximum rate of cable burial: 300m/hr Burial technique: Jetting or Mass Flow Excavator (MFE)	trench dimensions and rate of cable burial. Other details and justification for the MDS is set out in **Appendix 6.3, Volume 4.**
Construction: Increases in SSC and deposition of sediment to the seabed due to HDD drilling fluid release	**HDD drilling fluid release** Maximum number of cables and bores: 4 Punch-out location for HDD: intertidal Maximum conduit dimensions: 0.63m diameter; 1000m length, 312m^3 volume Drilling fluid concentration: 80kg/m^3 bentonite in water, approximate SSC 80,000mg/L Maximum volume and mass of drilling fluid released per HDD conduit: 312m^3 fluid (24,960kg bentonite) Maximum volume and mass of drilling fluid released for all four HDD conduits: 1,248m^3 fluid (99,840kg bentonite)	MDS represents the maximum volume of drilling fluid released is conservatively estimated as the total volume of the installed conduit. In practice, only a smaller proportion of the total volume might be expelled or lost from the conduit following breakout.
Construction: Changes to landfall morphology due to installation of export cable at the landfall	Maximum number of cables: 4 **Trenching in mainly nearshore subtidal areas, possibly into the lower intertidal area**	MDS represents the construction activities that give rise to the greatest (direct) disturbance to the beach and provide the greatest potential to interact with coastal processes

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Burial technique: plough and or manual excavation Trench depth: 1.5m Trench width at base: 2m **Drilling and associated works** Horizontal Directional Drilling (HDD) or alternative trenching techniques Punch-out location for HDD: intertidal Four HDD exit pits; 30 m long x 4 m wide x (up to) 1.5 m deep 16 Temporary Floatation Pits (TFPs); 4 pits (1 per cable) 160m long x 45m wide x (up to) 3m deep; 12 pits (3 per cable) 100m long x 40m wide x (up to) 2.5, 2 and 1.5m deep, respectively; Duration trenches, exit pits and TFPs may remain open: up to four months	responsible for maintaining the baseline form and function of the beach.
Construction: Changes to the tidal, wave, sediment transport regimes and seabed scour as a result of the presence of less than all windfarm infrastructure	MDS for Rampion 2 operation phase (as defined below)	The MDS for any partial proportion of the total amount of infrastructure, is the same as the total amount present in the operation phase.
Operation and Maintenance: Changes to the tidal regime due to presence of windfarm infrastructure	**Foundations** Array comprising the largest number (116) smaller turbine type WTGs (jacket foundations, four legs, 3m diameter; with suction	Combination of foundation type, dimensions and number that present the greatest total blockage width to currents and waves.

Project phase and activity/impact	Maximum assessment assumptions	Justification
Operation and Maintenance: Changes to the wave regime (presence of wind farm infrastructure) **Operation and Maintenance: Seabed scour due to the presence of windfarm infrastructure**	buckets, 15m diameter, up to 10m high) and three OSSs (jacket foundations, six legs, 3.5m diameter; with pin piles). Scour protection up to 3m high at the foundation, extending to 15m beyond the footprint of the foundation. Minimum foundation spacing of 860m (centre to centre for smaller turbine type WTGs). Project operational lifespan: approximately 30 years (but noting some blockage will also occur during the construction and decommissioning period, each lasting up to three years) **Cable protection** Options include rock placement, concrete mattresses, flow energy dissipation devices, protective aprons and bagged solutions Sloped profile above seabed level: 5m overall width and 1m height Total length of cables which may potentially require seabed protection: 20% of route Up to four array cable crossings (with the Aquind Interconnector in the western array area of the PEIR Assessment	Cable protection type, dimensions and length presenting the greatest total blockage to currents, waves and sediment transport. The worst case effect for the different types of protection is mainly considered in relation to the overall dimensions of the structure; a worst case surface shape and texture, resulting in maximum blockage to flow and sediments within the dimensions of the structure, is also considered. Longest duration of presence in operational service.

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Boundary). 50x50m overall width/length and 1m height.	
Decommissioning: Changes to SSC, bed levels and sediment type due to removal of foundations	MDS for Rampion 2 construction phase (as previously defined)	Activities associated with the removal of infrastructure during decommissioning will be similar to, or cause less disturbance than, those used during construction.
Decommissioning: Changes to landfall morphology due to removal of export cable at the landfall	MDS for Rampion 2 construction phase (as previously defined)	Activities associated with the removal of infrastructure during decommissioning will be similar to, or cause less disturbance than, those used during construction.
Decommissioning: Changes to the tidal, wave, sediment transport regimes and seabed scour due to removal/presence of less than all windfarm infrastructure	MDS for Rampion 2 operation phase (as previously defined)	The changes or effects associated with the removal, or the ongoing presence of some or all infrastructure during and after decommissioning will be no more than the changes caused by all infrastructure during the operation phase, relative to the baseline condition.

Embedded environmental measures

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

6.7.4 These measures typically include those that have been identified as good or standard practice and include actions that would be undertaken to meet existing legislation requirements. As there is a commitment to implementing these embedded environmental measures, and also to various standard sectoral practices and procedures, they are considered inherently part of the design and are set out in this PEIR.

6.7.5 **Table 6-10** sets out the relevant embedded environmental measures within the design and how these affect the coastal processes assessment.

Table 6-10 Relevant coastal processes embedded environmental measures

ID	Environmental measure proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to coastal processes assessment
C-36	The number of WTGs will not exceed that of the existing Rampion 1 project.	All phases	Development Consent Order (DCO) requirement or Deemed Marine Licence (DML) condition	Limits or affects the MDS blockage to waves and currents.
C-38	The selection of the foundation type will primarily be based upon the site conditions combined with the wind turbine generator (WTG) that is selected. The following foundation types are being considered: Monopile and Jacket.	All phases	DCO requirements or DML conditions	Limits or affects the MDS blockage to waves and currents.
C-39	To maintain suitable operational conditions for the combined foundation and wind turbine generator (WTG) structure, scour protection (typically consisting of rock aggregate or stone/ concrete mattresses) may need to be installed. The method of scour protection will generally be to use rock armour or other large size aggregate placed around the periphery of the foundation at the	Operation	DCO requirements or DML conditions.	Limits or affects the MDS blockage to nearbed currents and sediment transport.

ID	Environmental measure proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to coastal processes assessment
	seabed. However, other methods of scour protection, may also be used.			
C-40	There will be up to three offshore substations installed to serve the Proposed Development. The exact locations, design and visual appearance will be subject to a structural study and electrical design, which is expected to be completed post consent. The offshore substations will be installed on jacket or monopile foundations, similar to those described for the wind turbine generators (WTGs) themselves.	All phases	DCO requirements or DML conditions.	Limits or affects the MDS blockage to waves and currents.
C-41	The subsea interarray cables will typically be buried at a target burial depth of 1m below the seabed surface. The final depth of the cables will be dependant on the seabed geological conditions and the risks to the cable (e.g. from anchor drag damage).	Construction	DCO requirements or DML conditions.	Informs the MDS trench dimensions (depth) in relation to assessments of sediment disturbance.
C-42	The subsea interarray cables and the subsea export cables will be installed using one or	All phases	DCO requirements or DML conditions.	Informs the nature and rate of MDS sediment disturbance.

ID	Environmental measure proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to coastal processes assessment
	a combination of the three methods: ploughing, trenching or jetting. It is likely that a combination of these methods will be adopted for localised areas depending on seabed conditions. The installation methods will be selected during detailed design and tendering phases.			
C-43	The subsea export cable ducts will be drilled underneath the beach using horizontal directional drilling (HDD) techniques.	Construction	DCO requirements or DML conditions.	Informs the nature and rate of MDS sediment disturbance.
C-44	A Scour Protection Management Plan will be developed. It will include details of the need, type, quantity and installation methods for scour protection.	Construction and Operation	DCO requirements or DML conditions.	Limits or affects the MDS blockage to nearbed currents and sediment transport.
C-45	Where possible, cable burial will be the preferred option for cable protection. Cable burial will be informed by the cable burial risk assessment and detailed within the Cable Specification Plan.	Construction and Operation	DCO requirements or DML conditions.	Limits or affects the MDS blockage to nearbed currents and sediment transport.

6.8 Methodology for PEIR assessment

Introduction

6.8.1 The project-wide generic approach to assessment is set out in **Chapter 5: Approach to the EIA** subject to the aspect specific definitions set out below.

6.8.2 The impact magnitudes are defined as follows.

- High: Permanent changes across the near- and large parts of the far-field to key characteristics or features of the particular environmental aspect's character or distinctiveness.
- Medium: Permanent changes, over the near- and parts of the far-field, to key characteristics or features of the particular environmental aspect's character or distinctiveness.
- Low: Noticeable, temporary (for part of the Proposed Development duration) change, or barely discernible change for any length of time, restricted to the near-field and immediately adjacent far-field areas, to key characteristics or features of the particular environmental aspect's character or distinctiveness.
- Very Low: Changes which are not discernible from background conditions.

6.8.3 The sensitivity of coastal processes receptors is defined as follows.

- High: Very low or no capacity to accommodate the proposed form of change; and/ or receptor designated and/ or of international level importance. Likely to be rare with minimal potential for substitution. May also be of very high socioeconomic importance.
- Medium: Moderate to low capacity to accommodate the proposed form of change; and/ or receptor designated and/ or of regional level importance. Likely to be relatively rare. May also be of moderate socioeconomic importance.
- Low: Moderate to high capacity to accommodate the proposed form of change; and/ or receptor not designated but of district level importance.
- Very low: High capacity to accommodate the proposed form of change; and/ or receptor not designated and only of local level importance.

6.8.4 A distinction is made throughout the assessment between the magnitude, extent and duration of 'impacts' and the resulting significance of the 'effects' upon coastal processes receptors.

6.8.5 It is important to note that where the impact is considered to be a coastal process pathway without any associated receptors, this chapter of the PEIR does not consider the resulting significance of effects. These are considered in other aspect chapters.

Assessment of change

6.8.6 In order to assess the potential change on coastal processes relative to the existing (baseline) coastal environment, a combination of analytical methods have been used. The assessment methodology has been updated since the Scoping

Report (RED, 2020) to address the comments received in the Scoping Opinion (PINS, 2020) and as part of the Evidence Plan process.

6.8.7 These methods can be summarised as follows and subsequently described in relation to the impact pathways:

- the methods used (e.g. numerical modelling) and results created as part of the Rampion 1 EIA and consenting requirements;
- the 'evidence base' containing monitoring data collected during the construction and operation and maintenance of other offshore wind farm developments, especially Rampion 1;
- standard empirical equations describing (for example) the potential for scour development around structures (for example, Whitehouse, 1998);
- analytical assessments of Project-specific data; and
- project specific numerical wave modelling.

6.8.8 The assessment has been undertaken in accordance with industry best practice and guidance, as previously described (**paragraph 6.2.5**). Full details of the methodological approach to the assessment of sediment disturbance related effects and scour are set out in **Appendix 6.3, Volume 4**.

6.8.9 The assessment also considers likely naturally occurring variability in, or long-term changes to, physical processes within the Proposed Development lifetime due to natural cycles and/ or climate change (for example, sea level rise). This is important as it enables a reference baseline level to be established against which the potentially modified physical processes can be compared, throughout the Proposed Development lifecycle. Baseline conditions are described in detail within **Appendix 6.1, Volume 4** and include for the potential effects of climate change.

6.8.10 The assessment of impacts has been considered over two spatial scales. These are:

- Far-field. Defined as the area surrounding the Rampion 2 array and offshore export cable corridor over which indirect changes may occur (namely the study area).
- Near-field. Defined as the footprint of the Rampion 2 array and export cable corridor.

6.8.11 The full assessment of the magnitude of impact, taking account embedded environmental measures outlined in **Table 6-10** is documented in **Appendix 6.3, Volume 4**. A summary of the results of the assessments are provided in this Chapter of the PEIR. Sensitivity and significance of residual effect assessment is completed for coastal processes receptors only.

Assessment of potential changes to suspended sediment concentration and seabed deposition

6.8.12 Potential increases in SSC are associated with construction activities such as the installation of foundations and cable burial and associated seabed preparation. For these relatively common marine activities, the potential extent, duration and concentration of suspended sediment plumes is assessed using a combination of the available evidence base, and project specific spreadsheet based numerical models. The change is assessed in terms of the difference caused, relative the normal range of natural occurrence and variability.

6.8.13 Potential sediment deposition is associated with the settlement of sediment disturbed by installation activities. The potential extent and thickness of sediment deposition is assessed using a combination of the available evidence base, and project specific spreadsheet based numerical models. The change is assessed in terms of the difference caused, relative to the normal range of natural occurrence and variability.

Assessment of potential changes to coastal morphology at the landfall

6.8.14 Potential changes to coastal morphology at the landfall are associated with the process used to transition the export cables from the offshore to the onshore environment. The proposed method for cable landfall is to bury the cables beneath the beach using Horizontal Directional Drilling (HDD) techniques. By avoiding any disturbance to the coastline fabric or morphology, and due to the absence of any infrastructure at or near the surface, this method means that, unless the cable becomes exposed, there is unlikely to be interaction with or therefore impact upon coastal processes. The impact is assessed in terms of the difference caused, relative to the normal range of natural variability.

6.8.15 The assessment considers the potential for the planned transition to remain stable and buried throughout its operational lifetime, for example, avoiding exposure due to natural coastal retreat. The potential impact of any associated activities will also be assessed if identified in the proposed design, for example, requirements for HDD exit pits in nearshore areas. The assessment has been undertaken as a desktop exercise by an experienced coastal geomorphologist utilising a range of historical and present-day data relating to the coastline at and around the landfall location.

Assessment of potential changes to the wave and hydrodynamic regimes

6.8.16 Potential changes to the wave and hydrodynamic (tidal) regime are associated with local interaction with the obstacles presented by the wind farm infrastructure. The potential impact of the proposed design of Rampion 2 has been assessed in conjunction with the built design of Rampion 1.

6.8.17 New numerical modelling of waves has been undertaken to quantify the potential impact of maximum design scenarios for Rampion 2, together with the built design of Rampion 1 as part of the baseline. A full description of the model set-up is provided in **Appendix 6.2, Volume 4**.

6.8.18 Previous assessments of impact on currents for Rampion 1 used numerical modelling to consider a larger design scenario than was actually built; the EIA considered 80 gravity base structures and 95 large monopile structures (175 structures in total), whereas the wind farm was actually built with 116 relatively slender monopile foundations. The results of the previous modelling are used to inform an evidence-based assessment of the likely individual and combined impact of Rampion 2 and Rampion 1. The impact is assessed in terms of the difference caused, relative to the normal range of natural variability in the wave climate and tidal regime.

6.8.19 There are no coastal processes receptors identified that are directly sensitive to changes to the wave or hydrodynamic regimes alone. Resulting changes to patterns of sediment transport and morphological evolution may potentially affect a limited number of coastal processes receptors (including nearby coastlines, sandbanks and areas of designated seabed), which are separately considered below. Potential for changes to recreational surfing wave climate are considered as a specific wave condition scenario for coastal processes and will also be assessed if needed by other relevant aspects.

6.8.20 The impact on other sensitive receptors, which are potentially affected by changes in coastal processes, for example in relation to benthic ecology, are considered within those specific Chapters of the PEIR, with the outputs of the coastal processes assessments providing data to inform those assessments.

Assessment of potential changes to the sediment transport regime

6.8.21 Potential changes to the rate and patterns of sediment transport into, through and from the study area have been assessed, including nearby coastlines, sandbanks and areas of designated seabed. The assessment is informed by the consideration of potential changes to the hydrodynamic (tidal currents) and wave regimes, in conjunction with standard quantitative relationships for prediction of sediment transport. Potential differences in the sediment transport regime are assessed in the context of the normal range of natural variability. The impact is assessed in terms of the difference caused, relative to the normal range of natural variability in sediment transport.

Assessment of potential seabed scour

6.8.22 Potential changes to the local seabed level in the form of scour are associated with the local interaction between currents and waves and the obstacle presented by wind farm infrastructure located above the seabed surface. This interaction causes locally enhanced transport of seabed sediments, leading to localised erosion. Once an equilibrium state is reached, scour pits are a localised depression that may have a different seabed texture to the surrounding seabed, however, they have no further net effect on sediment transport into, through or from the area. Standard relationships, supported by the available evidence base, have been used to estimate the likely dimensions of scour for unprotected infrastructure. Scour protection around foundations or cables will prevent the formation of primary scour around the protected item by design, however, a smaller amount of secondary scour may occur at the edges of the scour protection.

6.9 Preliminary assessment: Construction phase

Increases in SSC and deposition of disturbed sediments to the seabed due to drilling for foundation installation

Overview

6.9.1 Monopile foundations and pin piles for jacket foundations will be installed into the seabed using standard piling techniques. In some locations, the geology may present some obstacle to piling, in which case, some or all of the seabed material might be drilled from within the pile footprint to assist in the piling process.

6.9.2 The impact of drilling operations mainly relates to the release of drilling spoil at or above the water surface which will put sediment into suspension and the subsequent re-deposition of that material to the seabed. The nature of this disturbance will be determined by the rate and total volume of material to be drilled, the seabed and subsoil material type, and the drilling method (affecting the texture and grain size distribution of the drill spoil). These changes are quantitatively assessed using the spreadsheet based numerical models as detailed in **Appendix 6.3, Volume 4**.

Magnitude of impact or change

6.9.3 Assuming that a mixture of sediment grain sizes are present, the overall spatial pattern of change due to drilling of a single monopile foundation is likely to be:

- the following increases are relative to a typical baseline SSC of five to 10mg/l in the middle and upper water column. However, SSC can be naturally much higher (order of tens to hundreds of mg/l) near to the seabed, especially during larger tidal ranges and stormier conditions where waves stir the seabed;
- SSC will be increased by tens to hundreds of thousands of mg/l at the point of sediment release (for a period of seconds to a few minutes), which is at or near the water surface;
- SSC will be increased by low tens of mg/l in a narrow plume (tens to a few hundreds of metres wide, up to one tidal excursion in length (up to 11 to 16km on spring tides and 5 to 8km on neap tides) aligned to the tidal stream downstream from the source;
- if drilling occurs over more than one flood or ebb tidal period, the plume feature may be present in both downstream and upstream directions;
- outside of the area up to one tidal excursion upstream and downstream of the foundation location, SSC less than 10mg/l may occur more widely due to ongoing dispersion and dilution of material;
- sufficiently fine sediment may persist in suspension for hours to days or longer, but will become diluted to very low concentrations (less than 5mg/l, indistinguishable from natural background levels and variability) within timescales of around one day; and

- over longer timescales, net displacement of any fine-grained material persisting in suspension will generally be in an approximate easterly direction across from the array area in accordance with the direction of longer-term net tidal current drift.

6.9.4 Sediment deposition as a result of drilling for a single foundation installation is concluded to be:

- deposits of mainly coarse grained and clastic sediment deposits will be concentrated within an area in the order of approximately ten to 100m downstream/upstream and a few tens of metres wide from individual foundations, with an average thickness in the order of one to ten metres (limited to realistically likely values);
- deposits of mainly sandy sediment deposits will be concentrated within an area (depending on the local water depth and current conditions at the time) in the order of approximately 150 to 650m downstream/upstream and tens to one hundred metres wide from individual foundations, with an average thickness in the approximate order of tens of centimetres to approximately one metre;
- fine grained material will be dispersed widely within the surrounding region and will not settle with measurable thickness; and
- the absolute width, length, shape and thickness of local sediment deposition as a result of drilling is estimated above. It cannot, however, be predicted with certainty and are likely to vary due to the nature of the drill spoil, the local water depth and the ambient environmental conditions during the drilling activity. Other possible combinations of shape, area and thickness of sediment deposition are provided in **Appendix 6.3, Volume 4**.

6.9.5 The local patterns of change to SSC and sediment deposition are described above, as a result of drilling activities for individual foundations of any type. In the array area, up to 38 (50 percent of 75) larger turbine type monopile foundations for WTGs may be installed using drilling, and up to three OSSs on jacket foundations may require drilling for up to all pin piles.

6.9.6 The total sediment volume potentially released by drilling 50 percent of all WTG foundations has also been assessed with respect to the total potential extent and thickness of sediment deposition. The actual shape, width, length and thickness of local or regional sediment deposition as a result of drilling cannot be predicted with certainty and is likely to vary according to the final distribution of foundations, the local nature of the drill spoil, the local water depth and the ambient environmental conditions during the drilling activity. However, the maximum total compacted sediment volume that could theoretically be released from drilling 50 percent of all WTG foundations (38 monopiles), and three OSS jacket with pin pile foundations, is 347,125m^3 and it is found that:

- if the total volume of drill arisings from all foundations is distributed equally across the whole potential array area (269.4km^2), the average increase in bed elevation will be approximately 0.0021m (2mm) (assuming a packing density of the deposited material of 0.6);
- if the total volume of drill arisings from all foundations is distributed equally across only the western or eastern array areas of the PEIR Assessment

Boundary, the average increase in bed elevation will be approximately double the values above (namely up to approximately 0.005m or 5mm) (assuming a packing density of the deposited material of 0.6); and

- a maximum area equal to approximately 4.3 percent of the whole potential array area (or up to ten percent of only the western or eastern array areas of the PEIR Assessment Boundary) could potentially be covered by an average thickness of 0.05m of material (assuming a packing density of the deposited material of 0.6).

6.9.7 When considering the potential for in-combination effects, given that the minimum spacing between the WTG foundations is 860 to 1,720m (for the smaller and larger turbine type WTG options, respectively), it is unlikely that coarse sands or gravels put into suspension will be dispersed far enough (namely between adjacent foundation locations) to cause any overlapping effects before being redeposited to the seabed. Only relatively fine sediment is likely to be advected far enough to potentially cause overlapping effects on SCC.

6.9.8 These results are consistent with similarly modelled patterns of change in assessments for other wind farms, and the wider monitoring evidence base which is discussed in **Appendix 6.3, Volume 4**.

6.9.9 There are no coastal processes receptors that are sensitive to increases in magnitude of SSC and deposition of disturbed sediments to the seabed due to drilling for foundation installation.

Sensitivity or value of receptor

6.9.10 All the identified coastal process receptors are insensitive to changes in SSC and changes in bed levels identified from the assessment. There is the potential for these changes to affect other aspect receptors, in particular:

- **Chapter 8: Fish and shellfish ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 9: Benthic subtidal and intertidal ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 10: Commercial fisheries** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 11: Marine mammals** (due to potential changes in seabed morphology, smothering and suspended sediments, affecting prey species and other indirect effects);
- **Chapter 12: Offshore ornithology** (due to potential changes in seabed morphology, smothering and suspended sediments, affecting prey species and other indirect effects);
- **Chapter 15: Nature conservation** (due to potential changes in seabed and coastal morphology); and
- **Appendix 27.3: Preliminary WFD assessment** (due to suspended sediments).

Significance of residual effect

6.9.11 There are no coastal process receptors sensitive to the impact pathway and assessment of residual effect is not applicable.

Increases in SSC and deposition of disturbed sediments to the seabed due to dredging for seabed preparation prior to installing jacket foundations

Overview

6.9.12 To provide a stable footing for jacket foundations, standard dredging techniques may be used to remove or lower the level of the mobile seabed sediment veneer within a footprint slightly larger than the foundation base. Dredging has the potential to cause elevated SSC by, sediment over-spill at the water surface during dredging and by the subsequent release of the dredged material from the dredger during spoil disposal at a nearby location. The subsequent settlement of the sediment disturbed by dredging will lead to sediment accumulation of varying thickness and extent on the seabed. These changes have been quantitatively assessed using spreadsheet based numerical models.

6.9.13 This section summarises the assessment of the increases in SSC and seabed deposition as a result of the bed preparation works for the jacket foundations.

Magnitude of impact or change

6.9.14 The influence of dredging overspill and spoil disposal on increasing SSC above ambient levels is assessed to be as follows:

- the following increases are relative to a typical baseline SSC of 5 to 10mg/l in the middle and upper water column. However, SSC can be naturally much higher (order of tens to hundreds of mg/l) near to the seabed, especially during larger tidal ranges and stormier conditions where waves stir the seabed;
- SSC levels will be highest (potentially tens to hundreds of thousands of mg/l) at the point of sediment release, which is at or near the water surface during dredging overspill and distributed through the whole water column during dredge spoil disposal. This feature will only be present during the periods of active dredging or during (the relatively short) dredge spoil disposal events;
- for fine material in dredging overspill, SSC levels will decrease rapidly through vertical and horizontal dispersion to low tens of mg/l within the order of hundreds of metres from the point of release;
- for fine material released into the passive plume phase during dredge spoil disposal, SSC levels will be initially higher than for overspill (due to the sudden nature of the sediment release). SSC levels will decrease through horizontal dispersion to a few thousand mg/l within the order of low hundreds of metres and a few tens of mg/l within the order of one thousand metres distance from the source;

- for sand and gravel material in dredging overspill, local SSC levels will decrease to low thousands or hundreds of mg/l locally (low tens of mg/l in a depth mean sense) through horizontal dispersion whilst settling to the seabed;
- for sand and gravel material released into the passive plume phase during dredge spoil disposal, local SSC levels will decrease from hundreds to tens of thousands of mg/l due to horizontal dispersion whilst settling to the seabed;
- sands will deposit to the seabed within the order of hundreds of metres from the source (taking in the order of five to 15 minutes to settle from surface to seabed), and gravels likewise within tens of metres (0.5 to 1.5 minutes). The horizontal diameter of the main sand or gravel plume footprint within the water column and on the seabed is likely to be in the order of only tens of metres;
- following cessation of dredging or spoil release, the influence of sands or gravels on SSC levels will reduce rapidly as described above and will end when the sediment is redeposited to the seabed (in the order of 0.5 to 15 minutes, depending on the grain size and water depth); and
- once redeposited to the seabed, the locally dredged overspill and spoil material are essentially the same as the local sediment type. The dredged material will therefore immediately re-join the natural sedimentary environment and will not contribute further to elevated SSC above naturally occurring levels.

6.9.15 The sediment deposition as a result of dredging is concluded as follows:

- deposits of mainly gravel sized dredge overspill will be concentrated within a relatively small area in the order of tens of metres from the site of dredging, with an average thickness in the order of less than ten centimetres;
- deposits of mainly sand sized dredge overspill sediment will be concentrated within an area in the order of 150 to 500m downstream/upstream and approximately tens to one hundred metres wide from individual foundations, with an average thickness in the order of less than a few centimetres;
- spoil disposal will form more concentrated sediment deposits on the seabed. The main mass of sediment (90 percent of the total volume, falling as the active phase of the plume) will initially result in discrete mounds of sediment in the order of tens to hundreds of metres in diameter (depending on the pattern of settlement) and tens of centimetres to a few metres in local thickness. An area equivalent to a circle of approximately 500m in diameter might be covered to an average depth of 0.05m. Any larger area of change would correspond to a smaller average thickness. It is possible that consecutive disposal events may overlap on the seabed, resulting in a greater local thickness of sediment but a smaller overall area of influence;
- the smaller mass of material (10 percent of the total volume) falling as the passive phase of the spoil disposal plume will result in a narrow deposit downstream either hundreds of metres in length and a few centimetres or less thick (for sands), or, tens of metres in length and up to tens of centimetres to a few metres thick (for gravels);
- fine grained material released as overspill or as the passive phase of spoil disposal will be dispersed widely within the surrounding region and will not

settle locally with measurable thickness. Fine grained material in the active phase of spoil disposal will remain bound in the main sediment mass and will not be differently dispersed to that described above;

- the assessments undertaken and the summaries above describe the influence of conservatively marginal scenarios where the material being dredged or disposed is entirely fines, sands or gravels. Based on these marginal cases, the following summary describes the overall influence of the same activities assuming that a mixture of sediment grain sizes is present;
- SSC of low tens of mg/l will be present in a narrow plume (tens to a few hundreds of metres wide, up to one tidal excursion in length (up to 13km on spring tides and 7km on neap tides) aligned to the tidal stream downstream from the source;
- if dredging occurs over more than one flood or ebb tidal period, the plume feature may be present in both downstream and upstream directions;
- outside of the area up to one tidal excursion upstream and downstream of the foundation location, SSC less than 10mg/l may occur more widely due to ongoing dispersion and dilution of material;
- most of the gravel and sand sized sediment will be deposited to the seabed within tens to hundreds of metres from the source, respectively. A larger proportion of such material in the plume may result in SSC reducing more rapidly in this region and reducing the length or extent of the plume feature overall; and
- sufficiently fine sediment may persist in suspension for hours to days or longer but will become diluted to very low concentrations (indistinguishable from natural background levels and variability) within timescales of around one day.

6.9.16 When considering the potential for in-combination effects, given that the minimum spacing between the WTG foundations is 860 to 1,720m (for the smaller and larger turbine type WTG options, respectively), it is unlikely that coarse sands or gravels put into suspension will be dispersed far enough (namely between adjacent foundation locations) to cause any overlapping effects before being redeposited to the seabed. Only relatively fine sediment is likely to be advected far enough to potentially cause overlapping effects on SCC.

6.9.17 These results are consistent with similarly modelled patterns of change in assessments for other wind farms, and the wider monitoring evidence base.

6.9.18 There are no coastal processes receptors that are sensitive to increases in magnitude of SSC and deposition of disturbed sediments to the seabed due to drilling for foundation installation.

Sensitivity or value of receptor

6.9.19 All the identified coastal process receptors are insensitive to changes in SSC and changes in bed levels identified from the assessment. There is the potential for these changes to affect other aspect receptors, in particular:

- **Chapter 8: Fish and shellfish ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);

- **Chapter 9: Benthic subtidal and intertidal ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 10: Commercial fisheries** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 11: Marine mammals** (due to potential changes in seabed morphology, smothering and suspended sediments, affecting prey species and other indirect effects);
- **Chapter 12: Offshore ornithology** (due to potential changes in seabed morphology, smothering and suspended sediments, affecting prey species and other indirect effects);
- **Chapter 15: Nature conservation** (due to potential changes in seabed and coastal morphology); and
- **Appendix 27.3: Preliminary WFD assessment** (due to potential changes in suspended sediments).

Significance of residual effect

6.9.20 There are no coastal process receptors sensitive to the impact pathway and assessment of residual effects is not applicable.

Increases in SSC and deposition of disturbed sediments to the seabed due to cable installation

Overview

6.9.21 Cable burial is the preferred option for cable protection. The cable burial will be informed by the cable burial risk assessment and detailed within the cable specification plan (C-45) identified in **Table 6-10**. The potential effects of sediment release due to cable burial are typically localised to the cable route or the active cable burial location.

6.9.22 Jetting and mass flow excavation methods have the greatest potential to energetically fluidise and eject material from the trench into suspension and have therefore been considered in the assessment. The rate of disturbance is similarly defined for both tools by the MDS dimensions of the trench and the rate of burial. By contrast, the other cable installation techniques (for example, ploughing or cutting) are expected to re-suspend a smaller amount of material into the water column. Due to spatial variation in the geotechnical properties of the underlying geology within this region, it is possible that a combination of techniques may be used.

Magnitude of impact or change

6.9.23 The assessment assumes that inter-array cables will be typically buried 1m below the seabed surface (C-41) with the installation method to be determined (C-42) identified in **Table 6-10**. The MDS assumes installation through jetting or mass flow excavation as these have the greatest potential to energetically fluidise and eject material from the trench into suspension. The maximum depth of burial in the export cable corridor is 1.5m as identified in **Table 6-9**.

6.9.24 The assessment has concluded that medium to coarse sand and gravels are likely to result in a temporally and spatially limited plume affecting SSC levels (and settling out of suspension) in close proximity to the point of release. SSC will be locally elevated within the plume close to active cable burial up to tens or hundreds of thousands of mg/l. However, the change will only be present for a very short time locally, in the order of seconds to tens of seconds for sand or gravel, before the material resettles to the seabed.

6.9.25 Depending on the height to which the material is ejected and the current speed at the time of release, changes in SSC and deposition will be spatially limited to within metres (up to 20m) downstream of the cable for gravels and within tens of metres (up to a few hundred metres) for sands.

6.9.26 Finer material will be advected away from the release location by the prevailing tidal current. High initial concentrations (similar to sands and gravels) are to be expected but will be subject to rapid dispersion, both laterally and vertically, to near-background levels (tens of mg/l) within hundreds to a few thousands of metres of the point of release. In practice, only a small proportion of the material disturbed is expected to be fines, with a corresponding reduction in the expected levels of SSC.

6.9.27 Irrespective of sediment type, the volumes of sediment being displaced and deposited locally are relatively limited (up to three m^3 per metre of cable burial) which also limits the combinations of sediment deposition thickness and extent that might realistically occur. Fundamentally, the maximum distance from each metre of cable trench over which three m^3 of sediment can be spread to an average thickness of (for example) 0.05m is 60m (or to 0.15m is 20m); any larger distance would correspond to a smaller average thickness. In practice, the local thickness and extent is likely be variable, but always within these joint limits. The assessment suggests that the extent and so the area of deposition will normally be much smaller for sands and gravels (although leading to a greater average thickness of deposition in the order of tens of centimetres, up to around one metre) and that fine material will be distributed much more widely, becoming so dispersed that it is unlikely to settle in measurable thickness locally.

6.9.28 If cable burial, or any other activity causing sediment disturbance, is undertaken simultaneously at two or more locations that are aligned in relation to the ambient tidal streams, then there is potential for overlap between the areas of effect on SSC and sediment deposition. In the worst case of a direct overlap, the combined effect can be estimated as the sum of the parts in the area of overlap.

6.9.29 These results are consistent with similarly modelled patterns of change in assessments for other wind farms, and the wider monitoring evidence base.

6.9.30 There are no coastal processes receptors that are sensitive to increases in magnitude of SSC and deposition of disturbed sediments to the seabed due to cable installation.

Sensitivity or value of receptor

6.9.31 All the identified coastal process receptors are insensitive to changes in SSC and changes in bed levels identified from the assessment. There is the potential for these changes to affect other aspect receptors, in particular:

- **Chapter 8: Fish and shellfish ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 9: Benthic subtidal and intertidal ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 10: Commercial fisheries** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 11: Marine mammals** (due to potential changes in suspended sediments affecting prey species and other indirect effects);
- **Chapter 12: Offshore ornithology** (due to potential changes in seabed morphology, smothering and suspended sediments, affecting prey species and other indirect effects);
- **Chapter 15: Nature conservation** (due to potential changes in seabed and coastal morphology); and
- **Appendix 27.3: Preliminary WFD assessment, Volume 4** (due to potential changes in suspended sediments).

Significance of residual effect

6.9.32 There are no coastal process receptors sensitive to the impact pathway and the assessment of residual effect is not applicable.

Increases in SSC and deposition of sediment to the seabed due to HDD drilling fluid release

Overview

6.9.33 The subsea export cable ducts will be drilled underneath the beach using HDD techniques (C-43), as identified in **Table 6-10**. The potential effects of drilling fluid release during the creation of underground conduits for the export cables at the landfall are typically localised to the landfall area and will only be present at and for a short time following HDD punchout for each conduit.

Magnitude of impact or change

6.9.34 The assessment assumes that subsea export cable ducts will be drilled underneath the beach using HDD techniques (C-43), as identified in **Table 6-10**. The MDS conservatively assumes the maximum volume of drilling fluid that might be released at one time is equivalent to the total volume of the drilled conduit as identified in **Table 6-9**.

6.9.35 The release of drilling fluids (which contain a lubricating natural clay mineral such as bentonite) along with drill cuttings from the HDD process will result in a localised and temporary plume of elevated SSC (tens of thousands of mg/l within 10m of the release but decreasingly to low thousands or hundreds of mg/l within a few hundred metres of the release).

6.9.36 The majority of the plume will be advected in the direction of the ambient tidal currents, which are broadly aligned to the coast. The direction of transport (to the east or west) will depend on the state of the tide (flood or ebb) at the time of the release.

6.9.37 It is expected that the plume will be dispersed to relatively low concentrations (low hundreds to tens of mg/l) within hours of release and to background concentrations (less than 10mg/l) within a few tidal cycles.

6.9.38 The bentonite is expected to remain in suspension (at very low concentrations) for at least hours or days and will be widely dispersed before settling. Therefore, it is not expected to accumulate anywhere in measurable thicknesses. If punchout (in the intertidal area) occurs during a low water condition, drilling fluid and/or drill cuttings may accumulate initially in or around the HDD exit pit, in this case, the volume of the pit is sufficient to initially contain the majority of that material. Following tidal inundation, any remaining drilling fluid will be reworked and redistributed to not-measurable concentrations and thicknesses over time by wave and tidal action.

6.9.39 The drilling fluid has an overall density and viscosity similar to seawater and so is expected to behave (advect, mix and disperse) in a similar manner. If the drilling fluid behaves as a slightly denser fluid, it may either accumulate in the HDD exit pit or move over the adjacent seabed downslope under gravity, i.e. in an offshore direction and away from nearshore areas.

6.9.40 If HDD works, or any other activity causing sediment disturbance, is undertaken simultaneously at two or more locations that are aligned in relation to the ambient tidal streams, then there is potential for overlap between the areas of effect on SSC and sediment deposition. In the worst case of a direct overlap, the combined effect can be estimated as the sum of the parts in the area of overlap.

6.9.41 These results are consistent with similarly modelled patterns of change in assessments for other wind farms, and the wider monitoring evidence base.

6.9.42 There are no coastal processes receptors that are sensitive to increases in magnitude of SSC and deposition of disturbed sediments to the seabed due to HDD drilling fluid release.

Sensitivity or value of receptor

6.9.43 All the identified coastal process receptors are insensitive to changes in SSC and changes in bed levels identified from the assessment. There is the potential for these changes to affect other aspect receptors, in particular:

- **Chapter 8: Fish and shellfish ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 9: Benthic subtidal and intertidal ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);

- **Chapter 10: Commercial fisheries** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 11: Marine mammals** (due to potential changes in suspended sediments affecting prey species and other indirect effects);
- **Chapter 12: Offshore ornithology** (due to potential changes in seabed morphology, smothering and suspended sediments, affecting prey species and other indirect effects);
- **Chapter 15: Nature conservation** (due to potential changes in seabed and coastal morphology); and
- **Appendix 27.3: Preliminary WFD assessment** (due to potential changes in suspended sediments).

Significance of residual effect

6.9.44 There are no coastal process receptors sensitive to the impact pathway and the assessment of residual effect is not applicable.

Changes to landfall morphology due to installation of export cable at the landfall

Overview

6.9.45 The Rampion 2 export cables will make landfall at Climping. The beach frontage here consists of mixed sand and shingle sediment with an approximate 1:7.5 slope to the sand foreshore and net sediment transport in an easterly direction. This mobile material overlies chalk bedrock which is located at or very close to the surface in this location (**Figure 6.3, Volume 3**). A failed seawall and groynes are also present at the landfall. The original shoreline management policy for this coastal unit (Unit 4d20) was for a strategy of ‘Managed Realignment’. However, this has evolved to 'Withdraw Management' and more recently, 'Do Minimum'. There is currently ongoing discussion regarding the most appropriate management policy for this stretch of coast.

6.9.46 The MDS for cable installation will involve trenching the four export cables into the shallow (sub-tidal) waters off the beach. From here, HDD will be used to install the cables under the beach to the transition jointing bays which will be set back from the beach, in a supra-tidal setting. The hard nature of the chalk substrate is likely to necessitate the use of temporary floatation pits (TFPs) for vessels installing the cables. These TFPs will allow the installation vessel to remain floating at low tide and avoid being beached/ grounded on the harder seabed surface.

6.9.47 It is noted here that TFPs of very similar dimensions have previously been successfully used at the Rampion 1 landfall (at Lancing), without any adverse impacts arising at the location of the TFP or elsewhere. Cable trenching was undertaken in 2015/16, whilst excavation of TFPs was undertaken in 2016/17 to facilitate installation of the existing cables (with work carried out under Marine Licence L/2016/00217/4). A subsequent licence to extend the operational timespan of the TFPs from approximately six months to up to five years was made in 2017. The TFPs (5 to 5.5m deep) were backfilled following completion of the installation works using either the spoil from excavation of subsequent TFPs, or using material temporarily stored in the Proposed Development spoil disposal site. Post-construction monitoring surveys (Natural Power, 2019) found that one year later, “the seabed has been returned to near identical levels to those seen during pre-construction, with barely perceptible amounts of variation when compared to the pre-construction background substrate”. An analysis of beach topography pre-, during- and post-construction concluded “no noticeable effect of the Project on beach topography changes can be discerned”.

6.9.48 There are several source/pathways via which morphological receptors at the landfall could potentially be impacted:

- trenching through chalk;
- excavation of TFPs;
- excavation of HDD exit pits;
- HDD drilling operations; and
- changes to the nearshore wave regime/ longshore sediment transport due to the presence of cable protection measures and/or any ancillary structures associated with cable installation.

Magnitude of impact or change

Trenching through chalk

6.9.49 Under the MDS, installation of four cables in the nearshore will require the excavation and side-casting of material along the trench:

- the trench will start near the proposed HDD exit points in water depths between zero and (approximately) 2.5m below LAT (**Figure 6.3, Volume 3**) extending offshore up to the TFPs;
- the trenches will have a base width of approximately two metres and be up to 1.5m deep along most of their length;
- the trenches will be dredged using a spud legged backhoe dredging vessel with side-casting and could remain open for up to four months; and
- the side cast material will be used to infill the trench on completion of the cable installation works.

6.9.50 The potential pathways by which the excavation of the nearshore burial trench could bring about changes in the beach morphology are set out below:

- the trenches could potentially infill in response to trapping of alongshore and cross-shore movements of sediment (which probably occur on a seasonal basis in response to seasonal changes in the distribution of wave energy). This could theoretically lead to a localised reduction in beach volume; and
- side-casting of material during the excavation process will increase the local elevation of the seabed, potentially causing modification of the nearshore wave regime (changes to wave height, period and direction through local wave

diffraction, refraction, shoaling and breaking in response to the local change in water depth).

Change in beach morphology due to infilling of the trench

6.9.51 The proposed trenches will be broadly shore-normal in orientation and therefore some infilling can realistically be expected primarily due to the interception of longshore sediment transport. The potential rate of infilling is difficult to determine; however, baseline rates of sediment transport in the shallow sub-tidal areas at the landfall are expected to be small, due to the limited availability of mobile material (Gardline, 2020; **Figure 6.3, Volume 3**).

6.9.52 The inshore trench sections will be located within the theoretically active part of the cross-shore beach profile, broadly defined by the 6m below LAT contour which corresponds to the depth of closure along this frontage (ABPmer, 2016). This means that there is some potential for beach material to move offshore from the beach and into the trench during storm events. However, given that the trenches will be orientated broadly shore normal and are both narrow and shallow (at two metres wide and 1.5m deep), the potential for large volumes of beach material to become trapped within the trench and leading to beach draw-down is considered to be low. The potential infill of beach material will be most likely in the trench sections in the shallowest water depths and will be small in absolute and relative terms (relative to the total beach volume).

6.9.53 The magnitude of change is considered **Very Low** as the changes will be temporary and spatially limited.

Change in beach morphology due to side-casting of material during trench excavation

6.9.54 The seabed across which the trenches will be excavated is located in a shallow sub-tidal setting. It is theoretically possible that any locally side-cast material could act similar to a submerged groyne, which could locally influence beach morphology through the re-distribution of wave energy and trapping of sediment. However, the extent to which morphological change could occur will be dependent upon a range of factors, including:

- the nature of the side-cast material (specifically whether it is mobile and therefore quickly eroded by waves);
- the degree of storminess during the time period when the side-cast material is present on the seabed;
- the composition of the seabed at this location (which is not considered to be highly susceptible to erosion); and
- the duration of time that the side-cast material is in place on the seabed and, or, the rate of alongshore sediment transport.

6.9.55 Review of evidence from the existing Rampion 1 TFPs, ABPmer (2017) identified that the chalk material to be side-cast is likely to be relatively resistant to erosion and so the local change to waves may occur up to the time that the TFPs are closed and the material remaining in the mounds is either dispersed or used as backfill.

6.9.56 The effect on the morphology of the lower beach could theoretically be a very marginal local re-distribution of beach material, including accretion immediately updrift of the side-cast berm and erosion immediately down drift. However, the extent of accretion and erosion will be highly localised to the side-cast berm itself (no more than that of the nearby groynes in intertidal and shallow subtidal areas) and will be temporary with the sediment distribution returning to its original state once the sidecast material is either naturally or mechanically redistributed and the trench backfilled.

6.9.57 During storm conditions, the side-cast material may theoretically cause some re-distribution of wave energy. In reality, this is expected to be minimal in the nearshore, as only a small volume of material is being excavated (due to the narrow width and shallow depth) and the associated berms will be of low profile. Also, the side-cast berm will be approximately shore normal and broadly perpendicular to the wave crests of the larger storm waves (which will naturally refract to become shore parallel as they approach the coast). Accordingly, this will limit the influence of the berm on larger waves. Overall, any effect of the side-cast berm on the beach morphology and volume will be of relatively temporary duration with the beach and nearshore morphology recovering once the trench is either naturally or mechanically backfilled.

6.9.58 It is noted that material excavated from trenches might also be temporarily stored within the offshore array area or export cable corridor, if and where designated as a spoil disposal area. This possibility will be confirmed in the final ES.

6.9.59 The magnitude of change is considered **Low** as the changes will be temporary and spatially limited.

Excavation of TFPs

6.9.60 The MDS for the excavation of TFPs is summarised as follows:

- requirement for 16 pits (four per cable), 4 pits (one per cable) measuring 160m long by 45m wide by up to three metres deep, 12 pits (three per cable) measuring 100m long by 40m wide by up to 2.5, 2 and 1.5 metres deep, respectively;
- total area for all 16 TFPs (115,000m^2);
- total volume of material excavated from all 16 TFPs (275,000m^3); and
- Individual TFPs open for no longer than four months.

6.9.61 It is understood that the excavated material will be temporarily stored within the array area, before being dredged again and used as backfill when the TFPs are closed. It has also been assumed that up to eight TFPs could be simultaneously open.

6.9.62 As previously mentioned, TFPs have been successfully used to facilitate export cable installation at the Rampion 1 landfall. Prior to their installation, ABPmer (2016) undertook a coastal impact assessment in support of the Marine Licence Application to ascertain (amongst other things) whether the construction of TFPs close to the shore could alter the nearshore wave regime in the short-term (that is, weeks to months), leading to enhanced erosion (or 'slumping') of beach material.

Using quantitative techniques, the assessment considered the likelihood of this occurring to be low and this finding has been supported by the pre- during- and post- construction monitoring reported in Natural Power (2019).

6.9.63 Although the total number of TFPs is greater for Rampion 2, 16 compared with six at Rampion 1, the following key similarities are noted:

- the TFPs are expected to be located in very similar water depths, within similar hydrodynamic and wave regimes;
- seabed conditions are expected to be very similar (that is, hard chalk substrate with very thin veneer of surficial mobile material);
- the total number of TFPs open at any given time will be very similar (namely, eight for Rampion 2 compared with six for Rampion 1).

6.9.64 Multibeam bathymetry data from the Rampion 1 TFPs showing change over the two-month period following excavation found that a small amount of infilling (typically zero to 0.2m) had occurred. This finding was consistent with the predictions set out in ABPmer (2016) and it can reasonably be assumed that infilling may occur at a broadly similar rate in the TFPs proposed for Rampion 2. The available monitoring evidence from the Rampion 1 TFPs does not enable the provenance of the material to be determined. Although it is theoretically possible that the material in the TFPs originated from the beach, it is arguably more likely that the material is of local origin and mobilised as bed load under the combined action of tide and wave induced currents. Accordingly, any temporary removal or redistribution of beach material along the Climping frontage is expected to be very small.

6.9.65 It is noted that material excavated from TFPs might also be temporarily stored within the offshore array area or export cable corridor, if and where designated as a spoil disposal area. This possibility will be confirmed in the final ES.

6.9.66 The magnitude of change is considered **Low** as any associated morphological change will be temporary and spatially limited.

Excavation of HDD exit pits

6.9.67 Each of the four export cables may require an exit pit to be excavated at the punch-out location. These will be up to 30m long by four metres wide by 1.5m deep (total volume 720m^3 for all four pits). They will be located between 800 and 1500m offshore in water depths between zero and (approximately) 2.5m below LAT (**Figure 6.3, Volume 3**) and be open for up to four months.

6.9.68 The potential mechanisms by which the presence of these pits could impact the coast at the landfall is the same as for the TFPs, principally via the modification for waves and interception of sediment. Both the size of individual pits and total number of pits will be less than that of the TFPs and so changes attributable to the presence of the HDD exit pits will be less than for the TFPs. However, it is acknowledged that any effects will be additive to the TFPs, as both the exit pits and TFPs will be open at the same time.

6.9.69 It is noted that material excavated from HDD exit pits might also be temporarily stored within the offshore array area or export cable corridor, if and where designated as a spoil disposal area. This possibility will be confirmed in the final ES.

6.9.70 The magnitude of change is considered **Low** as any associated morphological change will be temporary and spatially limited.

HDD drilling operations

6.9.71 Potential impacts to coastal process receptors have been reduced with subsea cable ducts being drilled underneath the beach using HDD techniques (C-43) (**Table 6-10**). The measures will be secured through implementation of the projects' COCP along with the DCO requirement and DML condition.

6.9.72 HDD works will likely be used to create an underground conduit for each of the two cables between the beach and onshore parts of the route. HDD will cause minimal direct disturbance to the existing coastline because, by design it will not interact directly with, or leave any infrastructure exposed in, the active parts of the beach (between the entry and exit points of the drill) and so will not impact upon littoral processes in these areas. Provided that the cable remains buried beyond the exit of the HDD, there is no possibility for it to interact with, or have any effect on nearshore beach processes or morphology. The design of the HDD operation will take this into account.

6.9.73 Owing to the uncertainty surrounding the future shoreline management policy at the landfall, it will be important for a full assessment of coastal variability to be undertaken under a range of coastal management and climate change scenarios. This will enable appropriate set back distances for the transition jointing bays to ensure that they are unaffected by the possibility of coastal retreat due to either natural erosion or sea level rise due to climate change.

6.9.74 The magnitude of change is considered **Very Low** with no discernible change from background conditions.

Changes to the nearshore wave regime/ longshore sediment transport due to the presence of cable protection measures

6.9.75 The requirement for cable protection measures at the landfall is not presently known but will be confirmed at a later date as part of the Cable Protection Plan. In theory, the installation of cable protection measures could cause a morphological response via (for instance) modification of the local nearshore wave regime and associated patterns of sediment transport. However, it is assumed that if cable protection was installed at the landfall it will be installed with a sufficiently low profile relative to the surrounding bed to present minimal barrier to the passage of waves and so cause no change to long term patterns of sediment transport.

6.9.76 The magnitude of change is considered **Low** as any associated morphological change will be barely discernible and spatially limited.

Sensitivity or value of receptor

6.9.77 The sensitivity of the Climping Beach SSSI as well as the wider coastal morphology at the landfall is considered to be **Medium**, reflecting that the receptor has some ability to tolerate the potential impacts and can reasonably be expected to recover to its baseline condition should morphological change occur.

Significance of residual effect

6.9.78 The assessment has concluded that the magnitude of impact on the morphology of the landfall arising from construction related activities is either Low or Very Low. Based upon the Medium sensitivity of the receptor identified above, the significance of residual effect is **Minor adverse** (**Not Significant**).

6.9.79 Effects will be indirect and temporary and **Not Significant** in EIA terms.

Changes to the tidal, wave, sediment transport regimes and seabed scour as a result of the presence of less than all windfarm infrastructure

Magnitude of impact or change

6.9.80 The installation of any WTG foundations, OSS foundations and cable protection measures all have the potential to result in a localised blockage of waves, tides and sediment transport. Only a partial amount of blockage, due to the presence of 'less than all' of the finally installed windfarm infrastructure, will be present when offshore construction begins, increasing incrementally up to the fully operational scenario. WTG and OSS foundation installation is expected to commence at the beginning of the second year of the construction programme and will last approximately 2 to 2.5 years.

6.9.81 The changes in the currents, wave and sediment transport regimes as a result of the fully operational Proposed Development are set out in **paragraphs 6.10.1** to **6.10.8, paragraphs 6.10.10** to **6.10.16** and **paragraphs 6.10.19** to **6.10.32**, respectively. Changes to waves have been assessed by numerical modelling of various complete layouts and wave climate scenarios and changes to currents and sediment transport have been assessed (in conjunction with the assessment of waves) using an evidence-based approach, as presented in **Appendix 6.3, Volume 4**.

6.9.82 The magnitude of change to these parameters will not be exceeded during the construction (or decommissioning) phase since the number of installed foundations will be less than for the fully operational Proposed Development.

Sensitivity or value of receptor

6.9.83 The receptors which could be affected by changes in the tidal, wave and sediment transport regimes through the presence of Proposed Development infrastructure are considered as follows:

- nationally and internationally designated sites are considered to have a **Medium** sensitivity: although designated, they do have moderate capacity to accommodate the proposed form of change;
- recreational surfing venues are considered to have a **Medium** sensitivity. They have a low capacity to accommodate the proposed form of change and have moderate socioeconomic importance;

- coastline morphology considered to have a **Medium** sensitivity. They have a moderate capacity to accommodate the proposed form of change but is considered to be of regional level importance with respect to its value for biodiversity, socio-economics and coastal defence; and
- nearby offshore sandbanks which are not designated are considered to have a **Low** sensitivity. They have a moderate capacity to accommodate change.

Significance of residual effect

6.9.84 The changes in the wave, tide and sediment transport regimes (including scour) as a result of the fully operational Proposed Development are set out in **Section 6.10** below.

6.10 Preliminary assessment: Operation and maintenance phase

Changes to the tidal regime due to presence of windfarm infrastructure

Overview

6.10.1 The interaction between the tidal regime and the foundations of the wind farm infrastructure will result in a general reduction in current speed and an increase in levels of turbulence locally due to frictional drag and the shape of the structure. Resistance posed by the array (due to the sum of all foundation drag) to the passage of water at a large scale may distort the progression of the tidal wave, also potentially affecting the phase and height of tidal water levels.

6.10.2 Changes to the tidal regime may potentially (indirectly) influence seabed morphology in several ways. In particular, the causal relationship between flow speed and bedform type can be expected (Belderson *et al*., 1982) and thus any changes to flows have the potential to alter seabed morphology over the lifetime of the Proposed Development. More generally, changes in flow may alter the balance between sediment erosion and deposition as well as the rate and direction of sediment transport.

6.10.3 The changes in the tidal regime have been assessed and results presented in **Appendix 6.3, Volume 4**.

Magnitude of impact or change

6.10.4 The Rampion 2 foundation options are considered collectively and individually to be too small and widely dispersed to affect the movement of water at the array scale and therefore will have no measurable effect on the progression of the tidal wave or on associated water levels (tidal or residual surge) at either the local or regional scale. There is no evidence from other operational offshore wind farms to suggest a measurable array scale effect on water levels. This assertion is entirely consistent with numerical modelling undertaken to inform Round 3 developments of broadly comparable (or larger) size to Rampion 2 (for example, East Anglia Offshore Wind, 2012; Moray Offshore Renewables Ltd, 2012, Navitus Bay Development Ltd, 2014).

6.10.5 The presence of the foundations will interfere with passage of tidal currents as a consequence of local drag and blockage effects, which would be expected to lead to a reduction in flow speed behind the structure and the development of a wake.

6.10.6 The lateral dimensions of the wake are likely to be initially similar to the width of the structure (e.g. 30m for a WTG monopile). This is likely to increase (widen) with distance downstream due to diffusion and dispersion of the effect; this is also the normal and natural mechanism for the recovery of time mean current speed and turbulence towards ambient conditions. Conservatively using a maximum leg spacing of 30m for the WTG jacket foundation (similar to the estimated total depth mean blockage cross section), and estimating the maximum measurable wake length as 80 diameters, then the likely extent of a measurable / detectable wake is estimated to be in the order of 2.4km, orientated along the local flood or ebb tidal current axis. This wake length distance is significantly less than the corresponding tidal excursion distance in the array area (11 to 16km, the distance over which water is displaced during each flood or ebb tide).

6.10.7 If these effects described above occurred from the outer limits of the proposed development area, then they are in such a direction that they would not overlap, or would remain too short to reach:

- the adjacent coastlines;
- more than a very small number of other foundations in the adjacent Rampion 1 array area, and only then where two foundations are closely aligned on the local tidal axis; and
- any adjacent sandbank features with designated nature conservation areas.

6.10.8 There are no coastal processes receptors that are sensitive to a change in the tidal regime.

Sensitivity or value of receptor

6.10.9 All the identified coastal process receptors are insensitive to changes in the tidal regime. There is the potential for these changes to affect other aspect receptors, in particular:

- **Chapter 9: Benthic subtidal and intertidal ecology** (due to potential changes in current speed or turbulence); and
- **Chapter 15: Nature conservation** (due to potential changes in current speed or turbulence).

Significance of residual effect

There are no coastal process receptors sensitive to the impact pathway and the assessment of residual effect is not applicable.

Changes to the wave regime through presence of wind farm infrastructure

Overview

6.10.10 The general effect of the wind farm infrastructure is to cause a local reduction in wave height at each foundation, and an array scale reduction in wave height in proportion to the overall blockage density presented by the WTG and substation foundations. The magnitude of the array scale effect on wave height gradually increases with distance downwind from the upwind edge through the array area. The effect then extends downwind of the array, gradually recovering to background values with distance.

6.10.11 The changes in the wave regime have been assessed through the numerical modelling of various completed layouts and wave climate scenarios as presented in **Appendix 6.3, Volume 4** along with figures of numerical model results.

Magnitude of impact or change

6.10.12 The magnitude of change in the wave climate is shown in **Figure 6.4, Volume 3** and is concluded to be the following.

- A very localised area of wave shadowing might occur immediately behind individual foundations, but wave heights are expected to recover rapidly (within a few tens of metres of the foundation) due to normal lateral spreading of the ambient wave energy.
- Associated changes to wave period and direction in the wave shadow are not measurable (namely, less than approximately 0.1 seconds and three degrees, respectively). Where present, the small magnitude of change follows a similar spatial pattern and footprint of effect as wave height, recovering to baseline conditions with distance (order of tens to a few hundreds of metres) downwind from the array.
- The relatively slender WTG monopiles and the single jacket OSS installed in Rampion 1 alone cause little to no effect on wave height greater than 2.5 percent of the baseline condition, either locally around each foundation, or as an array scale effect. A very localised effect between 2.5 and 5 percent is occasionally visible at the location of the Rampion 1 OSS.
- The greatest relative magnitude of effect of MDS jacket WTG and OSS foundations in Rampion 2 and relatively slender WTG monopiles and the smaller single jacket OSS installed in Rampion 1 together is between five and ten percent of the baseline wave height, within and immediately downwind of the Rampion 2 array area, associated with the 50 percent exceedance return period scenario, for each of the wave directions tested. The magnitude of effect reduces to less than five percent within a short distance (three to 4km) downwind of the array area. Even the smallest potentially measurable effects on wave height (more than 2.5 to five percent) do not extend to any of the adjacent coastlines.
- The relative magnitude and extent of the effect is greatest for the 50 percent exceedance return period scenario (the lowest energy wave height condition

considered), and progressively decreases through higher return period scenarios for all of the wave directions tested. This occurs because wave energy is proportional to the product of the wave height and the square of the wave period. A reduction in wave energy at higher energy levels will therefore result in a smaller proportional reduction in wave height. For a given return period, the relative magnitude and extent of the effect is similar for the range of wave directions simulated.

6.10.13 With respect to changes in the wave regime at nearby offshore sandbanks the following is concluded.

- Waves will not be measurably changed (less than five percent wave height, 0.1 seconds for wave period and three degrees for wave direction) at the location of East Bank or the northern part of the Outer Owers Bank. This is partly due to the small scale of change, but also due to the very limited number of wave directions where any change might extend to this particular location.
- The southern part of the Outer Owers Bank (also called Hooe Bank) is closer to and slightly overlaps the far northwest end of the array area of the PEIR Assessment Boundary. Within a relatively narrow corridor extending a few hundred metres downwind of individual WTG foundations sufficiently close to these banks, a local change (reduction) in wave height of up to five to 7.5 percent (but no associated measurable change in wave period or direction) might occur. Outside the narrow downwind corridor, and as a result of more diffuse array scale effects, waves will not be measurably changed (less than 2.5 to five percent wave height, 0.1 seconds for wave period and three degrees wave direction).
- The potential for any interaction is naturally limited by the location of the banks relative to the Rampion 2 array area. Interaction between Rampion 2 and sandbanks around Selsey Bill can only logically occur if foundations for Rampion 2 are located in the western end of the PEIR Assessment Boundary, and sufficiently close to the banks for a meaningful change to extend that far.
- The predominant wave climate controlling the evolution of the sandbanks around Selsey Bill (waves from the southwest and south-southwest, occurring approximately 60 percent of the time) will not pass through the PEIR Assessment Boundary array area and so will not be changed at all in any case. Realistically, only waves coming from the southeast or east-southeast (occurring approximately 12 percent of the time) have the potential to interact with Rampion 2 and then with the various sandbanks around Selsey Bill.

6.10.14 An assessment of the significance of effect with regards to impacts to the morphology of sandbanks around Selsey Bill is provided in relation to changes in sediment transport during the operational phase (**paragraphs 6.10.30** to **6.10.31**).

6.10.15 An assessment of the significance of effect with regards to impacts to the nearby coastlines during the operational phase is also provided (**paragraph 6.10.32**).

6.10.16 With respect to the recreational surfing venues the following is concluded.

- Wave direction is naturally variable over time and only locations directly downwind of the Rampion 2 array area will have any pathway for change under a particular wave condition and therefore intermittent over time. The model results show that the array scale effects extending outside of the array area are relatively dispersed and do not lead to a focussed effect at any particular location.

- Wave height, period and direction (for a wide range of typical everyday to severe storm conditions) will not be measurably changed at any coastal locations, including any recreational surfing venues. The magnitude of impact to recreational surfing venues is therefore considered **Very Low** with no discernible change from background conditions.

Sensitivity or value of receptor

6.10.17 The receptors which could be affected by changes in the wave regime through the presence of Proposed Development infrastructure are considered as follows.

- Recreational surfing venues are considered to have a **Medium** sensitivity. They have a low capacity to accommodate the proposed form of change and have moderate socioeconomic importance.

Significance of residual effect

6.10.18 Taking into consideration the magnitude of change and the sensitivity of the recreational surfing venue receptor, the significance of effect is concluded as **Minor adverse** (**Not Significant**)

The effects will be direct and permanent for the operational phase of the Proposed Development and **Not Significant** in EIA terms.

Changes to the sediment transport regime due to presence of wind farm infrastructure

Overview

6.10.19 Potential changes to the sediment transport regime could occur in response to the presence of the WTG foundations, sub-stations and cable protection measures. These structures may present a direct blockage to the transport of sediment or interact with the tide and wave regimes as follows.

- WTG foundations could potentially result in a reduction in normal current speed and wave energy resulting in wake effects behind WTGs.
- Elevated turbulence may also be present in the wake behind foundations, potentially enhancing the potential sediment transport rate and contributing to the formation of scour (considered in **paragraphs 6.10.36** to **6.10.40**).
- Persistent changes to wave and currents over larger areas could potentially cause changes over time to patterns of net sediment transport (rates and directions) with resulting changes to sedimentary bedform morphology and general seabed bathymetry.

6.10.20 The sensitivity of morphological features to these patterns of change depends upon the relative importance of currents and/or waves, the magnitude and extent of any change to them and the degree to which the system is presently in balance.

Detailed analysis of the potential change resulting from the Rampion 2 infrastructure is outlined in **Appendix 6.3, Volume 4** and is summarised below.

Magnitude of impact or change

Overview

6.10.21 Within the array and deeper offshore sections of the offshore export cable corridor, sediment transport is dominated by the action and asymmetry of tidal currents. The primary change as a result of the wind farm infrastructure is that time averaged current speed will be reduced, but turbulence intensity will also be increased in a narrow wake extending downstream from each foundation. The net effect on bedload sediment transport is a balance of the decrease in overall flow speed and increase in flow turbulence. Very close to the foundation, time mean flow is most reduced, however, the additional turbulence dominates, causing an increase in local sediment transport rate, contributing to local scour.

6.10.22 Time mean current speed may also be increased (typically by only a few centimetres per second) between rows of foundations if the final grid layout is aligned to the tidal axis. However, the difference is very small in absolute and relative terms, within the range of natural variability and not measurable in practice. Little to no net difference in the total flow rate of water through the array is predicted. No measurable changes to sediment transport patterns are expected or have been reported at any other wind farm (including a wide range of environmental settings).

6.10.23 Very localised changes in flow speed could influence overall rates of bedload transport within and nearby to the array area will depend upon the magnitude of change relative to sediment mobilisation thresholds. The overall result of these slight changes in flow speed could potentially be a very small reduction in the net volume of material transported as bedload through the array area. The reduction would likely not be measurable in practice and would be within the range of natural variability in sediment transport rates.

6.10.24 With respect to SSC, changes to tidal currents (which primarily control the rate and direction in which suspended sediment is transported) due to the operation of Rampion 2 is assessed to be very limited in absolute magnitude and spatially restricted to the array area plus a small distance downstream in the main flood and ebb directions.

6.10.25 During large storm events, waves may stir the seabed within shallower parts of the array area, naturally causing an additional short-term contribution to SSC levels. As discussed in **paragraphs 6.10.10** to **6.10.16**, Rampion 2 will potentially cause a small reduction in wave heights within and nearby to the array area and it is therefore possible that there will be a corresponding small reduction in the rate at which sediment is locally re-suspended from the seabed.

6.10.26 The change described above will only be apparent during larger storm events (if at all) and will potentially slightly reduce SSC from the baseline. However, levels of SSC will remain dominated by regional scale inputs that are not affected by the presence of the wind farm. No measurable changes to SSC outside the range of natural variability are expected to occur within or nearby to the array area.

6.10.27 The embedded environmental measures have sought where possible for cable burial to be the preferred option for cable protection (C-45) as identified in **Table 6-10**. However, installation of cable protection is likely to be required in some locations due to geophysical and morphological constraints. The cable protection (rock or alternative) could result in a locally raised obstacle up to 0.5m above the present-day seabed level. Cable protection would be placed onto the seabed surface above the cable and could therefore directly trap or block sediment in transport, locally impacting down-drift locations. The spatial extent and location of the cable protection actually required will be calculated and confirmed at a later stage as part of the Cable Protection Plan.

6.10.28 Following installation and under favourable conditions, an initial period of sediment accumulation may be expected to occur. The largest likely volume of sediment that could accumulate will be associated with the filling any open surface voids and the creation of a smooth stable sediment slope against or over the cable protection. Given the relatively high potential sediment transport rates within the study area, this process of accumulation may take place over a period as short as a few weeks to months, depending on the net rate of sediment transport onto (less any scour or erosion from) the cable protection.

6.10.29 Accordingly, for all areas in which cable protection is used (including where sandwaves are present), it is not expected that the presence of the cable protection devices will continue to affect patterns of sediment transport following any initial period of accumulation. It follows that any changes to seabed morphology away from the cable protection will also be very small. The presence of cable protection measures does not cause a long-term blockage to sediment transport where used within the export cable corridor.

Sandbanks (East Bank & northern Outer Owers Bank)

6.10.30 Waves will not be measurably changed (less than five percent wave height, 0.1 seconds for wave period and three degrees in wave direction) at the location of East Bank or the northern part of the Outer Owers Bank, due to the presence of MDS foundations in Rampion 2, and Rampion 1. This is partly due to the small scale of change, but also due to the very limited number of wave directions where any change might extend to this particular location. Magnitude of impact is therefore considered to be **Very Low** at these locations with changes not discernible from background conditions.

Sandbanks (Hooe Bank & southern Outer Owers)

6.10.31 The southern part of the Outer Owers Bank (also called Hooe Bank) is closer to and slightly overlaps the far north-western end of the array area of the PEIR Assessment Boundary. Within a relatively narrow corridor extending a few hundred metres downwind of individual WTG foundations sufficiently close to these banks, a local change (reduction) in wave height of up to five to 7.5 percent (but no associated measurable change in wave period or direction) might occur. Outside the narrow downwind corridor, and as a result of more diffuse array scale effects, waves will not be measurably changed (less than 2.5 to five percent wave height, 0.1 seconds for wave period and three degrees in wave direction). The magnitude of impact is therefore considered to be **Low** at these locations as the changes are not considered to be sufficiently persistent to result in any morphological change of the banks.

Regional coastline morphology

6.10.32 With respect to changes at the coast, based upon the quantitative analysis of potential changes to the wave regime (**paragraphs 6.10.10** to **6.10.16)** there will be no measurable reduction in wave height at adjacent coastlines. This is because the reductions in wave height along the downwind margin of the array area will be less than 2.5 percent. Changes in wave height of this magnitude are small in both absolute and relative terms. Such small differences are not measurable in practice and would be indistinguishable from normal short term natural variability in wave height (both for individual wave heights and in terms of the overall seastate). Accordingly, these changes are not predicted to have any measurable influence on alongshore or cross-shore sediment transport. Magnitude of impact is therefore considered to be **Very Low** at these locations with changes not discernible from background conditions.

Sensitivity or value of receptor

6.10.33 The receptors which could be affected by changes in the sediment transport regime through the presence of Proposed Development infrastructure are considered as follows:

- nationally and internationally designated sites are considered to have a **Medium** sensitivity: although designated, they have moderate capacity to accommodate the proposed form of change;
- coastline morphology considered to have a **Medium** sensitivity. They have a moderate capacity to accommodate the proposed form of change but is considered to be of regional level importance with respect to its value for biodiversity, socio-economics and coastal defence;
- recreational surfing venues are considered to have a **Medium** sensitivity. They have a low capacity to accommodate the proposed form of change and have moderate socioeconomic importance; and
- nearby offshore sandbanks which are not designated are considered to have a **Low** sensitivity because they have a moderate capacity to accommodate change in the sediment transport regime.

Significance of residual effect

6.10.34 The assessment has concluded that the magnitude of impact of windfarm infrastructure on the sediment transport regime, and hence morphology, for all receptors is Very Low. Based upon the sensitivities identified above, the significance of residual effect is as follows:

- nationally and internationally designated sites: **Minor adverse** (**Not Significant**);
- coastline morphology: **Minor adverse** (**Not Significant**);
- recreational surfing venues: **Minor adverse** (**Not Significant**);

- nearby offshore sandbanks (East Bank & northern Outer Owers Bank: **Negligible** (**Not Significant**); and
- nearby offshore sandbanks (Hooe Bank & southern Outer Owers Bank: **Minor adverse** (**Not Significant**).

6.10.35 These effects will be indirect and permanent for the duration of the windfarm.

Seabed scour due to the presence of windfarm infrastructure

Overview

6.10.36 There is the potential for the seabed around marine structures to become modified from its natural state through scour. This can occur through:

- a different (coarser) surface sediment grain size distribution may develop due to winnowing of finer material by the more energetic flow within the scour pit;
- a different surface character will be present if scour protection (for example, rock protection) is used;
- seabed slopes may be locally steeper in the scour pit; and
- flow speed and turbulence may be locally elevated.

6.10.37 Scour can also potentially impact other aspect receptors through habitat alteration and the volume and rate of additional sediment resuspension.

6.10.38 The magnitude of any change will vary depending upon the foundation type, the local baseline oceanographic and sedimentary environments and the type of scour protection implemented (if needed). In some cases, the modified sediment character within a scour pit may not be so different from the surrounding seabed; however, changes relating to bed slope and elevated flow speed and turbulence close to the foundation are still likely to apply.

Magnitude of impact or change

6.10.39 A detailed scour assessment is provided in **Appendix 6.3, Volume 4**. The assessment assumes that embedded environmental measures in the form of scour protection (C-39) (**Table 6-10**) will be installed subject to the conclusions of the Outline Scour Protection Management Plan (C- 44). The outcomes of the assessment are:

- scour development within the Rampion 2 array area is expected to be dominated by the action of tidal currents;
- scour will only occur if and where scour protection is not applied;
- some or all scour may occur in timescales of hours to days (so before the placement of scour protection) depending on the strength of tidal currents in that place and time. If applied, scour protection will likely cover at least the expected footprint of any scour;

- scour development within the Rampion 2 array area is expected to be dominated by the action of tidal currents but occasional wave contribution is possible for jackets on pin piles in shallower parts of the site;
- erosion resistant (pre-Holocene) material is present at or close to the seabed in most parts of the western array area of the PEIR Assessment Boundary and in the northern part of the eastern array area of the PEIR Assessment Boundary. In practice, this is likely to lead to a natural limitation of scour depth and a related reduction in the footprint and volume of seabed affected by scour in these areas, both for individual foundations and for that proportion of the array as a whole. The following assessment conservatively assumes no such limit to the dimensions of scour;
- the greatest area of local scour (per WTG foundation) is associated with the larger turbine type WTG monopile, with a potential area of 3,669m^2 susceptible to scour development;
- the greatest volume of local scour (per WTG foundation) is associated with the larger WTG type WTG monopile, with a potential scoured volume of 24,950m^3 per foundation;
- for the Rampion 2 array as a whole, the greatest total footprint of local scour will be associated with an array of 75 x larger WTG type WTG monopile foundations and three OSS jacket with pin pile foundations. The potential spatial extent of this scour (excluding the footprint of the foundations) is 278,682m^2, corresponding to approximately 0.10 percent of the total Rampion 2 array area; and
- for the Rampion 2 array as a whole, the greatest total footprint of global scour will be associated with an array of 116 x smaller WTG type WTG jacket with pin pile foundations and three OSS jacket with pin pile foundations. The potential spatial extent of this scour is 370,757m^2, corresponding to approximately 0.14 percent of the total Rampion 2 array area.

6.10.40 There are no coastal processes receptors that are sensitive to the effects of scour.

Sensitivity or value of receptor

6.10.41 All the identified coastal process receptors are insensitive to the scour described in this section. There is the potential for these changes to affect other aspect receptors, in particular:

- **Chapter 8: Fish and shellfish ecology** (due to changes in local seabed level and surface sediment texture in the scour pit);
- **Chapter 9: Benthic subtidal and intertidal ecology** (due to changes in local seabed level and surface sediment texture in the scour pit);
- **Chapter 10: Commercial fisheries** (due to changes in local seabed level and surface sediment texture in the scour pit); and
- **Chapter 15: Nature conservation** (due to changes in local seabed level and surface sediment texture in the scour pit).

Significance of residual effect

6.10.42 There are no coastal process receptors sensitive to scour and the assessment of residual effect is not applicable.

6.11 Preliminary assessment: Decommissioning phase

Changes to SSC, bed levels and sediment type due to removal of foundations

Overview

6.11.1 The following decommissioning activities could potentially give rise to increases in SSC and associated deposition of material within the Rampion 2 array area and export cable corridor:

- removal of foundation structures;
- cutting off of (monopile or jacket) foundation legs;
- cutting off export, array and interconnector cables and leaving in-situ; and/or
- (possible) removal of cables from the intertidal zone or other specific locations.

6.11.2 However, any changes will be comparable (or less than) to those already identified and described for the construction phase (**Section 6.9**).

Magnitude of impact or change

6.11.3 Changes to the wave, tidal or sediment transport regimes as a consequence of the decommissioning phase are mainly related to the local change associated with individual foundations. Changes associated with less than the total number of foundations and amount of cable protection will vary in proportion to the amount installed or removed, and so will only ever be less than the operational phase results during the construction and operation phases.

6.11.4 The removal of WTG foundations is expected to result in some localised seabed disturbance accompanied by temporary increases in SSC. Foundations involving piled solutions would be cut off at or just below bed level, potentially causing a localised disturbance of the bed and a temporary increase in SSC.

6.11.5 Post-decommissioning, the Rampion 2 array area and export cable corridor is expected to return to baseline conditions, within the range of natural variability and allowing for some measure of climate change.

6.11.6 There are no coastal processes receptors that are sensitive to increases in magnitude of SSC and deposition of disturbed sediments to the seabed due to removal of windfarm infrastructure.

Sensitivity or value of receptor

6.11.7 All the identified coastal process receptors are insensitive to changes in SSC and changes in bed levels identified from the assessment. There is the potential for these changes to affect other aspect receptors, in particular:

- **Chapter 8: Fish and shellfish ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 9: Benthic subtidal and intertidal ecology** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 10: Commercial fisheries** (due to potential changes in seabed morphology, smothering and suspended sediments);
- **Chapter 11: Marine mammals** (due to potential changes in suspended sediments affecting prey species and other indirect effects);
- **Chapter 12: Offshore ornithology** (due to potential changes in seabed morphology, smothering and suspended sediments, affecting prey species and other indirect effects);
- **Chapter 15: Nature conservation** (due to potential changes in seabed morphology, smothering and suspended sediments); and
- **Chapter 28: Water environment** (due to potential changes in suspended sediments).

Significance of residual effect

6.11.8 There are no coastal process receptors sensitive to the impact pathway and assessment of residual effect is not applicable.

Changes to landfall morphology due to removal of export cable at the landfall

Magnitude of impact or change

6.11.9 At the point of decommissioning, it is expected that the export cable at and near to the landfall will be buried along its full length, either within a cable trench in the subtidal area (with or without cable protection) or within the HDD conduit under the beach (including any coastal defences and the coastal hinterland).

6.11.10 If and where cables are decommissioned in situ (cut and left buried), they will have no potential to affect coastal processes for as long as they remain buried.

6.11.11 If and where cables are decommissioned by removal, they may need to be pulled or excavated from the seabed, and pulled back through the HDD conduit. The excavation processes will be no greater than that required for the original installation. The dimensions, duration and locations of excavated pits will be no larger than the HDD exit pits and temporary floatation pits described in relation to construction.

6.11.12 If and where cable protection has been present during the operational phase and is removed during decommissioning, the adjacent seabed and beach will reached a new equilibrium morphology. The removal of the protection will allow natural evolution of the beach towards a new equilibrium state controlled by the future baseline condition of the beach.

6.11.13 The magnitude of change will not exceed that described in relation to the construction phase.

Sensitivity or value of receptor

6.11.14 The sensitivity of the Climping Beach SSSI as well as the wider coastal morphology at the landfall is considered to be **Medium**, reflecting that the receptor has some ability to tolerate the potential impacts and can reasonably be expected to recover to its baseline condition should morphological change occur.

Significance of residual effect

6.11.15 The assessment has concluded that the magnitude of impact on the morphology of the landfall arising from decommissioning related activities is either Low or Very Low. Based upon the Medium sensitivity of the receptor identified above, the significance of residual effect is **Minor adverse** (**Not Significant**).

6.11.16 Effects will be indirect and temporary and **Not Significant** in EIA terms.

Changes to the tidal, wave, sediment transport regimes and seabed scour due to removal/presence of less than all windfarm infrastructure

6.11.17 The installation of any WTG foundations, OSS foundations and cable protection measures all have the potential to result in a localised blockage of waves, tides and sediment transport. This blockage will commence when offshore construction begins, increasing incrementally up to fully operational Proposed Development and then reduce as decommissioning commences. WTG and OSS foundation decommissioning may take up to 4 years in total to complete.

6.11.18 The changes in the wave, tide and sediment transport regimes as a result of the fully operational Proposed Development are set out in **Section 6.10** above. This has been assessed through the numerical modelling of various completed layouts and wave climate scenarios as presented in **Appendix 6.3, Volume 4.**

6.11.19 The magnitude of change to these parameters will not be exceeded during the construction (or decommissioning) phase since the number of installed foundations and the amount of cable protection will be less than for the fully operational Proposed Development.

6.11.20 During decommissioning, the removal of some or all infrastructure will result in a partial or complete reduction in the associated potential changes during the operational phase. Although returning to a state closer to the (future) natural baseline condition, this will be experienced as a relative change. Where the local environment has evolved to a new equilibrium with the installed infrastructure during the operational phase, there will be a period of adjustment back to a new natural equilibrium condition in the context of the future baseline environment. The scale and timescale of adjustment will be driven by similar processes and so will occur in a similar manner and rate to that described for the construction and operation phases.

Sensitivity or value of receptor

6.11.21 The receptors which could be affected by changes in the tidal, wave and sediment transport regimes through the presence of Proposed Development infrastructure are considered as follows:

- nationally or internationally designated sites are considered to have a **medium** sensitivity: although designated, they have moderate capacity to accommodate the proposed form of change;
- recreational surfing venues are considered to have a **medium** sensitivity. They have a low capacity to accommodate the proposed form of change and have moderate socioeconomic importance;
- coastline Morphology considered to have a **low** sensitivity. It has a moderate to high capacity to accommodate the proposed form of change but is not designated; and
- nearby offshore sandbanks are considered to have a **low** sensitivity. They have a moderate capacity to accommodate change.

Significance of residual effect

6.11.22 The changes in the wave, tide and sediment transport regimes as a result of the fully operational Proposed Development are set out in **Section 6.10** above.

6.12 Preliminary assessment: Cumulative effects

Approach

6.12.1 A preliminary cumulative effect assessment (CEA) has been carried out for Rampion 2 which examines the results from the combined impacts of Rampion 2 with other developments on the same single receptor or resource and the contribution of Rampion 2 to those impacts. The detailed method followed in identifying and assessing potential cumulative effects in relation to the offshore environment is set out in **Chapter 5, Section 5.10**.

6.12.2 The offshore screening approach has followed the RenewableUK (RenewableUK, 2013) accepted guidance which is specific to the marine elements of an offshore wind farm, addressing the need to consider mobile wide-ranging species (foraging species, migratory routes etc).

Scope of the cumulative effects assessment

6.12.3 For coastal processes the Zone of Influence (ZOI) has been applied for the CEA to ensure direct and indirect cumulative effects can be appropriately identified and assessed as illustrated in **Figure 6.1, Volume 3**. The ZOI for changes to currents and any sediment disturbance related effects is defined by the 'tidal excursion' buffer which describes the greatest distance that water (and any effect it is carrying) is likely to be displaced outside of the array area during a mean spring tidal condition. The wider study area ZOI includes the offshore areas and coastlines that might potentially experience changes to wave conditions as a result of waves passing through the array area.

6.12.4 A short list of other developments that may interact with the Rampion 2 ZOI during their construction, operation or decommissioning is presented in **Appendix 6.3: Coastal Processes Technical Report: Impact Assessment, Volume 4** and **Appendix 5.4: Cumulative effects assessment shortlisted developments, Volume 4** and on **Figure 5.4.1, Volume 4.** This short list has been generated applying criteria set out in **Chapter 5** and has been collated up to the finalisation of the PEIR through desk study, consultation and engagement.

6.12.5 Only those developments and activities in the short list that fall within the coastal processes ZOI have the potential to result in cumulative effects with the Proposed Development. The coastal processes ZOI is shown in **Figure 6.1, Volume 3**. All developments falling outside the coastal processes ZOI are excluded from this assessment.

6.12.6 In terms of the potential for cumulative changes to SSC, bed levels and sediment type, the screening approach is informed using modelled spring tidal excursion ellipses. This is because meaningful sediment plume interaction generally only has the potential to occur if the activities generating the sediment plumes are located within one spring tidal excursion ellipse from one another and occur at the same time.

6.12.7 Given the length and orientation of tidal excursion ellipses in the vicinity of Rampion 2, it is the case that the potential for sediment plume interaction would be limited to instances in which Rampion 2 construction activities occur simultaneously with the following and set out in **Table 6-11:**

- dredge disposal activities; and
- aggregation extraction operations.

6.12.8 On the basis of the above, specific other developments contained within the short list in **Appendix 5.4, Volume 4** are scoped out.

Table 6-11 Developments to be considered as part of the CEA

Development type	Project	Status	Confidence in assessment	Tier	Level of detail of CEA to be adopted
Dredge disposal activities	Open disposal site - Aquind Cable Site A	Open	High – Third-party project details published in the public domain and confirmed as being ‘accurate’ by the developer.	1	Qualitative

Development type	Project	Status	Confidence in assessment	Tier	Level of detail of CEA to be adopted
Aggregation extraction operations	Commercial aggregate dredging	Active	High	Tier 1	Qualitative

6.12.9 Baseline data and further information on other developments will continue to be collected prior to the finalisation of the ES and iteratively fed into the assessment. An updated cumulative effects assessment will be reported in the ES.

6.12.10 The following other developments have the potential to result in cumulative effects on coastal processes, the locations of which are shown in **Figure 6.5, Volume 3**:

- the interaction between sediment plumes generated by Rampion 2 cable or foundation installation activities and dredge disposal operations associated with the Aquind interconnector; and
- active aggregate dredging licence areas (Inner Owers, Inner Owers North and Inner Owers Extension) are sufficiently close (within one tidal excursion distance) that an overlapping plume effect could occur.

Dredge disposal activities

6.12.11 The Aquind interconnector cable corridor will be installed across the seabed at the western end of the PEIR Assessment Boundary is a licenced dredge disposal site (‘Aquind Cable Site A’). Although it is understood that the interconnector will be installed by the end of 2023 (well before construction of Rampion 2), it is possible that future cable reburial activities may require disposal of material at this site. Should Rampion 2 construction activities be occurring at the same time as dredge disposal activities at this site, there could be the potential for cumulative changes in SSC and bed levels.

6.12.12 The interaction between sediment plumes generated by Rampion 2 cable or foundation installation activities and those from nearby dredge disposal operations could occur in two ways:

- where plumes generated from the two different activities meet and coalesce to form one larger plume; or
- where a vessel or barge is disposing of material within the plume generated by Rampion 2 construction activities (or vice versa).

6.12.13 Given the very close proximity of the two activities, it is considered that both types of plume interaction could potentially occur. However, it is noted that in line with UNCLOS, (The United Nations Convention on the Law of the Sea), cable installation vessels typically request a one nautical mile (circa 1.85km) vessel safety zone when installing or handling cables. In addition to direct communications between the ships, this process will likely be managed via vessel management plans and official bulletins, such as notice to mariners. Accordingly, whilst plume interaction may still occur, the potential for much higher concentration and/or more persistent plumes than that previously described in the Proposed Development-alone assessments of SSC is small.

6.12.14 Cumulative increases in bed level could also theoretically occur although the potential for this to occur is expected to be very low, given the expected separation distance of the vessels.

Other aggregate dredging activities

6.12.15 Only a small number of active aggregate dredging license areas (namely: Inner Owers; Inner Owers North; and Inner Owers Extension) are sufficiently close to Rampion 2 (within one tidal excursion distance) that an overlapping plume effect is at all likely.

6.12.16 The aggregate dredging sites are located immediately to the north of the array area and immediately to the east of the export cable corridor. The orientation of the tidal axis means that interaction between plumes created by aggregate dredging and activities in the array area are very unlikely. Some overlap of plumes might occur in relation to export cable burial in the offshore end of the export cable corridor only, however, as assessed in **paragraphs 6.9.21** to **6.9.30**, the extent and duration of sediment plumes from cable burial are very limited.

6.12.17 Any cumulative increase in either the spatial footprint or peak concentration of sediment plumes are therefore likely to be indistinguishable from background levels. Any associated cumulative changes in bed level (different to that already assessed for Rampion 2 alone) are also unlikely to be measurable in practice.

6.13 Transboundary effects

6.13.1 Transboundary effects arise when impacts from a development within one European Economic Area (EEA) states affects the environment of another EEA state(s). A screening of transboundary effects has been carried out and is presented in Appendix B of the Scoping Report (RED, 2020).

6.13.2 No transboundary effects have been identified. This is because the predicted changes to the key coastal process pathways (i.e. tides, waves, and sediment transport) are not anticipated to be sufficient to influence identified receptors at this distance from Rampion 2.

6.14 Inter-related effects

6.14.1 The inter-related effects assessment considers likely significant effects from multiple impacts and activities from the construction, operation and decommissioning of the proposed development on the same receptor.

6.14.2 Potential inter-related effects include:

- Proposed Development lifetime effects: i.e., those arising throughout more than one phase of the Proposed Development (construction, operation, and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one phase were assessed in isolation; and

- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor (or group). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

6.14.3 The coastal processes assessments inherently consider inter-related effects within the range of parameters and impact types set out within this Chapter, with the assessments presenting information on what essentially comprise impact pathways for other topics (for example increased SSC and deposition representing a potential impact pathway for benthic ecology receptors). As such, there is limited potential for inter-related effects to arise on coastal processes.

6.15 Summary of residual effects

6.15.1 **Table 6-12** presents a summary of the preliminary assessment of significant impacts, any relevant embedded environmental measures and residual effects on coastal processes receptors.

Table 6-12 Summary of preliminary assessment of residual effects

Activity and impact	Magnitude of impact or change	Receptor and sensitivity or value	Embedded environmental measures	Preliminary assessment of residual effect (significance)
Construction				
Increases in SSC and deposition of disturbed sediments to the seabed due to drilling for foundation installation	Potential pathway of effect for other aspects			
Increases in SSC and deposition of disturbed sediments to the seabed due to dredging for seabed preparation prior to installing jacket foundations	Potential pathway of effect for other aspects			

Activity and impact	Magnitude of impact or change	Receptor and sensitivity or value	Embedded environmental measures	Preliminary assessment of residual effect (significance)
Increases in SSC and deposition of disturbed sediments to the seabed due to cable installation	Potential pathway of effect for other aspects			
Increases in SSC and deposition of sediment to the seabed due to HDD drilling fluid release	Potential pathway of effect for other aspects			
Changes to landfall morphology due to installation of export cable at the landfall	Low	Local coastline morphology (medium) Designated sites (medium)	C-41, C-42, C-43, C44, C45	Minor adverse (**Not Significant**)
Changes to the tidal, wave, sediment transport regimes and seabed scour as a result of the presence of less than all windfarm infrastructure	Very low	Designated sites (medium)	C-36, C-38, C-39, C-40, C-41, C-42, C-43, C44, C45	Minor adverse (**Not Significant**)
		Regional coastline morphology (medium)		Minor adverse (**Not Significant**)
		Recreational surfing venues (medium)		Minor adverse (**Not Significant**)
		Offshore sandbanks (low)		Negligible (**Not Significant**)

Activity and impact	Magnitude of impact or change	Receptor and sensitivity or value	Embedded environmental measures	Preliminary assessment of residual effect (significance)
Operation and maintenance				
Changes to the tidal regime due to presence of windfarm infrastructure	Potential pathway of effect for other aspects			
Changes to the wave regime (presence of wind farm infrastructure)	Low	Hooe Bank and southern Outer Owers (low)	C-36, C-38, C-39, C-40, C-41, C-42, C-43, C44, C45	Minor adverse (**Not Significant**)
	Very Low	East Bank and northern Outer Owers Bank (low)		Negligible (**Not Significant**)
	Very Low	Surfing Venues (medium)		Minor adverse (**Not Significant**)
Changes to the sediment transport regime due to presence of wind farm infrastructure	Very low	Designated sites (medium)	C-36, C-38, C-39, C-40, C-41, C-42, C-43, C44, C45	Minor adverse (**Not Significant**)
		Regional coastline morphology (medium)		Minor adverse (**Not Significant**)
		Recreational surfing venues (medium)		Minor adverse (**Not Significant**)
		East Bank and northern		Negligible

Activity and impact	Magnitude of impact or change	Receptor and sensitivity or value	Embedded environmental measures	Preliminary assessment of residual effect (significance)
		Outer Owers Bank (low)		(**Not Significant**)
	Low	Hooe Bank and southern Outer Owers (low)		Minor adverse (**Not Significant**)
Seabed scour due to the presence of windfarm infrastructure	Potential pathway of effect for other aspects			
Decommissioning				
Changes to SSC, bed levels and sediment type due to removal of foundations	Potential pathway of effect for other aspects			
Changes to landfall morphology due to removal of export cable at the landfall	Low	Local coastline morphology (medium) Nationally designated sites (medium)	C-42, C-43, C44, C45	Minor adverse (**Not Significant**)
Changes to the tidal, wave, sediment transport regimes and seabed scour due to removal/presence of less than all	Very low	Designated sites (medium)	C-36, C-38, C-39, C-40, C-41, C-42, C-43, C44, C45	Minor adverse (**Not Significant**)
		Regional coastline morphology (medium)		Minor adverse (**Not Significant**)

Activity and impact	Magnitude of impact or change	Receptor and sensitivity or value	Embedded environmental measures	Preliminary assessment of residual effect (significance)
windfarm infrastructure		Recreational surfing venues (medium)		Minor adverse (**Not Significant**)
		Offshore sandbanks (low)		Negligible (**Not Significant**)

6.16 Further work to be undertaken for ES

Introduction

6.16.1 Further work that will be undertaken to support the coastal processes assessment and presented within the ES is set out below.

Baseline

6.16.2 No further baseline information is required but the data collected will continue to be reviewed through to the final ES.

Assessment

6.16.3 Additional assessments will be undertaken using hindcast current speed and direction to estimate net sediment transport rates and directions at more locations within the PEIR Assessment Boundary and the wider study area. External comments received on the PEIR assessments will be addressed in the preparation of the ES.

Consultation and engagement

6.16.4 Further consultation and engagement that will be undertaken to inform the coastal processes assessment and presented within the ES is set out in **Table 6-13.**

Table 6-13 Further consultation and engagement

Consultee	Issues to be addressed	Relevance to assessment
Natural England, Cefas and the MMO.	Results of the PEIR in relation to coastal processes. To be addressed via the Expert Topic Group.	Ongoing consultation and discussion to encourage early agreement with regards to conclusions.

6.17 Glossary of terms and abbreviations

Table 6-14 Glossary of terms and abbreviations

Term (acronym)	Definition
Accretion	Build-up (accumulation) of material solely by the deposition of water or airborne material through natural processes.
Astronomical tide	The tide levels and character which would result from the gravitational effects of the earth sun and moon without any atmospheric influences.
Baseline	Refers to existing conditions as represented by latest available survey and other data which is used as a benchmark for making comparisons to assess the impact of development.
Baseline conditions	The environment as it appears (or would appear) immediately prior to the implementation of the Proposed Development together with any known or foreseeable future changes that will take place before completion of the Proposed Development.
Beach	A deposit of non-cohesive material (for example, sand, gravel) situated on the interface between dry land and the sea (or other large expanse of water) and actively "worked" by present-day hydrodynamic processes (for instance waves, tides and currents) and sometimes by winds.
Beach profile	A cross-section taken perpendicular to a given beach contour; the profile may include the face of a dune or seawall, extend over the backshore, across the foreshore, and seaward underwater into the nearshore zone.
Bedforms	Features on the seabed (for example, sandwaves, ripples) resulting from the movement of sediment over it.

Term (acronym)	Definition
Bedload	Sediment particles that travel near or on the bed.
Benthic	A description for animals, plants and habitats associated with the seabed. All plants and animals that live in, on or near the seabed are benthos.
Biodiversity	Biodiversity is an all-inclusive term to describe the living organisms of the planet.
Centre for Environment, Fisheries and Aquaculture Science (Cefas)	The UK government's marine and freshwater science experts. https://www.cefas.co.uk/
Climate change	A long term trend in the variation of the climate resulting from changes in the global atmospheric and ocean temperatures and affecting mean sea level, wave height, period and direction, wind speed and storm occurrence.
Coast	A strip of land of indefinite length and width that extends from the seashore inland to the first major change in terrain features.
Coastal processes	Collective term covering the action of natural forces on the coastline and adjoining seabed.
Coastal retreat	Natural recession of a coastline over time.
Code of Construction Practice (COCP)	The code sets out the standards and procedures to which developers and contractors must adhere to when undertaking construction of major projects. This will assist with managing the environmental impacts and will identify the main responsibilities and requirements of developers and contractors in constructing their projects.
Cohesive sediment	Sediment containing a significant proportion of clays, the electromagnetic properties of which cause the particles to bind together.
Construction Effects	Used to describe both temporary effects that arise during the construction phases as well as permanent existence effects that arise from the physical existence of development (for example new buildings).
(candidate) Special Area of Conservation (cSAC)	A candidate area for designation as a Special Area of Conservation (SAC).
Cumulative effects	Additional changes caused by a Proposed Development in conjunction with other similar developments or as a combined effect of a set of developments.

Term (acronym)	Definition
Cumulative Effects Assessment	Assessment of impacts as a result of the incremental changes caused by other past, present and reasonably foreseeable human activities and natural processes together with the Proposed Development.
DCO Application	An application for consent to undertake a Nationally Significant Infrastructure Project made to the Planning Inspectorate who will consider the application and make a recommendation to the Secretary of State, who will decide on whether development consent should be granted for the Proposed Development.
Decommissioning	The period during which a development and its associated processes are removed from active operation.
Development Consent Order (DCO)	This is the means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects, under the Planning Act 2008.
Embedded environmental measures	Equate to 'primary environmental measures' as defined by Institute of Environmental Management and Assessment (2016). They are measures to avoid or reduce environmental effects that are directly incorporated into the preferred masterplan for the Proposed Development.
Environmental Impact Assessment (EIA)	The process of evaluating the likely significant environmental effects of a proposed project or development over and above the existing circumstances (or 'baseline').
Environmental measures	Measures which are proposed to prevent, reduce and where possible offset any significant adverse effects (or to avoid, reduce and if possible, remedy identified effects.
Environmental Statement (ES)	The written output presenting the full findings of the Environmental Impact Assessment.
Erosion	Movement of material by such agents as running water, waves, wind, moving ice and gravitational creep.
Expert Topic Group (ETG)	A group of topic experts who will meet to discuss the development of the PERI and ES documents. Typically including representatives from the wind farm developer, the lead EIA consultant, EIA topic consultants, and relevant regulatory stakeholder groups.

Term (acronym)	Definition
Eustatic (changes to mean sea level)	Changes in local mean sea level as a result of changes to the volume of water present in the global ocean, or regional sea, due to climate change.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach and the information required to support the EIA and HRA for certain aspects.
Future baseline	Refers to the situation in future years without the Proposed Development.
Habitat	The place in which a plant or animal lives. It is defined for the marine environment according to geographical location, physiographic features and the physical and chemical environment (including salinity, wave exposure, strength of tidal streams, geology, biological zone, substratum, 'features' (for example, crevices, overhangs, rockpools) and 'modifiers' (for example, sand-scour, wave-surge, substratum mobility).
Hindcast	The retrospective prediction of historical (wind and wave) conditions.
Horizontal Directional Drill (HDD)	An engineering technique avoiding open trenches.
Hydrodynamic regime	The characteristic patterns and statistics of variation in water levels and currents for a given location or area. Potentially includes tidal, surge and other residual flow processes; (does not include waves).
Impact	The changes resulting from an action.
Indirect effects	Effects that result indirectly from the Proposed Development as a consequence of the direct effects, often occurring away from the site, or as a result of a sequence of interrelationships or a complex pathway. They may be separated by distance or in time from the source of the effects.
Intertidal zone	The zone between the highest and lowest tides. May also be referred to as the littoral zone.
Isostatic (changes to mean sea level)	Changes in local mean sea level as a result of changes to the local height of the coastline, due to geological processes.
Lowest Astronomical Tide (LAT)	The lowest tidal water level locally occurring during an approximately 18.6 year period.

Term (acronym)	Definition
Likely Significant Effects	It is a requirement of Environmental Impact Assessment Regulations to determine the likely significant effects of the Proposed Development on the environment which should relate to the level of an effect and the type of effect.
Littoral processes	The movement of beach material in the littoral zone by waves and currents. Includes movement parallel (longshore transport) and perpendicular (onshore-offshore transport) to the shore.
Longshore transport	Or alongshore or littoral drift or transport. Movement of sand and shingle along the shore. It takes place in two zones, at the upper limit of wave activity and in the breaker zone. Movement of beach (sediments) approximately parallel to the coastline.
Magnitude (of change)	A term that combines judgements about the size and scale of the effect, the extent of the area over which it occurs, whether it is reversible or irreversible and whether it is short term or long term in duration'. Also known as the 'degree' or 'nature' of change.
Marine Conservation Zone (MCZ)	An area designated for protection of certain characteristic features under various UK regulations.
Maximum Design Scenario (MDS)	The design scenario corresponding to the greatest potential impacts, out of the range of design options being considered.
Morphological evolution	Change in the dimensions or orientation of a morphological feature as a result of net changes in the volume or location of the material it comprises, for example: the seabed; sediment bedforms; sandbanks; coastlines.
Morphology	Of or relating to the form, shape and structure of landforms
Nationally Significant Infrastructure Project (NSIP)	Nationally Significant Infrastructure Projects are major infrastructure developments in England and Wales which are consented by DCO. These include proposals for renewable energy projects with an installed capacity greater than 100MW.
Neap tides	Tides with the smallest range between high and low water, occurring at the first and third quarters of the moon.

Term (acronym)	Definition
National Policy Statement (NPS)	National Policy Statements are produced by the UK government to describe reasons and objectives for the development of nationally significant infrastructure in a particular sector and state.
Marine Management Organisation (MMO)	The MMO's purpose is to protect and enhance the UK marine environment, and to support UK economic growth by enabling sustainable marine activities and development. https://www.gov.uk/government/organisations/marine-management-organisation
Operation and Maintenance (operation and maintenance)	The operational phase of the wind farm, following construction and up to decommissioning. The wind farm is operational (generating electricity); routine and unplanned maintenance will be undertaken as needed throughout this period.
Ordnance Datum Newlyn (ODN)	An Ordnance Datum is the vertical datum used to define heights in maps from the UK Ordnance Survey. ODN is the Ordnance Datum for Ordnance Surveys in Britain (defined as the mean sea level between 1915 and 1921 at the tide gauge in Newlyn, Cornwall).
Offshore Substation (OSS)	An electrical substation, typically mounted on a foundation, in the offshore environment.
Palaeo-channels	a geological term describing the remains of an inactive river or stream channel that has been filled or buried by younger sediment
Passive dispersion	When the sediment is dispersing by ambient tidal and wave conditions, and turbulence (the dispersion is not influenced by the activity causing the plume).
PEIR Assessment Boundary	The PEIR Assessment Boundary combines the search areas for the offshore and onshore infrastructure associated with the Proposed Development. It is defined as the area within which the Proposed Development and associated infrastructure will be located, including the temporary and permanent construction and operational work areas.
Planning Inspectorate (PINS)	The Planning Inspectorate deals with planning appeals, national infrastructure planning applications, examinations of local plans and other planning-related and specialist casework in England and Wales.

Term (acronym)	Definition
Preliminary Environmental Information Report (PEIR)	The written output of the Environmental Impact Assessment undertaken to date for the Proposed Development. It is developed to support formal consultation and presents the preliminary findings of the assessment to allow an informed view to be developed of the Proposed Development, the assessment approach that has been undertaken, and the preliminary conclusions on the likely significant effects of the Proposed Development and environmental measures proposed.
Proposed Development	The development that is subject to the application for development consent, as described in Chapter 4.
Receptor	These are as defined in Regulation 5(2) of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 and include population and human health, biodiversity, land, soil, water, air, climate, material assets, cultural heritage and landscape that may be at risk from exposure to pollutants which could potentially arise as a result of the Proposed Development.
Regime	The behaviour, statistical properties and trends characterising the variability of hydrodynamic, meteorological, sedimentological and morphological parameters.
Return period	In statistical analysis an event with a return period of N years is likely, on average, to be exceeded only once every N years.
Special Area of Conservation (SAC)	An area designated for protection of certain characteristic features under various UK regulations.
Salinity	Measure of all the salts dissolved in water.
Sandwave asymmetry	Shape of the sandwave as a result of tidal asymmetry
Site of Community Importance (SCI)	An area designated for protection of certain characteristic features under various UK regulations.
Scoping Opinion	A Scoping Opinion is adopted by the Secretary of State for a Proposed Development.
Scoping Report	A report that presents the findings of an initial stage in the Environmental Impact Assessment process.

Term (acronym)	Definition
Scour	Local erosion of sediments caused by local flow acceleration around an obstacle and associated turbulence enhancement.
Seastate	The state of the sea as described using the Douglas sea scale, based on wave height and swell, ranging from 1 to 10, with accompanying descriptions.
Secretary of State	The body who makes the decision to grant development consent.
Sediment	Particulate matter derived from rock, minerals or bioclastic debris.
Sediment deposition	Settlement of sediment in suspension back to the seabed, causing a localised accumulation.
Sediment plume	A sediment plume is a cloud of water containing higher suspended sediment concentration than the surrounding water body. The plumes form as a result of seabed disturbance activities (for example excavation or dredging). Plumes usually begin either at the bottom where the dredging/excavation takes place, or at the surface from either overflow from dredging equipment or disposal of dredged material in a different location.
Sediment transport	The movement of sediment by natural processes, as individual grains or as a collective volume.
Sediment transport pathway	The routes along which net sediment movements occur.
Sensitivity	A term applied to specific receptors, combining judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value associated to that receptor.
Shoreline Management Plan (SMP)	A Shoreline Management Plan (SMP) is a large-scale assessment of the risks associated with coastal processes. It aims to lessen these risks to people and the developed, historic and natural environments.
Significance	A measure of the importance of the environmental effect, defined by criteria specific to the environmental aspect.
Significant effects	It is a requirement of the EIA Regulations to determine the likely significant effects of the development on the environment which should relate to the level of an effect

Term (acronym)	Definition
	and the type of effect. Where possible significant effects should be mitigated.
Significant wave height	The average height of the highest of one third of the waves in a given sea state.
Site of Special Scientific Interest (SSSI)	An area designated for protection of certain characteristic features under various UK regulations.
Special Protection Area (SPA)	An area designated for protection of certain characteristic features under various UK regulations.
Spring tides	Tides with the greatest range which occurs at or just after the new and full moon.
Storm surge	A rise in water level in the open coast due to the action of wind stress as well as atmospheric pressure on the sea surface.
Surficial sediment material	Sediments located at the seabed surface (not necessarily of the same character as underlying sediments).
Surge	In water level as a result of meteorological forcing (wind, high or low barometric pressure) causing a difference between the recorded water level and that predicted using harmonic analysis, may be positive or negative.
Suspended load	The material moving in suspension in a fluid, kept up by the upward components of the turbulent currents or by the colloidal suspension.
Suspended sediment concentration (SCC)	Mass of sediment in suspension per unit volume of water.
Swell waves	Wind-generated waves that have travelled out of their generating area. Swell characteristically exhibits a more regular and longer period and has flatter crests than waves within their fetch.
Temporal Scope	The temporal scope covers the time period over which changes to the environment and the resultant effects are predicted to occur and are typically defined as either being temporary or permanent.
Temporary or permanent effects	Effects may be considered as temporary or permanent. In the case of wind energy development the application is for a 30 year period after which the assessment assumes that decommissioning will occur and that the site will be restored. For these reasons the development is referred to as long term and reversible.

Term (acronym)	Definition
The Applicant	Rampion Extension Development Limited (RED)
Tidal asymmetry	1) Relative difference in peak current speed or duration of adjacent flood and ebb half tidal cycles. 2) Relative difference in high or low water levels or duration of adjacent flood and ebb half tidal cycles.
Tidal excursion	The Lagrangian movement (the physics of fluid motion as an individual fluid parcel moves through space and time) of a water particle during a tidal cycle.
Tidal excursion ellipse	The path followed by a water particle in one complete tidal cycle.
Tide	The periodic rise and fall in the level of the water in oceans and seas; the result of gravitational attraction of the sun and moon.
Turbidity	Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particles. Suspended sediment concentration (SSC) refers to the mineral fraction of the suspended solids load whilst SPM includes both the in-organic and organic component.
United Kingdom Climate Projections (UKCP)	UKCP18 is the name given to the latest UK Climate Projections. UKCP18 provides information on plausible changes in 21st century climate for land and marine regions in the United Kingdom.
Water Framework Directive (WFD)	Laws and regulations regarding the quality of water bodies.
Wind Turbine Generator (WTG)	The combined tower, nacelle and blades of a wind turbine, designed to house and drive a generator to create electricity.
Zone of Influence (ZOI)	The area surrounding the Proposed Development which could result in likely significant effects.

6.18 References

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