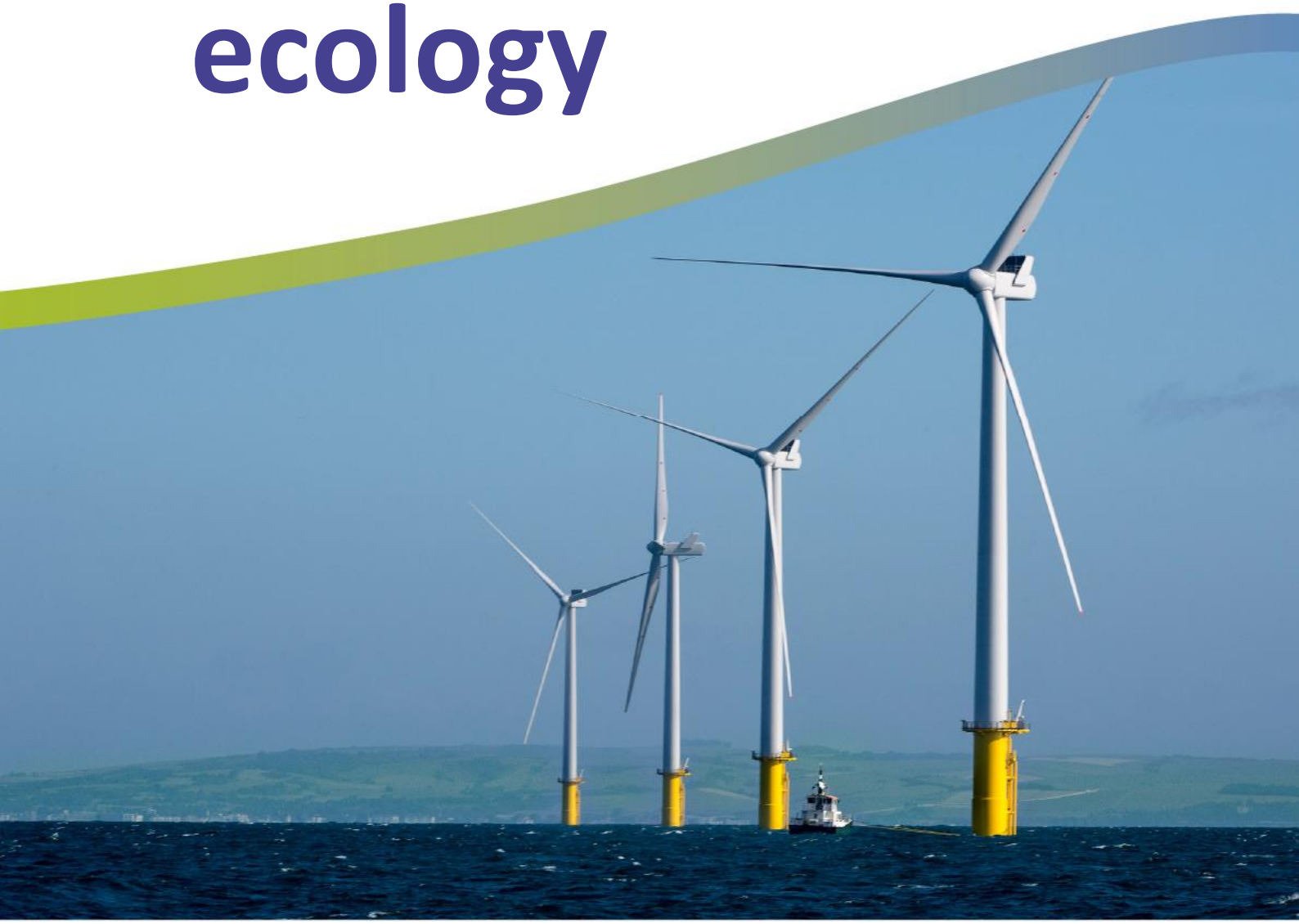
2.9

Rampion 2 WIND FARM

Volume 2, Chapter 9:

Benthic subtidal and intertidal ecology



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9. Benthic Subtidal and Intertidal Ecology

9.1 Introduction

9.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the preliminary results of the assessment of the likely significant effects of the Proposed Development with respect to benthic subtidal and intertidal ecology during construction, operation and maintenance and decommissioning phases. It should be read in conjunction with the project description provided in **Chapter 4: The Proposed Development** and the relevant parts of the following chapters:

- **Chapter 6: Coastal processes:** Changes to coastal processes have the potential to impact benthic subtidal and intertidal ecology receptors directly or indirectly, therefore the information from this assessment will be used to inform the benthic subtidal and intertidal ecology assessment;
- **Chapter 8: Fish and shellfish ecology:** The fish and shellfish ecology aspect include species that live within the benthos and therefore there is a degree of overlap between these topics. They must therefore be informed and assessed in unison, where this applies; and
- **Chapter 14: Nature conservation:** The nature conservation aspect will include designations that relate to protected benthic subtidal and intertidal ecology features and therefore must be considered together.

9.1.2 This chapter describes:

- the legislation, planning policy and other documentation that has informed the assessment (**Section 9.2: Relevant legislation, planning policy, and other documentation**);
- the outcome of consultation engagement that has been undertaken to date, including how matters relating to benthic subtidal and intertidal ecology within the Scoping Opinion received in August 2020 have been addressed (**Section 9.3: Consultation and engagement**);
- the scope of the assessment for benthic subtidal and intertidal ecology (**Section 9.4: Scope of the assessment**);
- the methods used for the baseline data gathering (**Section 9.5: Methodology for baseline data gathering**);
- the overall baseline (**Section 9.6: Baseline conditions**);
- embedded environmental measures relevant to benthic subtidal and intertidal ecology and the relevant maximum design scenario (**Section 9.7: Basis for PEIR assessment**);
- the assessment methods used for the PEIR (**Section 9.8: Methodology for PEIR assessment**);
- the assessment of benthic subtidal and intertidal ecology effects (**Section 9.9 to 9.11: Preliminary assessment** and **Section 9.12: Preliminary assessment: Cumulative effects approach**);

- consideration of transboundary effects (**Section 9.13: Transboundary effects**);
- consideration of Inter-related effects (**Section 9.14: Inter-related effects**);
- a summary of residual effects for benthic subtidal and intertidal ecology (**Section 9.15: Summary of residual effects**);
- an outline of further work to be undertaken for the Environmental Statement (ES) **(Section 9.16: Further work to be undertaken for ES**);
- a glossary of terms and abbreviations is provided in **Section 9.17: Glossary of terms and abbreviations**; and
- a references list is provided in **Section 9.18: References**.

9.1.3 This chapter is supported by the following appendices:

- **Appendix 9.1: Rampion 2 Predictive Seabed Mapping Methods Report, Volume 4**;
- **Appendix 9.2: Rampion 2 Offshore Wind Farm Intertidal Habitats Survey Report, Volume 4**;
- **Appendix 9.3: Rampion 2 Offshore Wind Farm Subtidal Benthic Characterisation Survey Report, Volume 4**; and
- **Appendix 9.4: Rampion 2 Geophysical Survey, Volume 4**.

9.2 Relevant legislation, policy and other information and guidance

Introduction

9.2.1 This section identifies the legislation, policy and other documentation that has informed the assessment of effects with respect to benthic subtidal and intertidal ecology. Further information on policies relevant to the Environmental Impact Assessment (EIA) and their status is provided in **Chapter 2: Policy and legislative context** of this PEIR.

Legislation and national planning policy

9.2.2 **Table 9-1** lists the legislation relevant to the assessment of the effects on benthic subtidal and intertidal ecology receptors.

Table 9-1 Legislation relevant to benthic subtidal and intertidal ecology

Legislation description	Relevance to assessment
EC Directive 92/43/EEC on Conservation of Natural Habitats and Wild Fauna and Flora, 1992 (the 'Habitats Directive')	

Legislation description	Relevance to assessment
The Habitats Directive requires Member States to take measures to maintain or restore natural habitats (listed on Annex I) and wild species (Annex II) at favourable conservation status by the designation of Special Areas of Conservation (SACs). The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) implement the Habitats Directive in relation to marine areas where the UK has jurisdiction beyond territorial waters (broadly 12 nautical miles (nm) to 200 nm). The Conservation of Habitats and Species Regulations 2017 (the Habitats Regulations) implement the Habitats Directive in relation to England and Wales as far as the limit of territorial waters (usually 12 nm).	The Proposed Development is not expected to have any potential effects on benthic subtidal or intertidal habitats or species that are listed as Annex I or Annex II habitats or species as the site does not directly or indirectly overlap with an SAC. A full nature conservation assessment is presented within **Chapter 14**. Sites within the national site network are considered in **Draft Report to Inform Appropriate Assessment (RIAA) (RED, 2021).**
The Wildlife and Countryside Act 1981	
Provides for the further protection of sites of at least national importance for nature conservation and varying levels of protection for species in need of conservation action, or other protection, within the UK. The Act provides for the designation of Sites of Special Scientific Interest (SSSIs). In SACs, Special Protection Areas (SPA) and Ramsar sites, SSSI designations also underpin the terrestrial and intertidal components of these sites.	The PEIR Assessment Boundary overlaps with the Climping Beach SSSI. Embedded mitigation measures (**Table 9-14**) to avoid direct impacts on the intertidal area and therefore Climping Beach SSSI have been provisioned (C–43). Potential indirect impacts to features have been assessed within **Section 9.9** to **Section 9.11**.
Marine and Coastal Access Act 2009	
The Marine and Coastal Access Act 2009 created a new type of Marine Protected Area (MPA) called a Marine Conservation Zone (MCZ), which are of national importance. MCZs are intended to protect areas that are important to conserve the diversity of rare, threatened and representative marine habitats, species, geology and geomorphology in UK waters and they, together with other types of	The PEIR Assessment Boundary does not cross any MCZs. There are three MCZs within the benthic subtidal and intertidal ecology study area (secondary ZOI), which comprise the Kingmere, Offshore Overfalls and Pagham Harbour MCZs. Benthic features of these MCZs have been assessed within **Section 9.9** to **Section 9.11**. A detailed MCZ assessment is

Legislation description	Relevance to assessment
MPAs, deliver the Government's objective for an ecologically coherent network of MPAs. As part of the MCZ process, so-called 'reference areas' will be designated, in which all extractive, depositional and/or disturbing and damaging activities are excluded.	presented in **Appendix 14.1: Marine conservation assessment, Volume 4**.
Natural Environment and Rural Communities (NERC) Act 2006 Section 41 Habitats of Principal Importance	
Places an obligation on public authorities, including local authorities, to encourage effective management of biodiversity. This includes internationally protected sites and habitats and species outside sites designated for their nature conservation importance.	NERC Act (2006) Section 41 Habitats of Principal importance are known to occur across the PEIR Assessment Boundary benthic subtidal study area. Impacts on habitats and species of conservation concern have been assessed within **Section 9.9**, using available literature to undertake a precautionary assessment. Furthermore, a nature conservation assessment is presented in **Chapter 14**.

9.2.3 **Table 9-2** lists the national planning policy relevant to the assessment of the effects on benthic subtidal and intertidal ecology receptors.

Table 9-2 National planning policy relevant to benthic subtidal and intertidal ecology

Policy description	Relevance to assessment
EN-1 NPS for Renewable Energy	
Paragraph 5.3.10 "*Sites of Special Scientific Interest (SSSIs) that are not incorporated within internationally designated sites should be provided with a high degree of protection*". Paragraph 5.3.11 "*Where a proposed development within or outside a SSSI is likely to have an adverse effect on an SSSI (alone or together with other developments) development consent should not normally be granted. If after mitigation an adverse effect is still likely then consent should only be given where the benefits (including need) for a development outweighs the impacts on the SSSI in question and also the wider SSSI*	The PEIR Assessment Boundary overlaps with the Climping Beach SSSI. Embedded mitigation includes measures (**Table 9-14**) to avoid direct impacts on the intertidal area and therefore Climping Beach SSSI have been provisioned (C–43). Potential indirect impacts to features have been assessed within **Section 9.9** to **Section 9.11**.

Policy description	Relevance to assessment
network. The Secretary of State (SoS) should use requirements and/or planning obligations to mitigate the harmful aspects of the development, and where possible, ensure the conservation of the site's biodiversity or geological interest".	
Paragraph 5.3.12 "*The SoS is bound by the duties in relation to MCZs imposed by sections 125 and 126 of the Marine and Coastal Access Act (MCAA) 2009*".	The PEIR Assessment Boundary does not cross or directly overlap with any MCZs. However, there are three MCZs within the benthic subtidal and intertidal ecology study area (secondary ZOI), which include the Kingmere, Offshore Overfalls and Pagham Harbour MCZs. Benthic features of these MCZs have been assessed within **Section 9.9** to **Section 9.11**. Furthermore, a detailed MCZ assessment is presented in **Appendix 14.1, Volume 4**.
EN-3 NPS for Renewable Energy	
Paragraph 2.6.64 "*Applicants should assess the effects on the offshore ecology and biodiversity for all stages of the lifespan of the proposed offshore wind farm*".	The potential effects on offshore ecology and biodiversity associated with the construction, operation and decommissioning of the Proposed Development have been assessed (**Section 9.9** to **Section 9.11**).
Paragraph 2.6.65 "*Consultation on the assessment methodologies should be undertaken at an early stage with the statutory consultees as appropriate*"	Consultation with relevant statutory and non-statutory stakeholders has been carried out from the early stages of the Proposed Development (**Section 9.3**).
Paragraph 2.6.66 "*Any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational offshore wind farms should be referred to where appropriate*".	Post-construction monitoring from other offshore wind farms has informed the assessment of the Proposed Development (**Section 9.9** to **Section 9.11**). The Marine Management Organisation (MMO) have produced a review (MMO, 2014) on post-construction monitoring for offshore wind farms, within which it is noted that there have been limited effects arising on benthic communities from certain impacts. Where appropriate, this chapter cross-refers to those studies, either individually or through reference to the MMO review.
Paragraph 2.6.67 "*Applicants should assess the potential for the scheme to*	Both the positive and negative effects of the Proposed Development on marine

Policy description	Relevance to assessment
have both positive and negative effects on marine ecology and biodiversity".	ecology and biodiversity have been assessed (**Section 9.9** to **Section 9.11**).
Paragraph 2.6.113 "*Applicants should assess the effects on the subtidal environment from habitat loss due to foundations and seabed preparation, predicted scour, scour protection and altered sedimentary processes*", and Paragraph 2.6.81 "*effects on the intertidal zone*".	The assessment has considered effects from all development stages on benthic and intertidal habitats and species in the vicinity of the PEIR Assessment Boundary. These assessments included all likely effects from temporary and long-term habitat loss and the effects of changes in physical processes (**Section 9.9** to **Section 9.11**).
Paragraph 2.6.113 "*Applicants should assess the effects on the benthic environment from extendible legs and anchors of construction vessels*" and Paragraph 2.6.81 "*habitat disturbance in the intertidal zone during cable installation and removal (decommissioning)*".	The assessment has considered the effects of the subtidal and intertidal disturbances throughout all stages of the Proposed Development (**Section 9.9** to **Section 9.11**).
Paragraph 2.6.113 "*Applicants should assess the effects of increased suspended sediment loads during construction on subtidal habitats*" and Paragraph 2.6.81 "*intertidal habitats*".	The likely rates of recovery of benthic species/habitats have been assessed for each impact discussed and have been used to inform each assessment of the significance of the effect (**Section 9.9** to **Section 9.11**).
Paragraph 2.6.113 "*Applicants should include environmental appraisal of array and cable routes and installation methods*".	Effects of cable installation on benthic ecology, based upon maximum design scenarios for cable installation methodologies, are assessed for all stages of the Proposed Development (**Section 9.9** to **Section 9.11**).
The Marine Policy Statement (MPS) (September 2011)	
"The high-level objective of 'Living within environmental limits' covers the points relevant to benthic ecology, this requires, that: 1) Biodiversity is protected, conserved and where appropriate recovered and loss has been halted. 2) Healthy marine and coastal habitats occur across their natural range and are able to support strong, biodiverse biological communities and the	The Proposed Development embedded mitigation (as shown in **Table 9-14**) include measures designed to protect, and conserve benthic ecology features of ecological importance wherever possible.

Policy description	Relevance to assessment
functioning of healthy, resilient and adaptable marine ecosystems. 3) Our oceans support viable populations of representative, rare, vulnerable, and valued species."	
UK Biodiversity Action Plan (BAP) Priority Species and Habitats	
The UK BAP identified priority species and habitats as being the most threatened and requiring conservation action.	Further details of UK BAP habitats are provided in **Section 9.6**, but of particular relevance to the proposed development are bedrock and chalk reef habitat which are listed as UK BAP.

Local planning policy

9.2.4 **Table 9-3** lists the local planning policy relevant to the assessment of the effects on benthic subtidal and intertidal ecology receptors.

Table 9-3 Local planning policy relevant to benthic subtidal and intertidal ecology

Policy description	Relevance to assessment
South Inshore and South Offshore Coast Marine Plan (July 2018)	
Policy Reference: S-MPA-1 '*Any impacts on the objectives of marine protected areas and the ecological coherence of the marine protected area network must be taken account of in strategic level measures and assessments, with due regard given to statutory advice on an ecologically coherent network*.'	Designated nature conservation sites within the PEIR Assessment Boundary benthic subtidal and intertidal ecology study area have been described in **Table 9-11**. Benthic features of marine protected areas have been assessed within **Section 9.9** to **Section 9.11**. Furthermore, a nature conservation assessment is presented in **Chapter 14**.
Policy Reference: S-NIS-1 '*Proposals must put in place appropriate measures to avoid or minimise significant adverse impacts on the marine area that would arise through the introduction and transport of non-indigenous species, particularly when: 1) moving equipment, boats or livestock (for example fish and shellfish) from one water body to another 2) introducing structures suitable for settlement of non-indigenous species, or the spread of invasive non-indigenous species known to exist in the area*.'	The Proposed Development embedded measures (as shown in **Table 9-14**) include measures to avoid the introduction or spread of Marine Invasive Non-Native Species (INNS) through the implementation of the Outline Project Environmental Monitoring and Management Plan (PEMMP) (C-95) which will be secured through Development Consent Order (DCO).

Policy description	Relevance to assessment
Policy Reference: S-BIO-1 '*Proposals that may have significant adverse impacts on natural habitat and species adaptation, migration and connectivity must demonstrate that they will, in order of preference:* *a) avoid, b) minimise c) mitigate significant adverse impacts'*.	The potential effects on offshore ecology and biodiversity associated with the construction, operation and decommissioning of the Proposed Development have been assessed (**Section 9.9** to **Section 9.11**). The Proposed Development embedded mitigation (as shown in **Table 9-14**) include measures designed to protect, and conserve benthic ecology features of ecological importance wherever possible.
Sussex BAP	
A BAP addresses threatened species and habitats, designed to protect and restore biological systems. The overall aim of the Sussex BAP is to conserve and enhance the biological diversity of Sussex and contribute to the conservation and enhancement of both national and international biodiversity.	Further details of BAP habitats are provided in **Section 9.6**, but of particular relevance to the proposed development are the following: Chalk and clay exposures; Ross worm *Sabellaria spinulosa* beds; and subtidal sands and gravels.

Other relevant information and guidance

9.2.5 A summary of other relevant information and guidance relevant to the assessment undertaken for benthic subtidal and intertidal ecology is provided here.

- EIA Directive (11/92/EU) (as amended). Requires adequate characterisation of the receiving environment.
- The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. Requires a description of the relevant aspects of the current state of the environment (baseline scenario).
- The Marine Strategy Framework Directive (MSFD), adopted in July 2008, , and transposed into law (The Marine Strategy Regulations 2010), has also been considered in the PEIR Assessment Boundary for benthic ecology. The relevance of the MSFD to the Proposed Development is described in full in **Chapter 2: Policy and legislative context**. The overarching goal of the MSFD is to achieve 'Good Environmental Status' (GES) by 2020 across Europe's marine environment.
- Guidelines for Ecological Impact Assessment in Britain and Ireland, Marine and Coastal (Institute for Ecology and Environmental Management (IEEM, 2010)).
- Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018). Requires that the baseline conditions for each ecological feature should be described clearly, objectively

and succinctly. Also requires that the ecological information is adequate for the purpose of the EIA.

- Review of post-consent offshore wind farm monitoring data associated with licence conditions (MMO, 2014).
- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Judd, 2012).
- Guidance on Environmental Considerations for Offshore Wind Farm Development (OSPAR, 2008).
- Guidance note for Environmental Impact Assessment in respect of FEPA (Food and Environment Protection Act 1985) and CPA (Coastal Protection Act 1949) requirements (Cefas *et al*., 2004).

9.3 Consultation and engagement

Overview

9.3.1 This section describes the outcome of, and response to, the Scoping Opinion in relation to benthic subtidal and intertidal ecology assessment and also provides details of the ongoing informal consultation that has been undertaken with stakeholders and individuals. An overview of engagement undertaken can be found in **Section 1.5** of **Chapter 1: Introduction**.

9.3.2 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 Microsoft Teams.

Early engagement

9.3.3 Early engagement was undertaken with a number of prescribed and non-prescribed consultation bodies including Natural England, the Marine Management Organisation (MMO) and Centre for Environment, Fisheries and Aquaculture Science (Cefas) in relation to benthic subtidal and intertidal ecology. This engagement was undertaken to introduce the Proposed Development and the proposed approach to scoping the EIA.

9.3.4 Rampion Extension Development Limited (RED) have engaged from the outset with Natural England, the MMO and Cefas, who attended a consultation meeting on 06 May 2020 to discuss the approach to survey methodology.

Scoping opinion

9.3.5 RED submitted a Scoping Report (RED, 2020) and request for a Scoping Opinion to the Secretary of State (administered by the Planning Inspectorate (PINS)) on 2 July 2020. A Scoping Opinion was received on 11 August 2020. The Scoping Report set out the proposed benthic subtidal and intertidal ecology assessment methodologies, outline of the baseline data collected to date and proposed, and the scope of the assessment. **Table 9-4** 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, Volume 4**. Regard has also been given to other stakeholder comments that were received in relation to the Scoping Report.

9.3.6 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 9-4 PINS Scoping Opinion responses – benthic subtidal and intertidal ecology

PINS ID number	Scoping Opinion comment	How this is addressed in this PEIR
4.4.1	*Accidental pollution events (Construction, operation and maintenance and Decommissioning)* The Inspectorate agrees that, with the implementation of measures to limit any potential pollution incidents, any potential impacts on benthic subtidal and intertidal ecology are unlikely to result in significant effects and therefore further assessment is not required. However, the Inspectorate seeks assurances as to the detail of such measures that would be employed and how they would be secured and therefore considers that this detail should be described within the ES.	The likelihood of an incident will be reduced by implementation of an Outline Project Environmental Monitoring and Management Plan (PEMMP) and Outline Marine Pollution Contingency Plan (MPCP); details of which are presented in **Section 9.7** and **Table 9-14**. The impacts of accidental pollution events have also been addressed within the assessment **Section 9.9** to **Section 9.11**, using available literature to undertake a precautionary assessment.
4.4.2	*Electromagnetic fields (EMF) generated by interarray and export cables during operation*. Although the Inspectorate notes the basis of the evidence provided to support the Applicant's proposed approach (Orpwood *et al*. (2015) and Armstrong *et al.* (2015)), the MMO and its technical advisors do not support these findings. The Inspectorate is of the view that uncertainties concerning operation effects of electromagnetic effects remain. The Inspectorate therefore does not agree that likely significant effects upon fish receptors from operational EMF can be excluded	The impacts of EMF on sensitive benthic subtidal ecology receptors have been addressed in **Section 9.10** using available literature to undertake a precautionary assessment.

PINS ID number	Scoping Opinion comment	How this is addressed in this PEIR
	at this stage and this matter should remain scoped into the ES.	
4.4.3	*Noise pollution during construction related activities.* The Scoping Report provides limited evidence to support the request and nothing to demonstrate agreement with relevant consultation bodies. The Inspectorate is not in a position to agree to scope these matters from the assessment. Accordingly, the ES should include an assessment of these matters where significant effects are likely to occur.	The impacts of noise pollution during construction related activities have been addressed within the assessment in **Section 9.9**, using available literature to undertake a precautionary assessment.
4.4.4	*Identification of sites and species.* Table 5.5.2 identifies designated sites and their features which have been screened in for assessment and these include European and nationally designated sites. The ES should ensure that impacts on protected habitats and species (including, but not limited to, those protected under the Habitats Directive, Wildlife and Countryside Act 1981, NERC Act s41 habitats and species of principal importance), together with local BAP habitats and species and other habitats/species of conservation concern are assessed where significant effects are likely.	Impacts on protected habitats and species, together with Local BAP habitats and species and other habitats/species of conservation concern have been assessed within **Section 9.9**, using available literature to undertake a precautionary assessment. Furthermore, a nature conservation assessment is presented in **Chapter 14**.
4.4.5	*C-45 cable burial.* It is not yet confirmed which method of cable protection will be adopted for the proposed development, though it is noted that cable burial is the preferred option. The ES should explain the types of cable protection which could be used, and the associated impacts upon benthic subtidal and intertidal ecology.	The exact form of cable protection to be used will depend upon local ground conditions, hydrodynamic regime/processes, and the selected cable protection contractor. However, the final choice will include one or more of the following: 1) concrete 'mattresses'; 2) rock placement; 3) geotextile bags filled with stone, rock or gravel;

PINS ID number	Scoping Opinion comment	How this is addressed in this PEIR
		4) polyethylene or steel pipe half shells, or sheathes; and 5) bags of grout, concrete, or another substance that cures hard over time. The impacts of introduced artificial substrates have been addressed in **Section 9.10** using available literature and a worst-case scenario to undertake a precautionary assessment.
4.4.6	*Baseline – subtidal sediments.* It is understood that of the eleven sites sampled, four supported levels of contaminants in excess of Action Level 1 for Arsenic and Chromium the ES should explain the significance of this finding, and the risk posed from any other contaminants found in the context of characterising the whole survey area.	The impacts of sediment contamination have been addressed within the assessment **Section 9.9** to **Section 9.11**, using available literature to undertake a precautionary assessment.
4.4.7	*Non-indigenous species.* The ES should include an assessment of the potential for the spread of non-indigenous species via the colonisation of hard substrates and for the Proposed Development to be used to reach the designated hard habitats in the adjacent Kingmere MCZ.	The impacts of Marine INNS have been addressed within the assessment **Section 9.9** to **Section 9.11**, using available literature to undertake a precautionary assessment.

Evidence Plan Process (EPP)

Overview

9.3.7 The EPP has been set up to provide a formal, non-legally binding, independently chaired forum to agree the scope of the EIA and Habitats Regulation Assessment (HRA), and the evidence required to support the DCO Application. For benthic, subtidal and intertidal ecology formal consultation has been ongoing with a number of stakeholders, including Regulators (for example, the MMO), Statutory Nature Conservation Bodies (SNCBS), local authorities, technical expert and interest groups. A summary of consultation undertaken between the completion of the Scoping Report (RED, 2020) and up to March 2021 is outlined in this section.

Natural England

9.3.8 Engagement with Natural England has been ongoing since 04 August 2020 in the form of conference calls and emails.

9.3.9 Natural England were unable to attend the first Coastal Processes, Benthic Ecology and Fish Ecology Expert Topic Group (ETG) meeting on 17 September 2020. However, an additional 'catch-up' ETG meeting was held on 13 October 2020. The proposed methodology was presented and there was a brief discussion of key datasets. Natural England stated during the ETG that they defer to the view of MMO and Cefas in relation to EMF. Natural England noted that they would welcome consultation on the PEMMP and MPCP documents and that they do not currently have any information on the measures that will be included to limit any potential pollution incidents. Therefore, they described it was too early to scope this impact out at this stage and has therefore been included in the assessment (see **Table 9-6** and **Sections 9.9**, **9.10** and **9.11**). No further agreements or disagreements were identified.

9.3.10 On 24 March 2021 the second Coastal Processes, Benthic Ecology and Fish Ecology ETG Meeting was held. The meeting presented an update on the benthic surveys completed since the first ETG Meeting (17 September 2020), discussions on the benthic indicative habitat model approach and a discussion on the comments received on the benthic subtidal and intertidal ecology method statement. Natural England noted that they disagree with the coverage and use of existing data within the benthic habitat model as it would not be considered a full characterisation of the area if it is lacking site-specific data. Natural England noted that the site-specific data may show the same habitat composition as the benthic habitat model, but they cannot make a definitive assessment of what is presented in the model without a full picture. No further agreements or disagreements were identified.

The Marine Management Organisation (MMO)

9.3.11 Engagement with the MMO has been ongoing since 04 August 2020 in the form of conference calls and emails.

9.3.12 On 17 September 2020 the first Coastal Processes, Benthic Ecology and Fish Ecology ETG Meeting was held and the scope of the assessment following scoping opinion responses was discussed. The proposed methodology was presented and there was a brief discussion of key datasets. The MMO confirmed agreement with the conclusion provided by Cefas that the justification to scope out operation EMF, noise and accidental pollution is satisfactory in a written response to the ETG meeting minutes on 30 November 2020. No further agreements or disagreements were identified by the MMO.

9.3.13 On 24 March 2021 the second Coastal Processes, Benthic Ecology and Fish Ecology ETG Meeting was held. The meeting presented an update on the benthic surveys completed since the first ETG Meeting (17 September 2020), discussions on the benthic indicative habitat model approach and a discussion on the comments received on the benthic subtidal and intertidal ecology method statement. No agreements or disagreements were identified.

Centre for Environment, Fisheries and Aquaculture Science (Cefas)

9.3.14 Engagement with the Cefas has been ongoing since August 2020 in the form of conference calls and emails.

9.3.15 On 17 September 2020 the first Coastal Processes, Benthic Ecology and Fish Ecology ETG meeting were held and the scope of the assessment following scoping opinion responses was discussed. The proposed methodology was presented and there was a brief discussion of key datasets. Cefas noted during the ETG meeting that they were happy for operational EMF (in relation to benthic invertebrates), noise and accidental pollution event effects on benthic ecology to be scoped out. No further agreements or disagreements were identified.

9.3.16 On 24 March 2021 the second Coastal Processes, Benthic Ecology and Fish Ecology ETG Meeting was held. The meeting presented an update on the benthic surveys completed since the first ETG Meeting (17 September 2020), discussions on the benthic indicative habitat model approach and a discussion on the comments received on the benthic subtidal and intertidal ecology method statement. Cefas noted in relation to the benthic habitat model approach that is would be useful to have additional new data, however Cefas recognised numerous data was used to create the model. In relation to scoping out EMF and operational noise Cefas initially were content with these out of the assessment. However PINS have requested both EMF and operational noise be scoped in, therefore Cefas have suggested further information and references should be provided in the PEIR assessment to support scoping out (see **Table 9-6** and **Section 9.10**). No further agreements or disagreements were identified.

Environment Agency

9.3.17 Engagement with the Environment Agency has been ongoing since August 2020 in the form of conference calls and emails.

9.3.18 On 17 September 2020 the first Coastal Processes, Benthic Ecology and Fish Ecology ETG meeting was held and the scope of the assessment following scoping opinion responses was discussed. The proposed methodology was presented and there was a brief discussion of key datasets. No agreements or disagreements were identified.

9.3.19 On 24 March 2021 the second Coastal Processes, Benthic Ecology and Fish Ecology ETG Meeting was held. The meeting presented an update on the benthic surveys completed since the first ETG Meeting (17 September 2020), discussions on the benthic indicative habitat model approach and a discussion on the comments received on the benthic subtidal and intertidal ecology method statement. No agreements or disagreements were identified.

The Wildlife Trust and Sussex Wildlife Trust

9.3.20 Engagement with The Wildlife Trust has been ongoing since August 2020 in the form of conference calls and emails.

9.3.21 On 17 September 2020 the first Coastal Processes, Benthic Ecology and Fish Ecology ETG meeting were held and the scope of the assessment following

scoping opinion responses was discussed. The proposed methodology was presented. No agreements or disagreements were identified.

9.3.22 On 24 March 2021 the second Coastal Processes, Benthic Ecology and Fish Ecology ETG Meeting was held. The meeting presented an update on the benthic surveys completed since the first ETG Meeting (17 September 2020), discussions on the benthic indicative habitat model approach and a discussion on the comments received on the benthic subtidal and intertidal ecology method statement. No agreements or disagreements were identified.

East Sussex County Council

9.3.23 Engagement with East Sussex County Council has been ongoing since August 2020 in the form of conference calls and emails.

9.3.24 On 17 September 2020 the first Coastal Processes, Benthic Ecology and Fish Ecology ETG meeting were held and the scope of the assessment following scoping opinion responses was discussed. The proposed methodology was presented and there was a brief discussion of key datasets. East Sussex County Council were unable to attend the meeting. No agreements or disagreements were identified following circulation of the meeting minutes.

9.3.25 On 24 March 2021 the second Coastal Processes, Benthic Ecology and Fish Ecology ETG Meeting was held. The meeting presented an update on the benthic surveys completed since the first ETG Meeting (17 September 2020), discussions on the benthic indicative habitat model approach and a discussion on the comments received on the benthic subtidal and intertidal ecology method statement. No agreements or disagreements were identified.

Informal consultation and engagement

9.3.26 Informal consultation has been ongoing with a number of prescribed and non-prescribed consultation bodies and local authorities in relation to benthic, subtidal and intertidal ecology. The informal consultation was undertaken between 14 January and 11 February 2021.

9.4 Scope of the assessment

Overview

9.4.1 This section sets out the scope of the PEIR assessment for benthic subtidal and intertidal ecology. This scope has been developed as the Proposed Development design has evolved and responds to feedback received to date as set out in **Section 9.3**. 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 the Proposed Development evolves and as a result of ongoing consultation.

Spatial scope and study area

9.4.2 The spatial scope of the benthic subtidal and intertidal ecology assessment is defined as the PEIR Assessment Boundary together with the secondary impact Zone of Influence (ZOI). The secondary ZOI has been informed by the tidal excursion extent and coastal processes modelling undertaken to inform the existing Rampion 1 offshore wind farm EIA (ABPmer, 2012) and the likely extent of potential sediment plume impacts described by the tidal excursion buffer as described in **Chapter 6**. The ZOI buffer therefore encompasses the area over which suspended sediments may travel following disturbance as a result of Proposed Development activities, extending a precautionary 15km around the array, and 10km surrounding the offshore export cable corridor (**Figure 9.1, Volume 3**).

9.4.3 The intertidal ecology study area is defined by the intertidal zone extending up to the Mean High-Water Spring (MHWS) mark within the offshore export cable corridor.

Temporal scope

9.4.4 The temporal scope of the assessment of benthic subtidal and intertidal ecology is the entire lifetime of Rampion 2 which therefore covers the construction, operation and decommissioning periods, as described in **Chapter 4: The Proposed Development**.

Potential receptors

9.4.5 The spatial and temporal scope of the assessment enables the identification of receptors which may experience a potential significant effect as a result of the Proposed Development. The receptors identified that may experience likely significant effects for benthic subtidal and intertidal ecology are described in detail within the baseline characterisation presented in **Section 9.6**. The receptors scoped into the assessment are outlined in **Table 9-5** with further information provided in **Table 9-12**.

Table 9-5 Receptors requiring assessment for benthic subtidal and intertidal ecology

Receptor group	Receptors included within group
Broadscale habitat features	Sandy sediments with low infaunal diversity and sparse epibenthic communities; Coarse and mixed sediments with moderate to high infaunal diversity and scour tolerant epibenthic communities; *S. spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock; Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay; Littoral barren sand and coarse sand with low infaunal diversity; Littoral exposed soft bedrock with burrowing infauna; Littoral rock and non-mobile substrata with ephemeral green or red seaweeds (freshwater or sand-influenced); Littoral sandy sediments with moderate to high infaunal diversity.

Receptor group	Receptors included within group
Features of MCZs	Subtidal chalk; Moderate energy infralittoral rock and thin mixed sediments; Seagrass beds; Defolin's lagoon snail (*Caecum armoricum*); Lagoon sand shrimp (*Gammarus insensibilis*).
Broadscale features of MCZs	Subtidal coarse sediment; Subtidal mixed sediments; Subtidal sand; Moderate energy infralittoral rock.

9.4.6 The list of receptors will be kept under review during the EIA as more detailed information is obtained from the site-specific surveys undertaken as well as any relevant data available from other aspects (technical topics), which will be reflected in the final ES.

Potential effects

9.4.7 Potential effects on benthic subtidal and intertidal ecology receptors that have been scoped in for assessment are summarised in **Table 9-6**.

Table 9-6 Potential effects on benthic subtidal and intertidal ecology receptors scoped in for further assessment

Receptor	Activity or impact	Potential effect
Construction		
Benthic subtidal ecology	Temporary habitat disturbance in the PEIR Assessment Boundary array area and offshore export cable corridor from construction activities	Potential for significant effect to benthic and intertidal resources through temporary, direct habitat loss and disturbance (**Section 9.9**).
Benthic subtidal ecology	Temporary increase in suspended sediment and sediment deposition in the PEIR Assessment Boundary array area and offshore export cable corridor	Potential for significant effect through smothering of sensitive benthic habitats and species (**Section 9.9**).
Benthic intertidal ecology	Temporary increase in Suspended Sediment Concentrations (SSC) and sediment deposition in the intertidal area	Potential for significant effect through smothering of sensitive intertidal habitats and species (**Section 9.9**).
Benthic subtidal & intertidal ecology	Direct and indirect seabed disturbances leading to the release of sediment contaminants	Potential for significant effect through release of sediment bound contaminants into the water column (**Section 9.9**).

Receptor	Activity or impact	Potential effect
Benthic subtidal ecology	Increased risk of introduction or spread of Marine INNS due to presence of partially constructed infrastructure and vessel movements (for example the discharge of ballast water)	Potential for significant effect through increased vessel movements during construction (for example ballast water) and may subsequently impact biodiversity and benthic ecology of the area (**Section 9.9**).
Benthic subtidal & intertidal ecology	Indirect disturbance arising from the accidental release of pollutants	Potential for significant effect through accidental pollution events on benthic and intertidal resources (**Section 9.9**).
Benthic subtidal ecology	Indirect disturbance from increased noise and vibration from construction activities	Potential for significant effect through the indirect disturbance from increased noise and vibration from construction activities (**Section 9.9**).
Operation and maintenance		
Benthic subtidal ecology	Long-term habitat loss/alteration from the presence of foundations, scour protection and cable protection	Potential for significant through loss of suitable substrate or sensitive habitat (**Section 9.10**).
Benthic subtidal ecology	Temporary habitat disturbance from jack-up vessels and cable maintenance activities	Potential for significant effect to benthic and intertidal resources through temporary, direct habitat loss and disturbance (**Section 9.10**).
Benthic subtidal ecology	Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes	Potential for significant effect through changes in the sediment transport and wave regimes resulting in potential effects on benthic communities (**Section 9.10**).
Benthic subtidal ecology	Colonisation of the Wind Turbine Generators (WTG) and scour/cable protection	Potential impacts on benthic ecology biodiversity and productivity due to the introduction of hard substrates (**Section 9.10**).
Benthic subtidal ecology	Increased risk of introduction or spread of Marine INNS due to presence of infrastructure and vessel movements (for	Potential for significant effect through increased vessel movements during construction (for example ballast water) and

Receptor	Activity or impact	Potential effect
	example the discharge of ballast water)	may subsequently impact biodiversity and benthic ecology of the area (**Section 9.10**).
Benthic subtidal ecology	Indirect disturbance arising from the accidental release of pollutants	Potential for significant effect through accidental pollution events on benthic resources (**Section 9.10**).
Benthic subtidal ecology	Indirect disturbance arising from EMF generated by the current flowing through the cables buried to <1.5m below the surface	Potential for significant effect through from EMF on benthic subtidal ecology (**Section 9.10**).
Decommissioning		
Benthic subtidal ecology	Temporary habitat disturbance from decommissioning of foundations, cables and rock protection	Potential for significant effect to benthic and intertidal resources through temporary, direct habitat loss and disturbance (**Section 9.11**).
Benthic subtidal ecology	Temporary increase in suspended sediment and sediment deposition from decommissioning of foundations, cables, and rock protection	Potential for significant effect through smothering of sensitive benthic habitats and species (**Section 9.11**).
Benthic subtidal ecology	Direct and indirect seabed disturbances leading to the release of sediment contaminants	Potential for significant effect through release of sediment bound contaminants into the water column (**Section 9.11**).
Benthic subtidal ecology	Increased risk of introduction or spread of Marine INNS due to presence of partially decommissioned infrastructure and vessel movements (for example the discharge of ballast water)	Potential for significant effect through increased vessel movements during decommissioning (for example ballast water) and may subsequently impact biodiversity and benthic ecology of the area (**Section 9.11**).
Benthic subtidal & intertidal ecology	Indirect disturbance arising from the accidental release of pollutants	Potential for significant effect through accidental pollution events on benthic and intertidal resources (**Section 9.11**).

Activities or impacts scoped out of assessment

9.4.8 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.

9.5 Methodology for baseline data gathering

Overview

9.5.1 Baseline data collection has been undertaken to obtain information over the study areas described in **Section 9.4: Scope of the assessment**. The current baseline conditions presented in **Section 9.6: Baseline conditions** sets out data currently available information from the study area.

Desk study

9.5.2 The data sources that have been collected and used to inform this benthic subtidal and intertidal ecology assessment are summarised in **Table 9-7**.

Table 9-7 Data sources used to inform the benthic subtidal and intertidal ecology PEIR assessment

Source	Date	Summary	Coverage of study area
The existing Rampion 1 benthic ecology baseline characterisation (EMU Limited, 2011)	Survey undertaken in April 2011	Drop-down video (DDV) and grab sampling gear were deployed to collect sediment for analysis (of benthic invertebrates, particle size, total organic carbon, and contaminants) across the existing Rampion 1 offshore wind farm project and surrounding area as part of the baseline characterisation.	Coverage across the benthic subtidal ecology study area, including the PEIR Assessment Boundary.
The existing Rampion 1 cable landfall intertidal baseline characterisation (RSK Environment Ltd, 2011	Survey undertaken in May 2011	A Phase 1 habitat survey across between East Worthing and South Lancing, as well as sampling sediment with a 0.01m^2 hand-core for analysis of benthic invertebrates, particle size, total organic carbon and a range of contaminants.	No coverage within the PEIR Assessment Boundary landfall but provides regional context.

Source	Date	Summary	Coverage of study area
The existing Rampion 1 pre-construction benthic survey report (Natural Power, 2016)	Survey undertaken in September and October 2015	DDV, benthic grab and epibenthic trawl stations were sampled. DDV was deployed to ground-truth areas suspected to be Annex I reef.	Coverage across the benthic subtidal ecology study area, including several points within the PEIR Assessment Boundary.
The existing Rampion 1 post-construction benthic survey report – year 1 (OEL, 2020b)	Survey undertaken in Autumn 2019 and Spring 2020.	Benthic grab and epibenthic trawl stations.	Coverage across the benthic subtidal ecology study area, including several points within the PEIR Assessment Boundary.
UKSeaMap (2018)	2018	EUNIS Level 4 model, detailing biological zone and substrate.	Complete modelled coverage up to MHWS.
Regional Seabed Monitoring Plan (RSMP) baseline dataset (Cooper and Barry, 2017))	Samples have been collected over a period of 48 years from 1969 to 2016, although the vast majority (96 percent) were acquired since 2000	The dataset comprises of 33,198 macrofaunal samples (83 percent with associated data on sediment particle size composition) covering large parts of the UK continental shelf. Data points for the PEIR Assessment Boundary benthic subtidal ecology study area were extracted. Full details on the dataset can be found here: - https://www.cefas.co.uk/data-and-publications/dois/rsmp-baseline-dataset/	Good coverage across the benthic subtidal ecology study area including the PEIR Assessment Boundary.
Biologically informed habitat map (Cooper *et al*., 2019)	As above.	A biologically informed habitat map produced using all available RSMP data. Full details of the habitat map can be found here: - https://doi.org/10.1111/1365-2664.13381	Complete modelled coverage up to MHWS.

Source	Date	Summary	Coverage of study area
Area 435/396, Area 453 and Area 488 Annual Monitoring Reports (EMU Limited, 2009; Fugro EMU Limited, 2013; 2014)	2009 to 2014	Environmental monitoring reports for marine aggregate extraction areas (Area 435/396, Area 453 and Area 488) within the region.	Regional context.
South Coast Regional Environmental Characterisation (REC) (James *et al*., 2010)	2010	South Coast REC. A multidisciplinary marine study of an extensive area of the English Channel. The full report can be found here: - http://nora.nerc.ac.uk/id/eprint/13120/1/OR09051.pdf	Regional dataset and report covering the benthic subtidal ecology study area.
The Eastern English Channel Marine Habitat Map (James *et al*., 2007)	2007	The Eastern English Channel Marine Habitat Map (EECMHM). The study provides regional scale geological and biological interpretations aimed to contribute to the effective stewardship of the marine environment by providing a broader understanding of how the potential resource areas relate to the wider regional ecology and coastal processes. The full report can be found here: - https://www.cefas.co.uk/publications/techrep/tech139.pdf	Regional dataset and report covering the benthic subtidal ecology study area.
The Marine Aggregate Levy Sustainability Fund (MALSF) synthesis study in the central and eastern English Channel (James *et al*., 2011)	2011	The MALSF synthesis study in the central and eastern English Channel. This synthesis report has as its core two REC studies, the EECMHM (James *et al.*, 2007) and the South Coast REC (James *et al.*, 2010). The full report can be found here: -	Regional dataset and report covering the benthic subtidal ecology study area.

Source	Date	Summary	Coverage of study area
		http://nora.nerc.ac.uk/id/eprint/14031/1/OR11001.pdf	

Site surveys

9.5.3 Although the desktop data review provides an important and useful source of evidence in relation to the surrounding areas of seabed and the wider region, site specific sampling has also been undertaken, as agreed with the Coastal Processes, Benthic Ecology and Fish and Shellfish Ecology ETG. **Table 9-8** details the site-specific survey data collected.

9.5.4 The intertidal survey of the landfall and intertidal portion of the offshore export cable corridor was completed in July 2020. Detailed survey methodologies, analysis and results are presented within **Appendix 9.2, Volume 4** and have been summarised in the baseline characterisation (**Section 9.6**).

9.5.5 A subtidal survey of the PEIR Assessment Boundary was completed in February 2021, after lengthy weather delays in addition to delays due to the COVID-19 pandemic restrictions. As a result of these delays, the benthic subtidal analysis was still being undertaken during the drafting of this PEIR. As a consequence, quantitative grab data and DDV imagery were not available for the PEIR. The subtidal survey report is expected to be completed in Q3 2021 and relevant data will be included within the final ES. Relevant available data have been utilised, however, through the provision of predictive habitat mapping to inform the baseline characteristics and features of subtidal habitats to ensure appropriate information is presented at this stage in advance of the grab and video data being incorporated. Additional information on the modelling is presented below (**paragraph 9.5.8**).

9.5.6 The benthic subtidal survey was designed using a strategic and iterative approach, whereby sample locations are coincident with the site-specific geophysical survey lines and representative of key modelled habitats across the PEIR Assessment Boundary. Furthermore, potential conservation features or sensitive habitat which were identified from the geophysical and/or benthic ground-truth data, were further investigated as 'Area(s) of Focus' by DDV and were undertaken to establish the extent and quality of such features (see **Table 9-8**). The data obtained from this survey will be used to update the characterisation of the benthic subtidal environment in terms of sediment type and associated benthic and epibenthic communities and will feed into an update of the predictive habitat model to determine likelihood of biotope presence across the PEIR Assessment Boundary as discussed with the Coastal Processes, Benthic Ecology and Fish Ecology ETG on 24 March 2021 (see **Section 9.3**).

9.5.7 All surveys have been designed to fulfil the aims of the EIA to provide a basis for an assessment of the direct and indirect physical disturbance and displacement during the construction, operation, and decommissioning phases of the Proposed Development. The data obtained will be used to update the characterisation of the benthic subtidal environment in terms of sediment type and associated benthic

and epibenthic communities and will feed into an update of the predictive habitat model to determine likelihood of biotope presence across the PEIR Assessment Boundary.

Table 9-8 Site surveys undertaken to inform the benthic subtidal and intertidal ecology PEIR assessment

Survey type	Scope of survey	Coverage of study area	Survey status
Rampion 2 Geophysical Survey (Gardline, 2020)	Geophysical survey using single-beam and multi-beam echo sounders (SBES and MBES), side scan sonar (SSS), magnetometer and a sub-bottom profiler (SBP).	Full coverage of the of PEIR Assessment Boundary	SBES, MBES and SSS survey was completed between July and August 2020. SBP and magnetometer survey was completed between September and October 2020.
Rampion 2 Benthic Subtidal Survey (Ocean Ecology Limited (OEL), in prep).	43 mini-Hamon grab stations, 23 DDV stations, 39 DDV transects and 15 chemical sampling stations.	Ground-truth locations across the PEIR Assessment Boundary (**Figure 9.2, Volume 3**).	Survey was completed between December 2020 and February 2021. Laboratory analyses of samples were being undertaken at the time of writing PEIR. Results will be incorporated into the ES.
Rampion 2 Intertidal Habitats Survey (OEL, 2020a) (see Appendix 9.2, Volume 4)	Phase I walkover survey carried out landward to mean low water springs (MLWS), 23 quadrat samples, 10 sediment core sites, (two duplicate cores per site), Unmanned Aerial Vehicle (UAV) imagery (1263 high resolution images)	Full coverage of the PEIR Assessment Boundary, in addition to a 25m buffer, from MLWS to MHWS (**Figure 9.2, Volume 3**).	Survey was completed in July 2020 and full sample analysis completed and reported.

Predictive habitat modelling

9.5.8 The Proposed Development predictive habitat model was developed by OEL to provide the most up to date full coverage knowledge on the distribution of

sediments, biological zones and biotopes across the PEIR Assessment Boundary, using the newly acquired site specific acoustic data and wealth of existing ground-truthing data available (see **Table 9-8**). This interim deliverable has been used to inform the baseline characterisation at PEIR while the site-specific survey data are analysed for inclusion into the final ES. The site-specific ground-truthing results will subsequently be fed into the model to produce a final high confidence EUNIS map, which will be available for inclusion into the ES. The EUNIS habitat classification is a comprehensive pan-European system for habitat identification. The classification is hierarchical and covers all types of habitats from natural to artificial, from terrestrial to freshwater and marine. The habitat types are identified by specific codes, names and descriptions. The full methodologies and results of the model are presented within **Appendix 9.1, Volume 4**.

Data limitations

9.5.9 Grab sampling and DDV surveys, while providing detailed information on the infauna and epifauna present, cannot cover wide swaths of the seabed and consequently represent point samples that must be interpreted in combination with the geophysical datasets to produce benthic maps that provide comprehensive cover.

9.5.10 Classification of survey data into benthic habitats and the production of benthic habitat maps from the survey data, while highly useful for assessment purposes, has two main limitations:

- difficulties in defining the precise extents of each biotope, even when using site specific geophysical survey data to characterise the seabed; and
- there is generally a transition from one biotope to another, rather than fixed limits and therefore, the boundaries of where one biotope ends, and another starts often cannot be precisely defined.

9.5.11 Consequently, the biotope maps presented in this chapter should not be considered as definitive, nor should the habitat boundaries be considered to be fixed, they do however represent a robust characterisation of the receiving environment appropriate for the purposes of EIA.

9.6 Baseline conditions

Current baseline

Overview

9.6.1 A detailed baseline description of benthic intertidal ecology resources across the PEIR Assessment Boundary are presented within **Appendix 9.2, Volume 4** and are summarised within the following section. As previously described, benthic subtidal ecology site specific surveys and associated reporting will be available for inclusion into the ES, however for PEIR the current baseline is drawn from the substantial body of existing data and the newly acquired site-specific geophysical datasets that form the base data for the predictive habitat mapping to present detailed information on the distribution of sediments, biological zones and biotopes

across the PEIR Assessment Boundary. Full details of the habitat modelling are presented within **Appendix 9.1, Volume 4**.

Subtidal sediments

9.6.2 Broadscale regional habitat mapping to EUNIS Level 4, detailing biological zone and substrate (UKSeaMap, 2019), indicates that the dominant habitats across the PEIR Assessment Boundary are predominantly characterised by circalittoral coarse sediments, deep circalittoral coarse sediments, and deep circalittoral sand across the mid to offshore portion of the PEIR Assessment Boundary and by sublittoral sediments, infralittoral coarse sediments and circalittoral fine sands or circalittoral muddy sands across the inshore portion of the proposed offshore export cable corridor (**Figure 9.3, Volume 3**). Similar substrates are found across the wider benthic subtidal ecology study area.

9.6.3 UKSeaMap predictions also include Atlantic and Mediterranean low energy infralittoral rock within the inshore regions of the wider benthic subtidal ecology study area. This is further recorded by studies detailing the presence of underwater chalk features in the region (Irving, 1999; James *et al*., 2011). Irving (1999) describes the presence of underwater chalk cliffs and gullies in the region, although these are more likely within 1km of the shore, not the deeper subtidal regions.

9.6.4 **Figure 9.3, Volume 3** represents point sediment data that have been collected across the benthic subtidal ecology study area, as part of monitoring programmes conducted at the existing Rampion 1 offshore wind farm project (EMU Limited, 2011; Natural Power, 2016), in addition to the Regional Seabed Monitoring Plan (RSMP) baseline dataset (Cooper and Barry, 2017). This data shows that the sediments within the western section of the PEIR Assessment Boundary and offshore export cable corridor are predominantly characterised by coarse and mixed sediments. In comparison, the eastern area of the PEIR Assessment Boundary have a greater proportion of sand and muddy sand sediments.

Sediment contamination

9.6.5 As part of the benthic ecology baseline characterisation at Rampion 1 offshore wind farm, surface sediments were tested for a range of contaminants. EMU Limited (2011) undertook the benthic subtidal and intertidal surveys and the results revealed that the levels of contaminants within the sediments were generally low, suggesting sediment across Rampion 1 offshore wind farm will not present any concern for seabed disturbance. However, eleven of the sites sampled supported levels of contaminants in excess of Action Level 1 for Arsenic and Chromium, at four of the sites, prior to construction of Rampion 1 offshore wind farm (EMU Limited, 2011).

9.6.6 Site specific sediment contaminant data from across the PEIR Assessment Boundary was being analysed during the drafting of PEIR, but it should be noted that this information will be presented within the final ES.

Subtidal benthic ecology

9.6.7 As described above, the benthic subtidal ecology study area has been demonstrated to comprise of a mixture sands, muds and gravels which is typical of the wider region, representing a mosaic of different habitat types. James *et al*. (2010) also described the occurrence of occasional and sometimes extensive areas of exposed bedrock and boulder reefs across the central and eastern English Channel.

9.6.8 James *et al*. (2010) described the following variety of these habitats at a regional level.

- Gravel and mixed sediment habitats cover extensive subtidal and offshore areas of the eastern English Channel (Jones *et al*., 2004). Areas of nearshore mixed sediments tend to be formed of variable amounts of sand, gravel and cobble, often mixed with dead shells and shell gravel. In areas where these mixed sediments are stable, settlement and subsequent growth of a rich variety of plant and animal species occurs. The anemones *Anemonia viridis* and *Urticina felina* are typical of gravel areas, with *Cerianthus lloydii* also frequently encountered. The slipper limpet *Crepidula fornicata* (a non-native species) is commonly associated with gravel and its shells can form the main hard substrate in areas of soft sediments. Gravel habitats found in deeper offshore areas (>30 metres), tend to be less affected by natural disturbance than those closer inshore. As a result, these areas tend to support diverse marine fauna which may include a wide range of anemones, polychaete worms.
- Sandy sediments are widespread throughout the eastern English Channel. Sand sediments are found in regions of moderate to strong tidal currents where they can settle but finer particles cannot. In such situations, the sand is often coarse and clean with little mud, but with occasional shell fragments present. Mobile sands tend to be characterised by robust and sometimes impoverished faunas, typically venerid bivalves, amphipods, polychaete worms and heart urchins. Clean sand is favoured by the burrowing heart urchin *Echinocardium cordatum*, the masked crab *Corystes cassivelaunus* and the sea mouse *Aphrodita aculeata*. A number of species, such as the anemones *U. felina* and *Cereus pedunculatus*, are sand tolerant but require an underlying stone or hard substrate for attachment (Collins and Mallinson, 2000). Mobile species typically found in such areas include hermit crabs *Pagurus* spp. and gastropod molluscs such as *Tritia reticulata* and *Buccinum undatum*. Flatfish include brill *Scophthalmus rhombus*, plaice *Pleuronectes platessa*, dab *Limanda limanda* and Dover sole *Solea solea*.
- Mud Habitats are less common because of the exposed nature of the seabed in much of the eastern English Channel, few areas of mud-dominated sediment are present except in deeper, sheltered, inshore waters such as the Solent. Generally, the muddy and silty sediments of the Solent contain chains of slipper limpets *C. fornicata*, which provide attachment for other organisms such as hydroids (for example *Kirchenpaueria pinnata* and *Hydrallmania falcata*) and sponges (for example *Halichondria* spp. and *Suberites* spp.). Several small crab species, such as *Pisidia longicornis, Macropodia rostrata* and *Pagurus bernhardus*, are found in cover provided by the slipper limpet shell epifauna. Polychaete worms, bivalve molluscs such as cockles, and brittlestars can also be numerically dominant in

mud habitats where hard biogenic substrates (for instance *Crepidula* shells) are absent.

- Rock Habitats: the type of organisms that can colonise rock habitats, including stony reefs, can be strongly influenced by the type of rock present, be it chalk, sandstone or limestone. Therefore, benthic assemblages tend to differ between rocky substrate types. Generally, harder rock habitats are often colonised by keelworms *Spirobranchus triqueter* and by barnacles *Balanus* spp. In slightly deeper water, the hydroids *Halecium halecinum, K. pinnata, H. falcata, Nemertesia antennina* and the foliose bryozoan *Flustra foliacea* can be found. Mobile species commonly found on rock are the whelk *B. undatum,* the topshell *Gibbula cineraria* and the netted dogwhelk *Hinia reticulata,* together with hermit crabs *Pagurus spp.* and the swimming crabs *Liocarcinus spp.* Where there is foliose algal cover there is a greater range of mobile fauna, including the spider crabs *M. rostrata* and *Pisa tetraodon.* In even deeper water, several species of sponge are likely to be conspicuous, including *Esperiopsis fucorum* and *Dysidea fragilis*. Ross coral *Pentapora foliacea,* a bryozoan is often conspicuous on bedrock outcrops. Softer chalk reef habitats in the eastern English Channel (which represent 75 percent of all chalk reefs in Europe) support a wide range of characteristic species, some of which are predominantly found on or in this type of substrate. A number of species are capable of boring into the rock, and these tend to dominate the associated subtidal communities. These species include bivalve piddocks (in particular *Pholas dactylus*, *Hiatella arctica*, *Barnea* spp. and *Petricola pholadiformis*), polychaete worms (especially spionids) and sponges. The biotope dominated by piddocks is often the most widespread of the biotopes which occur on these reefs.

Predictive subtidal habitat and biotope maps

9.6.9 The results from the OEL predictive habitat modelling revealed that seven biotopes were identified as occurring throughout the PEIR Assessment Boundary. The biotopes are presented in **Table 9-9** and their predicted spatial distribution are presented in **Figure 9.4, Volume 3**. A description of each biotope identified is also presented below.

Table 9-9 Key biotopes recorded from the predictive habitat mapping exercise of the PEIR Assessment Boundary

EUNIS BSH	EUNIS Code	EUNIS Description
A3.2 – Atlantic and Mediterranean moderate energy infralittoral rock	A3.215	*S. spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock
A4.2 – Atlantic and Mediterranean moderate energy circalittoral rock	A4.231	Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay

EUNIS BSH	EUNIS Code	EUNIS Description
A5.1 – Sublittoral coarse sediment	A5.141	*S. triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
	A5.142	*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel
A5.2 – Sublittoral sand	A5.231	Infralittoral mobile clean sand with sparse fauna
A5.4 – Sublittoral mixed sediments	A5.431	*C. fornicata* with ascidians and anemones on infralittoral coarse mixed sediment
	A5.444	*F. foliacea* and *H. falcata* on tide-swept circalittoral mixed sediment

- *Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock[1] (A3.215)*: Laminaria hyperborean* kelp forest on shallow infralittoral bedrock and boulders characterised by encrustations of *S. spinulosa* tubes which cover much of the rock, together with sand-tolerant red seaweeds such as *Phyllophora pseudoceranoides, Dilsea carnosa* and *Polysiphonia elongate* and *Polysiphonia fucoides*. Red seaweeds such as *Plocamium cartilagineum* and *Delesseria sanguinea* may also be found beneath the kelp canopy, although typically low in abundance. They can be colonised by the ascidian *Botryllus schlosseri*. The cowrie *Trivia arctica* can also be found here. Much of the available rock is covered with encrusting coralline algae together with patches of the encrusting sponge *Halichondria panicea* and the anthozoan *U. felina.* More mobile fauna include the echinoderms *Asterias rubens, Henricia sanguinolenta, Echinus esculentus*, and *Ophiothrix fragilis,* the gastropod *G. cineraria* and the hermit crab *P. bernhardus*. The scouring effect of mobile sand adjacent to the rock maintains a reduced underflora and fauna compared to the association of species found in non-scoured kelp forests. Scour-resistant fauna such as the barnacle *Balanus crenatus* can be locally abundant on the rock, while the bivalve *Pododesmus patelliformis* can be found seeking shelter underneath the cobbles. Above the effect of scour, kelp stipes may be densely colonised by red seaweeds such as *Phycodrys rubens*, *Palmaria palmata* and *Membranoptera alata*, together with some sponges and ascidians.
- Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay[2] (A4.231): This biotope occurs on circalittoral soft rock, such as soft chalk or clay, most often in moderately exposed tide-swept conditions. As soft chalk and firm clay are often too soft for sessile filter-feeding animals to attach and thrive in large numbers, an extremely impoverished epifauna results on upward-facing surfaces, although vertical faces may be somewhat richer. The rock is sufficiently soft to be bored by bivalves. Species vary with location, but *P. dactylus* is the most

[1] https://mhc.jncc.gov.uk/biotopes/jnccmncr00000723
[2] https://mhc.jncc.gov.uk/biotopes/jnccmncr00002162

widespread borer and may be abundant. Other species present may include the sponges *D. fragilis* and *Suberites carnosus* and the polychaete *Bispira volutacornis*. Foliose red algae may be present on the harder, more stable areas of rock. Mobile fauna often include the crabs *Necora puber* and *Cancer pagurus*.

- *Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles[3] (A5.141): This biotope is characterised by a few ubiquitous robust and/or fast growing ephemeral species which are able to colonise pebbles and unstable cobbles and slates which are regularly moved by wave and tidal action. The main cover organisms tend to be restricted to calcareous tube worms such as *S. triqueter*, small barnacles including *B. crenatus* and *Balanus balanus*, and a few bryozoan and coralline algal crusts. Scour action from the mobile substratum prevents colonisation by more delicate species. Occasionally in tide-swept conditions tufts of hydroids such as *Sertularia argentea* and *H. falcata* are present. This biotope often grades into SMX.FluHyd which is characterised by large amounts of the above hydroids on stones also covered in *S. triqueter* and barnacles. The main difference here is that SMX.FluHyd, seems to develop on more stable, consolidated cobbles and pebbles or larger stones set in sediment in moderate tides. These stones may be disturbed in the winter and therefore long-lived and fragile species are not found.
- *Mediomastus fragilis, Lumbrineris spp.* and venerid bivalves in circalittoral coarse sand or gravel [4] (A5.142): Circalittoral gravels, coarse to medium sands, and shell gravels, sometimes with a small amount of silt and generally in relatively deep water (generally over 15 to 20m), may be characterised by polychaetes such as *M. fragilis, Lumbrineris* spp., *Glycera lapidum* with the sea urchin *Echinocyamus pusillus*. Other taxa may include Nemertea spp., *Protodorvillea kefersteini, Owenia fusiformis, Spiophanes bombyx* and *Amphipholis squamata* along with amphipods such as *Ampelisca spinipes*.
- Infralittoral mobile clean sand with sparse fauna[5] (A5.231): Medium to fine sandy sediment in shallow water, often formed into dunes, on exposed or tide-swept coasts often contains very little infauna due to the mobility of the substratum. Some opportunistic populations of infaunal amphipods may occur, particularly in less mobile examples in conjunction with low numbers of mysids such as *Gastrosaccus spinifer*, the polychaete *Nephtys cirrosa* and the isopod *Eurydice pulchra*. Sand eels *Ammodytes* spp. may occasionally be observed in association with this biotope.
- *Crepidula fornicata* with ascidians and anemones on infralittoral coarse mixed sediment[6] (A5.431): Medium-coarse sands with gravel, shells, pebbles and cobbles on moderately exposed coasts may support populations of the slipper limpet *C. fornicata* with ascidians and anemones. *C. fornicata* is common in this biotope though not as abundant as in the muddier estuarine biotope CreMed to which this is related. Anemones such as *U. felina* and *Alcyonium digitatum* and ascidians such as *Styela clava* are typically found in this biotope. Bryozoans such as *F. foliacea* are also found along with polychaetes such as *Lanice conchilega*.

[3] https://mhc.jncc.gov.uk/biotopes/jnccmncr00000659
[4] https://mhc.jncc.gov.uk/biotopes/jnccmncr00002012
[5] https://mhc.jncc.gov.uk/biotopes/jnccmncr00000775
[6] https://mhc.jncc.gov.uk/biotopes/jnccmncr00001227

Little information is available with regard the infauna of this biotope but given the nature of the sediment the infaunal communities are liable to resemble those in biotopes from the SCS habitat complex. This biotope could be considered a superficial or epibiotic overlay but more data are required to support this.

- *Flustra foliacea and Hydrallmania falcata on tide-swept circalittoral mixed sediment*[7] (A5.444): This biotope represents part of a transition between sand-scoured circalittoral rock where the epifauna is conspicuous enough to be considered as a biotope and a sediment biotope where an infaunal sample is required to characterise it and is possibly best considered an epibiotic overlay. *F. foliacea* and the hydroid *H. falcata* characterise this biotope; lesser amounts of other hydroids such as *S. argentea, N. antennina* and occasionally *Nemertesia ramose*, occur where suitably stable hard substrata is found. The anemone *U. felina* and the soft coral *A. digitatum* may also characterise this biotope. Barnacles *B. crenatus* and tube worms *S. triqueter* may be present and the robust bryozoans *Alcyonidium diaphanum* and *Vesicularia spinosa* appear amongst the hydroids at a few sites. *Sabella pavonina* and *L. conchilega* may be occasionally found in the coarse sediment around the stones. In shallower (for instance upper circalittoral) examples of this biotope scour-tolerant robust red algae such as *Polysiphonia nigrescens, Calliblepharis* spp. and *Gracilaria gracilis* are found.

Intertidal benthic ecology

9.6.10 The location of landfall that has been identified by the PEIR Assessment Boundary is shown in **Figure 9.1, Volume 3**. Existing intertidal habitat mapping (MagicMap) suggests the biotopes present within Climping Beach and the surrounding area primarily consist of intertidal sand and gravel. The eastern part of the PEIR Assessment Boundary is dominated by finer sand (EUNIS A2.2). Coarser sediments, including gravel and cobbles (EUNIS A2,1 and A5.1), are the most abundant habitats present in the central areas and to the west. Occasional rocky areas (EUNIS A1) occur, particularly around coastal defence structures.

9.6.11 Full details of the site-specific Phase I walkover, the UAV mapping and Phase II sampling survey undertaken across the intertidal ecology study area are detailed within **Appendix 9.2, Volume 4**, with the summary of results presented within this section.

9.6.12 Habitat and biotope mapping of the intertidal area across the intertidal ecology study area revealed that there was a total of nine unique biotopes (EUNIS level 5 or above) from a total of four broadscale habitats (**Table 9-10**) as mapped in **Figure 9.5, Volume 3** to **Figure 9.7, Volume 3**.

9.6.13 The extreme upper shore of the eastern section of the survey area was characterised by shingle with sea kale *Crambe maritima* (B2.32) giving way to a steep bank of shingle (pebbles) and gravel representative of the biotope A2.11 (**Figure 9.5, Volume 3**). A narrow strandline habitat (A2.21) was present within the transition zone between A2.11 and a sandier area characterised by polychaete/amphipod- dominated fine sand shores (A2.23). The mid shore area was generally dominated by fine sand representative of the biotope A2.23

[7] https://mhc.jncc.gov.uk/biotopes/jnccmncr00000460

interspersed with muddy sand supporting the sandworm *Arenicola marina* and representative of the biotope A2.24. The lower shore was a mosaic of littoral rocks and sandy sediments consisting of chalk pebbles as well as bored chalk often covered in green and red seaweeds (A1.45) with small patches of fine rippled sand supporting the polychaete *L. conchilega* (A2.245) (**Figure 9.5, Volume 3**).

9.6.14 The middle section of the survey area showed a zonation similar to that of the east zone but with no *C. maritima* and a much narrower shingle bank in the upper shore (A2.11) (**Figure 9.6, Volume 3**). The mid shore was similarly dominated by fine and muddy sands representative of the biotopes A2.2, A2.23 and A2.24; however, outcropping chalk and clay exposures (A1.46) were also observed in the upper shore.

9.6.15 The western area had coarser sediments in the upper shore grading into fine sand/muddy sand in the mid shore (**Figure 9.7, Volume 3**). A larger area of chalk outcrops was present in the upper and mid shore area as well as a number of rockpools characterised by the presence of green and red seaweeds (A1.45). The lower shore was fringed with more littoral rocks consisting of chalk pebbles covered in *Ulva* spp. The area to the west of Climping beach was also interspersed with various artificial defences including rock armour groynes running parallel to the shore with barnacles (Balanoidea) on the lower two metres and bare rock above. Wooden groin structures running down the shore were either covered in *Ulva* spp. and *Fucus spiralis* or Balanoidea (**Figure 9.7, Volume 3**).

9.6.16 A summary of EUNIS classifications recorded during the survey is provided in **Appendix 9.2, Volume 4** along with supporting example photographs.

Table 9-10 Key biotopes recorded from the intertidal survey of PEIR Assessment Boundary intertidal ecology study area

EUNIS BSH	EUNIS Code	EUNIS Description
A1.4 – Features of Littoral Rock	A1.45	Ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrata
	A1.46	Hydrolittoral soft rock
A2.1 – Littoral Coarse Sediment	A2.11	Shingle (pebble) and gravel shores
	A2.111	Barren littoral shingle
A2.2 – Littoral Sand and Muddy Sand	A2.21	Strandline
	A2.23	Polychaete/amphipod-dominated fine sand shores
	A2.24	Polychaete/bivalve-dominated muddy sand shores
	A2.245	*L. conchilega* in littoral sand

EUNIS BSH	EUNIS Code	EUNIS Description
B2.3 – Upper shingle beaches with open vegetation	B2.32	Channel *C. maritima* communities

Features of conservation interest

9.6.17 Outcrops of bedrock forming reef features, some of which comprise chalk substrata, are known to occur through the inshore portion of the benthic subtidal ecology study area. These features were positively identified in the existing Rampion 1 offshore wind farm characterisation study (EMU Limited, 2011) and have been identified through the predictive habitat mapping process as biotopes '*Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock (A3.215)' and 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231)' (**Figure 9-4, Volume 3**). Both bedrock and chalk reef habitat are listed as UK BAP and were those that were identified as being the most threatened and requiring conservation action under the UK BAP, as required under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006.

9.6.18 The reef forming worm *S. spinulosa* was recorded within grab samples collected during the existing Rampion 1 offshore wind farm characterisation study, although no biogenic reef from this species was identified (EMU Limited, 2011), nor was it found during the pre-construction survey (Natural Power, 2015) and post-construction survey campaign (OEL, 2020b). James *et al*. (2011) noted that although *S. spinulosa* is widespread within the central and eastern English Channel the presence of large reef structures is limited.

9.6.19 In addition to the above, NERC Act (2006) Section 41 Habitats of Principal importance are known to occur across the PEIR Assessment Boundary benthic subtidal study area. These include 'Sheltered Muddy Gravels' and 'Subtidal Sands and Gravel'.

9.6.20 Areas of rock noted across the intertidal survey area were almost entirely made up of rockpools dominated by chalk cobbles and bored chalk covered in green seaweeds; these were deemed to be representative of the biotope 'ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrata (A1.45)'. These features of littoral rock are protected here under NERC Act 2006. Significant portions of the upper and middle shore were dominated by chalk outcrops and clay exposures 'hydrolittoral soft rock (A1.46)', especially to the west of the survey area also representative of NERC habitats. Habitats of Principal importance include 'mudflats and sandflats not covered by seawater at low tide'.

Designated sites

9.6.21 The PEIR Assessment Boundary does not overlap spatially with the International site network (for instance SACs and SPAs) with benthic ecology features. A few nationally designated sites overlap with the proposed offshore export cable

corridor landfall as detailed within **Table 9-11**. The sites that lie in the area of potential secondary impact (ZOI) of the Proposed Development are also detailed in **Table 9-11**. This table also summarises the qualifying features that relate to seabed habitats and benthic subtidal and intertidal ecology and the distance from the closest part of the PEIR Assessment Boundary. The locations of sites are presented in **Figure 9-8, Volume 3**.

9.6.22 As no subtidal designated sites with benthic ecology features directly overlap with the PEIR Assessment Boundary, there will be no direct impact assessment on any designated sites. An assessment of indirect impacts (for example changes in SSC and/or sediment deposition) as determined by the assessment presented in **Chapter 6** has been undertaken on relevant benthic subtidal ecology features within sites that have the potential to be indirectly affected by the Proposed Development. Those benthic subtidal ecology and seabed habitat features of designated sites with a 15km buffer surrounding the array area, and a 10km buffer around the offshore export cable corridor PEIR Assessment Boundary have been screened into the assessment.

9.6.23 Two intertidal designates sites with intertidal ecology features overlap with the PEIR Assessment Boundary, however there will be no direct impact assessment of features within these designated sites, as the Proposed Development embedded mitigation (as shown in **Table 9-14**) include measures to avoid any direct impact to these features through horizontal directional drilling (HDD) installation work (C-43). Indirect impacts on these features have been assessed.

9.6.24 A full assessment of the potential impacts to Nature Conservation is provided in **Chapter 14**. An assessment of the potential impacts on MCZs is provided in **Appendix 14.1, Volume 4**. Several of the benthic ecological qualifying broadscale habitat features of the MCZs are predicted to occur within the PEIR Assessment Boundary (although there is no spatial overlap with the MCZ sites) and have therefore been assessed for both direct and indirect impacts, as per the normal assessment. Where broadscale habitat or marine features were not found within the PEIR Assessment Boundary, these features have only been assessed under the indirect impact assessment.

Table 9-11 Marine nature conservation designations with relevance to benthic subtidal and intertidal ecology

Site	Location relative to the Proposed Development	Features or description
International		
Solent and Dorset Coast SPA	Approximately 1km from the PEIR Assessment Boundary	The site has been designated to protect internationally important breeding populations of common tern (*Sterna hirundo*), Sanwich tern (*Sterna sandvicensis*) and little tern (*Sternula albifrons*).

Site	Location relative to the Proposed Development	Features or description
Pagham Harbour SPA	Approximately 10km from the PEIR Assessment Boundary	This site is designated as the estuarine basin is made up of an extensive central area of saltmarsh and intertidal mudflats, surrounded by lagoons, shingle, open water, reed swamp and wet permanent grassland. The mudflats are rich in invertebrates and algae and provide important feeding areas for the many bird species that use the site.
National		
Kingmere MCZ	Lies adjacent to the PEIR Assessment Boundary offshore export cable corridor	Kingmere MCZ is named after Kingmere Rocks, which is a rocky and boulder reef running through the middle of the site. There are also areas of chalk and different types of sediment. It is a place where black seabream (*Spondyliosoma cantharus*) come to breed in the spring. The features of this site are moderate energy infralittoral rock and thin mixed sediments, subtidal chalk and black seabream.
Offshore Overfalls MCZ	Lies adjacent to the PEIR Assessment Boundary array area	The site is designated for several marine habitats including subtidal coarse sediment, subtidal mixed sediments, subtidal sand and English Channel outburst flood features.
Pagham Harbour MCZ	Approximately 10km from the PEIR Assessment Boundary	This site is designated for several marine features including: Seagrass beds, defolin's lagoon snail (*C. armoricum*), and the Lagoon sand shrimp (*G. insensibilis*).
Climping Beach SSSI	Overlaps with the PEIR Assessment Boundary offshore export cable corridor landfall	This site is designated for aggregations of non-breeding birds including sanderling and *Calidris alba* as well as coastal vegetated shingle, fixed dune grassland and sand dune communities.
Local		
West Beach Local Nature Reserve (LNR)	Overlaps with the PEIR Assessment Boundary offshore export cable corridor landfall	The West Beach LNR is part of the Climping Beach SSSI. It includes sand dunes, vegetated shingle, sand flats and a small patch of saltmarsh. Sand lizards (*Lacerta agilis*) protected under the Wildlife and Countryside Act

Site	Location relative to the Proposed Development	Features or description
		1984, and four nationally scarce burrowing bees and wasps occur in the dunes. The vegetated shingle, though locally common, is internationally rare, and is used by a Red Data Book ant species. The sand flats host large numbers of migratory waders in the winter months.
Worthing Lumps Local Wildlife Sites (LWS)	Overlaps with the PEIR Assessment Boundary array area	Worthing Lumps MSNCI seabed includes chalk cliff with bolders, gravel and sand. Two separate north facing chalk cliffs exposures (approximately 2 to 3m in height), separated by pebble/gavel/sand. Sublittoral exposures of chalk are rare, though they are relatively common off the Sussex coast. The upper parts of the cliff are bored by piddocks, with the common piddock *P. dactylus* present here
Shelley Rocks LWS	Approximately 1.4km from the PEIR Assessment Boundary offshore export cable corridor	The site contains mixed sediment of boulders, cobbles, gravel and sand on chalk bedrock or exposures of grey clay. This site is a marine SNCI due to the wide range of seabed types found in a relatively small area. Boring organisms including piddocks and sponges are found on the chalk cobbles and flint cobbles are dominated by growths of the leafy bryozoan (*Flustra*), seasquirts and sponges.
The Waldrons Reef LWS	Approximately 2.7km from the PEIR Assessment Boundary offshore export cable corridor	The site main features include sandstone bedrock reef with large boulders. Pink calcareous algae encrust much of the bedrock. Foliaceous algae with sparse, stunted kelp plants dominate the uppermost surfaces.
Outer Owers LWS	Approximately 5km from the PEIR Assessment Boundary array area	The sites seabed feature includes shallow (to deep) mixed substrata with limestone bedrock, boulders and mudstone on a tide-swept grave slope.
Kingmere Rocks LWS	Approximately 5.8km from the PEIR Assessment Boundary offshore	The site comprises of a large area of sandstone and mudstone reefs, mostly of boulders, cobbles and mixed ground. The upward-facing surfaces of sandstone bedrock and boulders having a covering of foliose red algae, whilst those

Site	Location relative to the Proposed Development	Features or description
	export cable corridor	slightly deeper are dominated by a dense animal turf, particularly the bryozoans *Bugula* spp. and *F. foliacea*. Extensive patches of encrusting coralline algae are present on the sides of the boulders, together with various sponges (*E. fucorum*, *D. fragilis*, *Tethya aurantium*, *Suberites ficus* and *Polymastia mamilaris*), *A. digitatum*, sea squirts (especially *Clavelina lepadiformis*, *Aplidium punctum* and *Morchellium argus*), and occasional *A. rubens*.
South-West Rocks LWS	Approximately 10km from the PEIR Assessment Boundary	Chalk cliff, sand and pebbles. The upper part of the vertical face extending onto the upper horizontal surface is dominated by a dense animal turf including hydroids and foliose red algae. Other faunal components of the 'turf' include *A. digitatum* and sponges, principally *E. fucorum* and *D. fragilis*, and bryozoans such as *F. foliacea* and *Bugula* spp.
Looe Gate LWS	Approximately 10km from the PEIR Assessment Boundary	Chalk cliff, silty sand mixed with shells. The uppermost parts of the cliff support a sparse foliose red algal turf. The sea bed on the north (lower) side of the reef is of mixed sediment: chalk pebbles, gravel, sand, shell debris and occasional small chalk boulders. Occasional sparse red algae can be found attached to cobbles and small boulders.
Ship Rock LWS	Approximately 11km from the PEIR Assessment Boundary	Low-lying chalk reef/cliff. The vertical chalk faces have a general covering of hydroid-bryozoan turf and are frequently riddled by piddock holes. Other fauna such as colonial ascidians, sponges and bryozoans cover the chalk surface. Occasional clusters of *B. volutacornis* are present in places.
Marina Reef LWS	Approximately 11.5km from the PEIR Assessment Boundary	Reef of chalk and grey clay with chalk slabs and boulders. Sparse foliose red algae are present on the shallowest parts of the reef, with the upper vertical faces being dominated by a hydroid-bryozoan turf along with *N. antennina* and *H. falcata*, *A. digitatum*, *B. volutacornis*, white anemones *Actinothoe sphyrodeta* and various small ascidians.

Site	Location relative to the Proposed Development	Features or description
Mixon Hole LWS	Approximately 13km from the PEIR Assessment Boundary	The sites main features includes limestone a cap of limestone bedrock overlying cliff or 'soft grey' and 'stiff blue' clay; boulders, pebble and shell seabed. Hydroids, keel worms and sea squirts have colonised the cobbles and small boulders near the base of the cliff.
Subtidal wave-cut chalk platform (Brighton to Newhaven) LWS	Approximately 13.3km from the PEIR Assessment Boundary	Dissected chalk platform with ridges and gullies - site extends from mid-shore to approximately 750m seaward. The gully floors have a light covering of sand or silt, with occasional chalk and flint cobbles. The surface of the chalk bedrock is pitted by holes, mostly caused by piddocks or boring worms such as spionids and horseshoe worms *Phoronis hippocrepia*.
Whirlpool Hole LWS	Approximately 14km from the PEIR Assessment Boundary	Steeply sloping seabed of gravel, with a few large boulders at the base which are adorn with encrusting sponges, sea squirts and bryozoans and dense clusters of *F. foliacea*.

Valued Ecological Receptors (VERs)

9.6.25 The value of ecological features is dependent upon their biodiversity, social, and economic value within a geographic framework of appropriate reference (CIEEM, 2016). The most straightforward context for assessing ecological value is to identify those species and habitats that have a specific biodiversity importance recognised through international or national legislation or through local, regional or national conservation plans (for example, Annex I habitats under the Habitats Directive, OSPAR, UK BAP habitats and species, habitats/species of principal importance listed under the NERC Act 2006 and habitats/species listed as features of MCZs/recommended MCZs). However, only a very small proportion of marine habitats and species are afforded protection under the existing legislative or policy framework. Therefore, evaluation must also assess value according to the functional role of the habitat or species. For example, some features may not have a specific conservation value in themselves but may be functionally linked to a feature of high conservation value.

9.6.26 **Table 9-12** presents the VERs, their conservation status and importance within the benthic subtidal and intertidal ecology study area and the justification and regional importance of each receptor.

Table 9-12 Valued Ecological Receptors (VERs) within the PEIR Assessment Boundary benthic subtidal and intertidal ecology study area

VERs	Representative biotope found within PEIR Assessment Boundary	Protection status	Conservation interest	Distribution within the PEIR Assessment Boundary benthic and intertidal ecology study area	Importance within the PEIR Assessment Boundary benthic and intertidal ecology study area and justification
Sandy sediments with low infaunal diversity and sparse epibenthic communities	A5.231	None	Habitats of Principal importance (sublittoral sands and gravels)	Modelling predicted that this habitat is likely located across much of the PEIR Assessment Boundary eastern array and further offshore of the western array where sandy sediments are characteristic (**Figure 9-4, Volume 3**)	Regional – Habitats of Principal Importance with regional distribution across the English Channel.
Coarse and mixed sediments with moderate to high infaunal diversity and scour tolerant epibenthic communities	A5.142, A5.141, A5.431, A5.444	None	Habitats of Principal importance (sublittoral sands and gravels)	Modelling predicted this habitat is likely located across much of the offshore export cable corridor and western array, particularly further inshore on the array where coarse and mixed sediments are more abundant (**Figure 9-4, Volume 3**)	Regional – Habitats of Principal Importance with regional distribution across the English Channel.
***S. spinulosa* with kelp and red**	A3.215	None	Habitats of Principal importance	Modelling predicted this habitat is likely to occur at locations where hard substrate or rock outcrop	Regional – Habitats of Principal Importance and although it qualifies as

VERs	Representative biotope found within PEIR Assessment Boundary	Protection status	Conservation interest	Distribution within the PEIR Assessment Boundary benthic and intertidal ecology study area	Importance within the PEIR Assessment Boundary benthic and intertidal ecology study area and justification
seaweeds on sand-influenced infralittoral rock			and UK BAP (*S. spinulosa* reefs)	occur across the middle of the offshore export cable corridor, which is patchy in nature (**Figure 9-4, Volume 3**)	potential reef habitat, it does not form part of a European designated site.
Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay	A4.231	None	Habitats of Principal importance and UK BAP (Littoral and sublittoral chalk) Feature of Conservation Interest	Modelling predicted this habitats occurrence at discreet locations across the middle of the offshore export cable corridor, where soft chalk or clay outcrops are expected to occur (**Figure 9-4, Volume 3**)	Regional – Habitats of Principal Importance Although it qualifies as a potential reef habitat, it does not form part of a European designated site.
Littoral barren sand and coarse sand with low infaunal diversity	A2.111, A2.21	None	N/A	This habitat was recorded at the upper shore of the intertidal PEIR Assessment Boundary surrounding the strandline (**Figure 9-5; Figure 9-6; Figure 9-7, Volume 3**)	Local – Habitat is not protected under any conservation legislation and are found widespread around much of the UK.
Littoral exposed soft bedrock with	A1.46	None	Habitats of Principal importance	Outcropping chalk and clay exposures were recorded in the upper shore of the intertidal PEIR	Regional – Habitats of Principal Importance and although it qualifies as

VERs	Representative biotope found within PEIR Assessment Boundary	Protection status	Conservation interest	Distribution within the PEIR Assessment Boundary benthic and intertidal ecology study area	Importance within the PEIR Assessment Boundary benthic and intertidal ecology study area and justification
burrowing infauna			and UK BAP (Littoral and sublittoral chalk)	Assessment Boundary (**Figure 9-5; Figure 9-6; Figure 9-7, Volume 3**)	potential reef habitat, it does not form part of a European designated site.
Littoral rock and non-mobile substrata with ephemeral green or red seaweeds (freshwater or sand-influenced)	A1.45	None	N/A	Numerous chalk outcrops were present in the upper, mid-shore and lower area of the intertidal PEIR Assessment Boundary, which were characterised by this habitat (**Figure 9-5; Figure 9-6; Figure 9-7, Volume 3**)	Local – Habitat is not protected under any conservation legislation
Littoral sandy sediments with moderate to high infaunal diversity	A2.23, A2.24, A2.245, B2.32	SSSI	Protected feature within the Climping Beach SSSI	This habitat was recorded across much of the intertidal area across the PEIR Assessment Boundary (**Figure 9-5; Figure 9-6; Figure 9-7, Volume 3**)	National – included as a protected feature of the Climping Beach SSSI
Features of MCZs					

VERs	Representative biotope found within PEIR Assessment Boundary	Protection status	Conservation interest	Distribution within the PEIR Assessment Boundary benthic and intertidal ecology study area	Importance within the PEIR Assessment Boundary benthic and intertidal ecology study area and justification
Subtidal chalk	A4.231	MCZ	Protected feature within the Kingmere MCZ Habitats of Principal importance and UK BAP (subtidal chalk)	Representative biotopes of this feature of the Kingmere MCZ are predicted to occur within the PEIR Assessment Boundary but are not protected as part of the MCZ. Protected features of the MCZ fall within the secondary impact ZOI (**Figure 9-8, Volume 3**)	National – included as a protected feature of the Kingmere MCZ
Moderate energy infralittoral rock and thin mixed sediments	A3.215	MCZ	Protected feature within the Kingmere MCZ Habitats of Principal importance	Representative biotopes of this feature of the Kingmere MCZ are predicted to occur within the PEIR Assessment Boundary but are not protected as part of the MCZ. Protected features of the MCZ fall within the secondary impact ZOI (**Figure 9-8, Volume 3**)	National – included as a protected feature of the Kingmere MCZ
Seagrass beds	N/A	MCZ	Protected feature within the Pagham Harbour MCZ	This habitat is not predicted to be found within the PEIR Assessment Boundary but is a protected feature of the Pagham Harbour MCZ which falls within	National – included as a protected feature of the Pagham Harbour MCZ

VERs	Representative biotope found within PEIR Assessment Boundary	Protection status	Conservation interest	Distribution within the PEIR Assessment Boundary benthic and intertidal ecology study area	Importance within the PEIR Assessment Boundary benthic and intertidal ecology study area and justification
			Habitat of Principal importance and UK BAP (seagrass beds)	the secondary impact ZOI (**Figure 9-8, Volume 3**)	
Defolin's lagoon snail (*C. armoricum*),	N/A	MCZ	Protected feature within the Pagham Harbour MCZ Species of principal importance	This species is a protected feature of the Pagham Harbour MCZ which falls within the secondary impact ZOI (**Figure 9-8, Volume 3**)	National – included as a protected species of the Pagham Harbour MCZ
Lagoon sand shrimp (*G. insensibilis*).	N/A	MCZ	Protected feature within the Pagham Harbour MCZ Species of principal importance	This species is a protected feature of the Pagham Harbour MCZ which falls within the secondary impact ZOI (**Figure 9-8, Volume 3**)	National – included as a protected species of the Pagham Harbour MCZ
Broadscale features of MCZs					

VERs	Representative biotope found within PEIR Assessment Boundary	Protection status	Conservation interest	Distribution within the PEIR Assessment Boundary benthic and intertidal ecology study area	Importance within the PEIR Assessment Boundary benthic and intertidal ecology study area and justification
Subtidal coarse sediment	A5.142, A5.141, A5.431, A5.444	MCZ	Broadscale feature of Offshore Overfalls MCZ	Representative biotopes of this broadscale feature of the Offshore Overfalls MCZ are predicted to occur within the PEIR Assessment Boundary but are not protected as part of the MCZ. Protected features of the MCZ fall within the secondary impact ZOI (**Figure 9-8, Volume 3**)	National – included as broadscale feature of Offshore Overfalls MCZ
Subtidal mixed sediments	A5.142, A5.141, A5.431, A5.444	MCZ	Broadscale feature of Offshore Overfalls MCZ	Representative biotopes of this broadscale feature of the Offshore Overfalls MCZ are predicted to occur within the PEIR Assessment Boundary but are not protected as part of the MCZ. Protected features of the MCZ fall within the secondary impact ZOI (**Figure 9-8, Volume 3**)	National – included as broadscale feature of Offshore Overfalls MCZ
Subtidal sand	A5.231	MCZ	Broadscale feature of Offshore Overfalls MCZ	Representative biotopes of this broadscale feature of the Offshore Overfalls MCZ are predicted to occur within the PEIR Assessment Boundary but	National – included as broadscale feature of Offshore Overfalls MCZ

VERs	Representative biotope found within PEIR Assessment Boundary	Protection status	Conservation interest	Distribution within the PEIR Assessment Boundary benthic and intertidal ecology study area	Importance within the PEIR Assessment Boundary benthic and intertidal ecology study area and justification
				are not protected as part of the MCZ. Protected features of the MCZ fall within the secondary impact ZOI (**Figure 9-8, Volume 3**)	
Moderate energy infralittoral rock	A4.231, A3.215	MCZ	Broadscale feature of Kingmere MCZ	Representative biotopes of this broadscale feature of the Kingmere MCZ are predicted to occur within the PEIR Assessment Boundary but are not protected as part of the MCZ. Protected features of the MCZ fall within the secondary impact ZOI (**Figure 9-8, Volume 3**)	National – included as broadscale feature of Kingmere MCZ

Future baseline

9.6.27 An assessment of the future baseline conditions has been carried out (in the event of no development) and is described within this section. The baseline environment is not static and will exhibit some degree of natural change over time, with or without the Proposed Development in place, due to naturally occurring cycles and processes. Therefore, when undertaking impact assessments, it will be necessary to place any potential impacts in the context of the envelope of change that might occur naturally over the timescale of the Proposed Development.

9.6.28 Further to potential change associated with existing cycles and processes, it is necessary to take account of the potential effects of climate change on the marine environment. Variability and long-term changes on physical influences may bring direct and indirect changes to benthic and intertidal habitats and communities in the mid to long term future (UK Offshore Energy Strategic Environmental Assessment 3 (OESEA3), 2016). A strong base of evidence indicates that long-term changes in the benthic ecology may be related to long-term changes in the climate or in nutrients (OESEA3, 2016), with climatic process driving shifts in abundances and species composition of benthic communities (Marine Climate Change Impacts Partnership (MCCIP), 2015). Studies of the benthic ecology over the last three decades have shown that biomass has increased by at least 250 to 400 percent; opportunistic and short-lived species have increased; and the abundance of long-living sessile animals has decreased (Krönke, 1995; Krönke, 2011). Modelling sea surface temperature in relation to climate change in the UK has shown that the rate of temperature increase over the previous 50 years has been greater in waters off the east coast of the UK compared to the west and this is predicted to continue for the next 50 years (MCCIP, 2015). MCCIP (2020) noted over the past 30 years, warming has been most pronounced to the north of Scotland and in the North Sea, with sea-surface temperature increasing by up to 0.24°C per decade. Within the English Channel and the southern North Sea, increased sea surface temperatures may lead to an increase in the relative abundance of species associated with more southerly areas and subsequently MCCIP (2020) suggest further declines in some cold-water species are expected as sea temperature increases.

9.6.29 Furthermore, most literature to date focuses on specifically temperature, with regards to the effects of climate change on marine habitats. MCCIP (2020) suggest the warming of UK shelf seas is projected to continue over the coming century, with most models suggesting an increase of between 0.25°C and 0.4°C per decade. Warming is expected to be greatest in the English Channel and the North Sea, with smaller increases in the outer UK shelf regions (MCCIP, 2020). Climatic warming also causes deoxygenation within the water column. Over the past 50 years, oxygen content within the water column has decreased from 0.06 to 0.43 percent (Stramma *et al*., 2010) with a further 7 percent decrease predicted for the year 2100 (IPCC, 2013). It was concluded from 26 years of monitoring a benthic community within the Firth of Clyde, UK that the benthic communities had been affected by the decreasing levels of oxygen. This finding agreed with other short-term studies (Breitburg *et al*., 2018, Levin *et al*., 2009). Specific changes included changes in morphology, burrow depth, bioturbation and feeding mode (Caswell *et al*.,2018).

9.6.30 Moreover, the Sussex Inshore Fisheries and Conservation Authority (IFCA) introduced the Nearshore Trawling Byelaw 2019 which came into effect on 22 March 2021. This byelaw updates a previous trawling exclusion byelaw, which incorporated a seasonal trawling ban in inshore IFCA waters. The Nearshore Trawling Byelaw 2019 bans trawling along a large area of the Sussex inshore coastline between Selsey and Shoreham-by-Sea and encompasses Selsey Bill & the Hounds MCZ. The aim of this byelaw is to encourage the regeneration of marine habitats - particularly kelp forests – that act as nursery and feeding grounds for fish species.

9.6.31 As such, the baseline in the PEIR Assessment Boundary study area described in **Section 9.6** is a 'snapshot' of the present benthic ecosystem within a gradually yet continuously changing environment. Any changes that may occur during the construction, operation and decommissioning of the Proposed Development should be considered in the context of both greater variability and sustained trends occurring on national and international scales in the marine environment, and the changes that will be expected to occur naturally in the absence of the Proposed Development.

9.7 Basis for PEIR assessment

Maximum design scenario

9.7.1 Assessing using a parameter-based design envelope approach means that the assessment considers a maximum design scenario 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.

9.7.2 The maximum assessment assumptions that have been identified to be relevant to benthic subtidal and intertidal ecology are outlined in **Table 9-13** below and are in line with the Project Design Envelope (**Chapter 4**).

Table 9-13 Maximum assessment assumptions for impacts on benthic subtidal and intertidal ecology

Project phase and activity/impact	Maximum assessment assumptions	Justification
Construction		
Temporary habitat disturbance in the Rampion 2 array area and offshore cable corridor from construction activities	**Total temporary habitat disturbance = 26,421,466m^2** **Boulder clearance in the array area:** Total clearance impact area - Pre-lay Plough for cables = 7,500,000m^2 Total clearance impact area - subsea grab for cables = 4,500,000m^2 Total clearance impact area - Foundations and Jack-up legs = 1,100,000m^2 **Boulder clearance in the offshore export cable corridor:** Total clearance impact area - Pre-lay Plough = 1,900,000m^2 Total clearance impact area - subsea grab = 1,140,000m^2 **Sandwave clearance in the array area** Total sandwave clearance area = 631,415.93m^2 (60,000m of array cable x 10m width = 600,000m^2; and π 100^2 = 31,415.93m^2 for foundations). Construction vessel anchorage footprint = 20,050m^2 **Offshore export cable installation** Total seabed disturbance = 2,015,000m^2 Seabed disturbance for temporary floatation pits = 115,000m^2 **Interconnector cable installation** Total seabed disturbance = 1,250,000m^2	The temporary disturbance relates to seabed preparation for foundations and cables, jack up and anchoring operations, and cable installation. It should be noted that the seabed preparation area for foundations is less than the footprint of the foundation scour protection and the footprint of infrastructure, including cable protection, is assessed as a permanent impact in operation and maintenance.

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Array cable installation Total seabed disturbance = 6,250,000m^2 Impact area for cable/ pipeline crossings = 10,000m^2	
Temporary increase in suspended sediment and sediment deposition in the Rampion 2 array area and offshore cable corridor	**Total volume disturbed as a result of sandwave clearance on spoils = 2,906,248m^3** **Sandwave clearance** Total sandwave clearance volume in array area = 1,375,000m^3 **WTG installation** Spoil volume for all 116 WTG foundations from drill arisings (if drilling required due to pile driving refusal and assuming 10m diameter 60m embedment monopile) = 464,000m^3 Spoil volume for three offshore substation foundations (jacket with pin piles foundations) from drill arisings (if drilling required): 36,000m^3 **Export cable installation** Burial spoil = 155,000m^3 Spoil from temporary floatation pits = 275,000m^3 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) **Interconnector cable installation** Burial spoil (jetting) = 100,000m^3	The maximum design scenario for foundation installation results from the largest volume suspended from seabed preparation and presents the worst case for WTG installation. For cable installation, the maximum design scenario results from the greatest volume from sandwave clearance and installation. This also assumes the largest number of cables and the greatest burial depth.

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Array cable installation Burial spoil (ploughing) = 500,000m^3	
Temporary increase in SSC and sediment deposition in the intertidal area	Spoil from temporary floatation pits = 275,000m^3 Floatation pits will come out below MLWS, so will not directly impact the intertidal.	The maximum design scenario for temporary habitat disturbance in the intertidal area from the HDD works is included, although It is important to note that floatation pits will be located below MLWS, so this figure is highly precautionary.
Direct and indirect seabed disturbances leading to the release of sediment contaminants	The maximum design scenario for seabed disturbance is presented above in 'Temporary habitat disturbance in the Rampion 2 array area and offshore export cable corridor from construction activities'	This scenario represents the maximum total seabed disturbance and therefore the maximum amount of contaminated sediment that may be released into the water column during construction activities.
Increased risk of introduction or spread of Marine INNS may affect benthic ecology and biodiversity	**The total number of vessel return trips made during construction = 2,636** **WTG foundation installation (116):** 3 installation vessels (60 return trips) 10 support vessels (60 return trips) 6 transport vessels (40 return trips) 6 crew transport vessels (500 return trips) **WTG installation (116):** 2 installation vessels (40 return trips) 10 support vessels (100 return trips)	Maximum design scenario with regards to maximum number of vessel movements during construction activities in relation to the maximum number of WTG (116).

Project phase and activity/impact	Maximum assessment assumptions	Justification
	10 crew transport vessels (1,200 return trips). **Offshore substation installation:** 3 installation vessels (12 return trips) 20 support vessels (12 return trips) 6 transport vessels (12 return trips) 6 crew transfer vessels (60 return trips). **Inter-array and interconnector cable installation:** 3 main cable laying vessels (12 return trips) 3 main burial vessels (6 return trips) 13 support vessels (300 return trips). **Offshore export cable installation:** 1 main laying vessel (6 return trips) 1 main cable joining vessel (6 return trips) 2 main cable burial vessels (6 return trips) 4 multicat-type vessels (16 return trips) 4 spoil barrages (128 return trips) 10 support vessels (60 return trips)	
Indirect disturbance arising from the accidental release of pollutants	**The maximum number of vessel return trips made during construction = 2,636** Synthetic compound, heavy metal and hydrocarbon contamination resulting from offshore infrastructure installation and return trips to port by construction vessels over the construction period (as detailed in above). Water-based drilling muds associated with drilling to install foundations, should this be required.	These maximum assessment assumptions are considered to represent the maximum design scenario with regards to vessel movement during construction

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Potential contamination of intertidal habitats resulting from machinery use and vehicle movement.	
Indirect disturbance from increased noise and vibration from construction activities	**Maximum spatial design scenario:** Monopile WTG foundations 116 smaller WTG foundations Up to three offshore converter substations Maximum hammer energy 4,400kJ 4- hour piling duration 2 monopiles per day. 60 piling days **Maximum temporal design scenario:** 116 smaller WTGs on piled jacket foundations (3 to 4 legs per jacket, 3 to 4 piles per jacket) – 464 pin piles Up to three offshore converter substations (4 to 6 legs per jacket, up to 12 pins per jacket) – 36 pin piles Total of 500 pin piles in the array. Maximum hammer energy 2,500kJ 4 pin piles per day 125 piling days	The maximum spatial design scenario equates to the greatest effect from subsea noise at any one-time during piling. Piling fewer WTGs (75) 13.5m monopiles represents a greater spatial impact than (116) 10m monopiles. The maximum temporal design scenario represents the longest duration of effects from subsea noise. This scenario assumes pin-pile foundations, which could result in a longer duration of piling per foundation.
Operation and Maintenance		
Long-term habitat loss/alteration from the presence of foundations, scour protection and cable protection	**Total habitat loss / change = 1,117,400m^2** **Array area** The total WTG footprint based on 75 larger WTG scenario) with scour protection = 690,000m^2	The maximum design scenario is defined by the maximum area of seabed lost as a result of the placement of structures, scour protection and cable protection. Habitat loss from drilling and drill arisings is of

Project phase and activity/impact	Maximum assessment assumptions	Justification
	The total offshore substation footprint (jacket with pin piles foundation) with scour protection = 26,400m^2 **Array and interconnector cables** Maximum rock protection area for array cable crossings (10,000m^2 per crossing (four crossing expected) Maximum rock protection area for array cables (based on 20 percent of cable requiring protection) = 260,000m^2 Maximum rock protection area for interconnector cables (based on 20 percent of cable requiring protection) = 40,000m^2 **Offshore export cable corridor** Maximum rock protection area for export cables = 61,000m^2	a smaller magnitude than presence of Proposed Development infrastructure.
Temporary habitat disturbance from jack-up vessels and cable maintenance activities	**The total direct disturbance to seabed from jack-up and cable maintenance activities = 5,990,500m^2** **WTG operation and maintenance activities:** *Major WTG component replacement* Maximum of 3 to 4 events per WTG over the lifetime of the Proposed Development = 350. The footprint of seabed disturbance for all events via jacking-up activities = 1,100m^2 (+ 10 percent) Total footprint = 385,000m^2 *WTG access ladder replacement* Maximum of 600 ladder replacement events. The footprint of seabed disturbance for all events via jacking-up activities = 1,100m^2 (+ 10 percent)	Defined by the maximum number of jack-up vessel operations and maintenance activities that could have an interaction with the seabed anticipated during operation.

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Total footprint = 660,000m^2 *Wind WTG anode replacement* Maximum of 600 anode replacement events. The footprint of seabed disturbance for all events via jacking-up activities = 1,100m^2 (+ 10 percent) Total footprint = 660,000m^2 *WTG J-tube replacement or modification* Maximum of 200 J-tube replacement or modification. The footprint of seabed disturbance for all events via jacking-up activities = 1,100m^2 (+ 10 percent) Total footprint = 220,000m^2 **Offshore substations and accommodation platform activities:** *Offshore substation platform major component replacement* Maximum of 27 exchange events (9 per platform). The footprint of seabed disturbance for all events via jacking-up activities = 1,100m^2 (+ 10 percent) Total footprint = 29,700m^2 *Offshore platform access ladder replacement* Maximum of 36 ladder replacement events (assumes 3 platforms, 2 ladders per platform). The footprint of seabed disturbance for all events via jacking-up activities = 1,100m^2 (+ 10 percent) Total footprint = 39,600m^2 *Offshore platform anode replacement*	

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Maximum of 72 anode replacement events (assumes 4 legs on each of 3 platforms). The footprint of seabed disturbance for all events via jacking-up activities = 1,100m^2 (+ 10 percent). Total footprint = 79,200m^2 *Offshore platform J-Tube replacement* Maximum of 60 J-tube replacement or modification (assumes 2 per J-Tube over lifetime). The footprint of seabed disturbance for all events via jacking-up activities = 1,100m^2 (+ 10 percent).) Total footprint = 66,000m^2 **Array cable activities:** Maximum of 18 remedial burial events. The maximum temporary footprint of seabed disturbance for all array remedial burial events = 3,600,000m^2 (18 x 200,000m^2 Total footprint of seabed disturbance for array cable repairs via jacking-up activities = 6,600m^2 (6 x 1,100m^2). Array cable protection replacement = 25 percent of original cable protection requiring replacement **Offshore export cable activities:** Maximum of 3 remedial burial events per cable (4 export cables). The maximum temporary footprint of seabed disturbance for all offshore cable corridor remedial burial events = 240,000m^2 (3 per cable (4 cables) x 20,000m^2) Total footprint of seabed disturbance for all export cable repairs via jacking-up activities = 4,400m^2 (4 x 1,100m^2)	

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Offshore export cable protection replacement = 25 percent of original cable protection requiring replacement	
Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities	See maximum design scenario presented in **Chapter 6**	This impact is defined by any anticipated changes to physical processes as defined in **Chapter 6.**
Colonisation of the WTGs and scour/cable protection may affect benthic ecology and biodiversity	**The total area of introduced hard substrate at seabed level (scour & cable protection) = 1,117,400m^2** Maximum water depth in array area = 65m Maximum number of WTG = 116 Maximum number of Offshore Substations = up to three. Total surface area of introduced hard substrate in the water column for monopiles = 236,756m^2 (31.4m^2 per m of water depth for monopile x 65 x 116) Total surface area of introduced hard substrate in the water column for offshore substation = 7,410m^2 (38m^2 per m of water depth x 65 x 3) **Therefore, the total surface area of introduced hard substrate in the water column = 1,361,566m^2**.	The maximum design scenario is defined by the maximum area of structures, scour protection, cable protection and cable crossings introduced to the water column, including surface area of vertical structures

Project phase and activity/impact	Maximum assessment assumptions	Justification
Increased risk of introduction or spread of Marine INNS due to presence of infrastructure and vessel movements (for example the discharge of ballast water) may affect benthic ecology and biodiversity	**Total surface area of introduced hard substrate in the water column = 1,361,566m^2** **Total of number of vessel return trips per year:** Jack-up WTG visits (per year) = 12 Jack-up platform visits (per year) = 6 Crew transfer vessels WTG visits (per year) = 1,095 **Total number of vessel trips over the lifetime of the Proposed Development = 33,390**.	Defined by the maximum surface area introduced into the water column as described Maximum design scenario with regards to maximum number of vessel movements during operation and maintenance activities
Indirect disturbance arising from the accidental release of pollutants	Synthetic compound, heavy metal and hydrocarbon contamination resulting from operation and maintenance of up to 116 WTGs and up to three offshore substations. Accidental pollution may also result from the number of vessel return trips over the approximate 30-year design lifetime.	This presents the maximum design scenario with regards to vessel movement during the operational period
Indirect disturbance arising from EMF generated by the current flowing through the cables buried to less than 1.5m below the surface	**WTGs** 116 WTGs **Array cables** Up to 250km of array cable operating at a maximum of 66kV. Target cable depth = 1m **Interconnector cables** Up to 50km of interconnector cable (two cables approximately 25km in length), operating up to 275kV. Target cable depth = 1m **Offshore export cables**	The maximum design scenario is associated with the greatest length of interarray cable and four export cables as this results in the longest total length of export cable

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Length of cable corridor 19km (four cables approximately 19km length each in corridor), operating up to 275kV. Target cable depth = <1.5m.	
Decommissioning		
Temporary habitat disturbance from decommissioning of foundations, cables and rock protection	**Total seabed disturbance = 9,916,000m^2**. **Interconnector cable** Total seabed disturbance = 1,250,000m^2 **Array cable** Total seabed disturbance = 6,250,000m^2 **Array and interconnector cables** Maximum rock protection area for array cable crossing = 10,000m^2 per crossing (four crossing expected). Maximum rock protection area for array cables (based on 20 percent of cable requiring protection) = 260,000m^2. Maximum rock protection area for interconnector cables (based on 20 percent of cable requiring protection) = 40,000m^2. **Offshore export cable** Total seabed disturbance = 2,015,00m^2. Maximum rock protection area for export cables = 61,000m^2.	Maximum design scenario is assumed to be similar to the construction phase, with all infrastructure removed in reverse-construction order. The removal of cables and rock protection is considered the maximum design scenario, however the necessity to remove cables and rock protection will be reviewed at the time of decommissioning

Project phase and activity/impact	Maximum assessment assumptions	Justification
Temporary increase in suspended sediment and sediment deposition from decommissioning of foundations, cables, and rock protection	The impacts are expected to be equivalent to construction apart from the structures that may remain (for example cables to be removed but not cable protection measures)	Maximum design scenario is assumed to be as per the construction phase, with all infrastructure removed in reverse-construction order. The removal of cables is considered the Maximum design scenario, however the necessity to remove cables will be reviewed at the time of decommissioning
Direct and indirect seabed disturbances leading to the release of sediment contaminants	As above for construction impacts	This scenario represents the maximum total seabed disturbance and therefore the maximum amount of contaminated sediment that may be released into the water column. Maximum design scenario as per the construction phase and assumes the removal of all foundations and buried subtidal and intertidal cables
Increased risk of introduction or spread of Marine INNS may affect benthic ecology and biodiversity	As above for construction impacts. The removal of introduced hard substrate from the water column, which will be a positive impact apart from the structures that may remain (for example cables to be removed but not cable protection measures)	Maximum design scenario for vessel return trips as per construction
Indirect disturbance arising from the accidental release of pollutants	Synthetic compound, heavy metal and hydrocarbon contamination resulting from the decommissioning of a maximum of 116 WTGs and up to three offshore substations.	Maximum design scenario as per construction phase

Project phase and activity/impact	Maximum assessment assumptions	Justification
	Potential contamination in the intertidal resulting from machinery use and vehicle movement	

Embedded environmental measures

9.7.3 As part of the Proposed Development design process, a number of embedded environmental measures have been adopted to reduce the potential for impacts on benthic subtidal and intertidal ecology. 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.

9.7.4 These measures typically include those that have been identified as good or standard practice and include actions that will 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 of the Proposed Development and are set out in this PEIR.

9.7.5 **Table 9-14** sets out the relevant embedded environmental measures within the design and how these affect the benthic subtidal and intertidal ecology assessment.

Table 9-14 Relevant benthic subtidal and intertidal ecology embedded environmental measures

ID	Environmental measure proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to benthic subtidal and intertidal ecology assessment
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 dependent on the seabed geological conditions and the risks to the cable (e.g. from anchor drag damage).	Scoping	DCO requirements or deemed Marine Licence dML conditions.	This measure will reduce the risk of EMF impacts on sensitive receptors.
C-43	The subsea export cable ducts will be drilled underneath the beach using horizontal directional drilling (HDD) techniques.	Scoping	DCO requirements or dML conditions.	This measure will avoid direct impacts to intertidal designated sites associated with the offshore

ID	Environmental measure proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to benthic subtidal and intertidal ecology assessment
				export cable corridor.
C-44	An Outline Scour Protection Management Plan will be developed. It will include details of the need, type, quantity, and installation methods for scour protection.	Scoping	DCO requirements or dML conditions.	This measure will minimise where possible long-term habitat loss.
C-45	Where possible, seabed 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.	Scoping	DCO requirements or dML conditions.	This measure will reduce the risk of EMF impacts on sensitive receptors.
C-53	An Outline Marine Pollution Contingency Plan (MPCP) will be developed. This MPCP will outline procedures to protect personnel working and to safeguard the marine environment and mitigation measures in the event of an accidental pollution event arising from offshore operations relating to Rampion 2. The MPCP will also include relevant key emergency contact details.	Scoping	DCO requirements or dML conditions.	This measure will minimise the risk of accidental pollution associated with the Proposed Development on sensitive receptors.

ID	Environmental measure proposed	Project phase measure introduced	How the environmental measures will be secured	Relevance to benthic subtidal and intertidal ecology assessment
C-65	The proposed offshore export cable corridor and cable landfall (below mean high water springs [MHWS]) will avoid all statutory marine designated areas.	Scoping	DCO requirements or dML conditions.	This measure will reduce the risk of disturbance on sensitive receptors within statutory marine designated areas.
C-95	The assessment will take into consideration the mitigation and control of invasive species measures that will be incorporated into an Outline Project Environmental Monitoring and Management Programme (PEMMP).	Scoping	DCO requirements or dML conditions.	This measure will reduce where possible the risk of introducing invasive species into the region.
C-111	A Decommissioning Plan will be prepared for the Proposed Development in line with the latest relevant available guidance.	PEIR	DCO requirement or dML conditions.	This measure will be developed to cover the decommissioning phase and will minimise impact on benthic, subtidal and intertidal ecology receptors, where appropriate.

9.8 Methodology for PEIR assessment

Introduction

9.8.1 The Proposed Development-wide generic approach to assessment is set out in **Chapter 5: Approach to the EIA**. The assessment methodology for benthic subtidal and intertidal ecology for the PEIR is consistent with that provided in in the Scoping Report (RED, 2020).

Impact assessment criteria

9.8.2 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts.

9.8.3 In line with the Chartered Institute of Ecology and Environmental Management (CIEEM) guidance (CIEEM, 2016), the sensitivities of different biotopes have been classified by the Marine Life Information Network (MarLIN) on the Marine Evidence based Sensitivity Assessment (MarESA) scale (MarLIN, 2021). The scale takes account of the resistance and recoverability (resilience) of a species or biotope in response to a stressor. Specific benchmarks (duration and intensity) are defined for the different impacts for which sensitivity has been assessed (for example smothering, abrasion, habitat alteration etc.). Detailed information on the benchmarks used and for further information on the definition of resistance and resilience can be found on the MarLIN website[8].

9.8.4 For the purposes of this assessment, four sensitivity categories have been defined, each drawing on the four MarLIN MarESA categories (**Table 9-15**). The values for the MarESA criteria and the assessment sensitivity values are therefore the same (with the addition of the 'very high' value for receptors of intertidal importance).

Table 9-15 Definition of terms relating to the sensitivity of the receptor

Value	Criteria
Very High	Equivalent to MarLIN MarESA sensitivity category 'High' and with a receptor value of 'international' importance. The habitat or species is noted as exhibiting 'None' or 'low' resistance (tolerance) to an external factor and is expected to recover only over very extended timescales for instance >25 years or not all (resilience is 'Very Low'); OR > 10 or up to 25 years (resilience is 'Low').
High	Equivalent to MarLIN MarESA sensitivity category 'High' and with a receptor value of national importance. The habitat or species is noted as exhibiting 'None' or 'low' resistance (tolerance) to an external factor and is expected to recover only over very extended timescales for instance >25 years or not all (resilience is 'Very Low'); OR > 10 or up to 25 years (resilience is 'Low').
Medium	Equivalent to MarLIN MarESA sensitivity category 'Medium' and with a receptor of local/county to international importance. The habitat or species is noted as exhibiting 'None' or 'Low'

[8] https://www.marlin.ac.uk/sensitivity/sensitivity_rationale

Value	Criteria
	resistance (tolerance) to an external factor and is expected to recover over medium timescales for instance > 2 or up to 10 years (resilience is 'Medium'); OR The habitat or species is noted as exhibiting 'None' resistance (tolerance) to an external factor and is expected to recover over <2 years (resilience is 'High'); OR The habitat or species is noted as exhibiting 'Medium' resistance (tolerance) to an external factor and is expected to recover over medium to very long timescales for instance > 2 years or up to 25 years or not at all (resilience is 'Medium', 'Low' or 'Very Low').
Low	Equivalent to MarLIN MarESA sensitivity category 'Low' and 'Not Sensitive' and with a receptor of <local/county to national importance. The habitat or species is noted as exhibiting 'Low' or 'Medium' resistance (tolerance) to an external factor and is expected to recover over <2 years (resilience is 'High'); OR The habitat or species is noted as exhibiting 'High' resistance (tolerance) to an external factor and is expected to recover over medium to very long timescales, for instance > 2 years or up to 25 years or not at all (resilience is 'Medium', 'Low' or 'Very Low'); OR The habitat or species is noted as exhibiting 'High' resistance (tolerance) to an external factor and is expected to recover over short timescales, for instance <2 years (resilience is 'High').

9.8.5 The criteria for defining magnitude in this chapter are outlined in **Table 9-16** below. The magnitude of potential impacts is defined by a series of factors, including the spatial extent of any interaction, the likelihood, frequency and duration of a potential impact.

Table 9-16 Definition of terms relating to magnitude of the impact

Magnitude of impact	Definition used in this chapter
Major	Fundamental, permanent/irreversible changes, over the whole receptor, and/or fundamental alteration to key characteristics or features of the particular receptors character or distinctiveness.
Moderate	Considerable, permanent/irreversible changes, over the majority of the receptor, and/or discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Minor	Discernible, temporary (throughout Proposed Development duration) change, over a minority of the receptor, and/or limited

Magnitude of impact	Definition used in this chapter
	but discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Negligible	Discernible, temporary (for part of the Proposed Development duration) change, or barely discernible change for any length of time, over a small area of the receptor, and/or slight alteration to key characteristics or features of the particular receptors character or distinctiveness.

9.8.6 The significance of the effect upon benthic subtidal and intertidal ecology is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The method employed for this assessment is presented in **Table 9-17**. Where a range of significance of effect is presented in **Table 9-17**, the final assessment for each effect is based upon expert judgement.

9.8.7 For the purposes of this assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of the EIA Regulations.

Table 9-17 Matrix used for the assessment of the significance of the effect

		Magnitude of Change			
		Major	**Moderate**	**Minor**	**Negligible**
Sensitivity/ importance/ value	**Very High**	Major (Significant)	Major (Significant)	Moderate (Potentially significant)	Minor (Not significant)
	High	Major (Significant)	Moderate (Potentially significant)	Minor (Not significant)	Minor (Not significant)
	Medium	Moderate (Potentially significant)	Minor (Not significant)	Minor (Not significant)	Negligible (Not significant)
	Low	Minor (Not significant)	Minor (Not significant)	Negligible (Not significant)	Negligible (Not significant)

9.9 Preliminary assessment: Construction phase

Introduction

9.9.1 The impacts of offshore construction of the Proposed Development have been assessed on benthic subtidal and intertidal ecology. A description of the potential effects on benthic subtidal and intertidal ecology receptors caused by each identified impact is given below.

Temporary habitat disturbance in the Rampion 2 array area and offshore cable corridor from construction activities

Magnitude of impact

9.9.2 The total maximum area of temporary subtidal habitat disturbance due to construction activities described in **Table 9-13** is predicted to be up to approximately 26.42km^2. This equates to approximately 8 percent of the total seabed area within the PEIR Assessment Boundary. It should be noted that the maximum design scenario presents a precautionary approach to temporary habitat disturbance because it counts both the total footprint of seabed clearance as well as cable burial across both the array and offshore export cable corridor. This approach effectively counts the footprint of seabed habitat to be impacted by construction in the same area twice in some instances. However, this precautionary approach has been taken because there is some potential for recovery of habitats between the activities due to Proposed Development timescales.

9.9.3 Of the total area of temporary habitat loss described in **Table 9-13**, a maximum of approximately 21.25km^2 is predicted to be temporarily lost/disturbed within the PEIR Assessment Boundary array area as a result of seabed preparations for foundations, jack-up barge operations and the installation and burial of inter-array and interconnector cables (including associated anchor placements). This equates to approximately 6.45 percent of the total seabed area within the PEIR Assessment Boundary array area.

9.9.4 Of the total temporary habitat loss/disturbance described in **Table 9-13**, a maximum of approximately 5.17km^2 will be temporarily disturbed within the subtidal areas of the PEIR Assessment Boundary offshore export cable corridor as a result of seabed preparation, offshore substation installation, export cable installation, burial and jointing. This equates to approximately 8.8 percent of the total seabed area within the PEIR Assessment Boundary offshore export cable corridor. Any potential permanent loss have been considered in **Section 9.10**, **paragraph 9.10.1** to **paragraph 9.10.6**.

9.9.5 Given that the benthic habitats that characterise the PEIR Assessment Boundary are not geographically restricted to within the proposed development area and are typically widespread throughout the wider eastern English Channel region (as described in **Section 9.6**), the temporary habitat disturbance during construction activities will have an impact on a limited footprint compared to their overall extent.

9.9.6 Therefore, the magnitude that temporary habitat disturbance relating to construction activities at the Proposed Development will have on benthic subtidal receptors is considered to be **minor**, indicating that the potential is for localised disturbance and/or loss of habitat that does not threaten the long-term viability of the resource.

9.9.7 As noted in the project description as provided in **Chapter 4** and within **Table 9-14**, there is a commitment made for HDD (C-43). Therefore, no temporary habitat disturbance will occur within the intertidal area from export cable installation as the two HDD works exit pits will be located within the subtidal area (below MHWS) and will be discrete in nature. Therefore, the magnitude that

temporary habitat disturbance relating to construction activities at the Proposed Development will have on benthic intertidal receptors is considered to be **negligible**.

Sensitivity or value of receptor

9.9.8 The sensitivity of all subtidal biotopes that have been predicted to characterise the PEIR Assessment Boundary (**Section 9.6**) have been assessed according to the detailed MarESA sensitivity assessments (**Table 9-18**). This assessment has determined that all biotopes have a 'low' to 'medium' sensitivity to a disturbance of this nature. As detailed within the baseline characterisation (**Section 9.6**), comparable habitats are distributed within the wider region and eastern English Channel. Therefore, given the relatively small spatial scales for the total temporary habitat disturbance outlined above, this loss is not expected to undermine regional ecosystem functions or diminish biodiversity.

9.9.9 As demonstrated in **Table 9-18**, the sandy sediment communities were all determined as having a 'low' sensitivity. These biotopes are typical of high energy environments and are therefore naturally subject to, and tolerant of, high levels of physical disturbance. The communities that predominantly characterise these biotopes include infaunal mobile species such as polychaetes and bivalves. Such species can re-enter the substratum following temporary habitat disturbance. The recoverability of such communities is likely to occur as a result of the combination of recruitment from surrounding unaffected areas and larval dispersal, and recovery is likely to occur within one to ten years (based on the MarESA assessments).

9.9.10 Further evidence to support recovery is supported by research at aggregate extraction sites, where it was reported that the characteristic recovery time for typical sand communities may be two to three years, following cessation of dredging activity (Newell *et al*., 2004). Research indicated that following the initial suppression of species' diversity, abundance and biomass recovery of species' diversity to within 70 to 80 percent of that in non-dredged areas was achieved within 100 days (Newell *et al*., 2004). Species' abundance also recovered within 175 days (Newell *et al*., 2004). It is important to acknowledge however, that the activities associated with aggregate extraction are different to those associated with offshore wind farm construction activities. (for instance, they involve the complete removal of sediment). Data collated from more analogous activities such as the burial of telecommunications cables, as well as the monitoring of offshore wind farms indicate that recovery is rapid with limited, if any, significant effects being discernible (Foden *et al*., 2011).

9.9.11 Abrasion of coarse sediments is likely to disturb epifauna and may damage a proportion of the characterising species, which is why resistance is recorded as either 'low' or 'medium', for coarser sediments. However, opportunistic species are likely to recruit rapidly, and some damaged characterising species may recover or recolonise, resulting in a high resilience (see **Table 9-18**). Impacts to the epibenthic community from the construction of Rampion 1 offshore wind farm noted that the taxa diversity and abundance increase between pre- and post-construction, with high abundances of green sea urchin (*Psammechinus miliaris*), common starfish *(A. rubens*) and brittle stars (*Ophiura* species), however, no significant changes were observed in taxa diversity between treatment areas and

seasons (OEL, 2020b).

9.9.12 The biotope 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231)' is present within the array area specifically in relation to Worthing Lumps LWS (see **Table 9-11**) and has been identified within offshore export cable corridor through the geophysical survey (Gardline, 2020) and the predictive habitat model (see **Table 9-9** and **paragraph 9.6.9**). This biotope is described as having a 'medium' MarESA sensitivity to a disturbance of this nature. Piddocks are afforded some protection for surface abrasion due to the species inhabiting burrows, however where abrasion or disturbance impacts occur deeper than the surface of the soft rock, individuals inhabiting the chalk or clay are vulnerable to damage. The MarSEA data highlight that sensitivity in relation to physical seabed change for this habitat is 'high', albeit with a low confidence based on lack of evidence (Tillin and Hill, 2016). Whilst denuded areas of exposed chalk will likely be re-colonised by piddocks once construction activities have ceased, where removal of chalk or clay results in a loss of exposed soft substratum, these specific parts of the substratum directly impacted cannot recover through natural processes. The resilience of this biotope is therefore assessed as very low. Where exposed chalk or clay substratum does remain, or where restoration work has emplaced comparable material to restore the habitat, recovery of the biological assemblage is reported to be 'medium', occurring over a period of two to ten years (Tillin and Hill, 2016).

9.9.13 The biotope '*Sabellaria spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock (A3.215)' is descried as having a 'medium' MarESA sensitivity to a disturbance of this nature. The predictive modelling (**Figure 9-4, Volume 3**) did not describe the potential for *S. spinulosa* reefs within this area and the desktop study details that although *S. spinulosa* is widespread within the central and eastern English Channel the presence of large reef structures is limited. The PEIR assessment is therefore based on encrusting individuals rather than reef habitat, which will be reviewed following receipt of site-specific ground-truth data for inclusion within the ES. The resistance of the characteristic species of this biotope is regarded as low as abrasion at the surface of *S. spinulosa* crusts is likely to damage the tubes and result in sub-lethal and lethal damage to the worms. It is also likely to remove a proportion of the *Laminaria* canopy, attached epiphytes, *Laminaria* holdfasts and understorey macroalgae (where present). However, the resilience of this biotope is regarded as medium, with the ability to recover within two to ten years.

9.9.14 The sensitivity of the benthic subtidal features of the PEIR Assessment Boundary is therefore considered to be **medium**, reflecting that the receptors have some ability to tolerate the potential impacts and could potentially recover to an acceptable status over a 10-year period. The sensitivity of the biotope 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231)' is considered **high** for physical disturbance, however, could potentially recover to an acceptable status over a two to ten-year period (following habitat restoration, see **paragraph 9.9.17**).

Table 9-18 MarESA assessment for the benthic subtidal habitats for abrasion / disturbance

Biotope code (JNCC and EUNIS codes)	Biotope name	MarESA sensitivity assessment	Assessment confidence
A5.141/ SS.SCS.CCS.SpiB[9]	*S. triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Low (based on a low resistance and high resilience)	Confidence is high as the assessment is based on peer reviewed papers and the assessment is based on the same pressures acting on the same type of feature in the UK.
A5.142/ SS.SCS.CCS.MedLumVen[10]	*M. fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel	Low (based on a medium resistance and high resilience)	Confidence is high as the assessment is based on peer reviewed papers, although the assessment was based on similar pressures on the feature.
A5.231/ SS.SSa.IFiSa.IMoSa[11]	Infralittoral mobile clean sand with sparse fauna	Low (based on a low resistance and high resilience)	Confidence is high as the assessment is based on peer reviewed papers, although the assessment was based on similar pressures on the feature.
A5.431/ SS.SMx.IMx.CreAsAn[12]	*C. fornicata* with ascidians and anenomes on infralittoral coarse mixed sediment	Low (based on a low resistance and high resilience)	Confidence is medium as the assessment is based on some peer reviewed papers but also relies on grey literature and relies on similar pressures on the feature.

9 https://www.marlin.ac.uk/habitats/detail/177
10 https://www.marlin.ac.uk/habitats/detail/382
11 https://www.marlin.ac.uk/habitats/detail/262
12 https://www.marlin.ac.uk/habitats/detail/1139

Biotope code (JNCC and EUNIS codes)	Biotope name	MarESA sensitivity assessment	Assessment confidence
A5.444/ SS.SMx.CMx.FluHyd[13]	*F. foliacea* and *H. falcata* on tide-swept circalittoral mixed sediment	Medium (based on low resistance and medium resilience)	Confidence is medium as the assessment is based on some peer reviewed papers but also relies on grey literature and relies on similar pressures on the feature.
A4.231/ CR.MCR.SfR.Pid[14]	Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay	Medium (based on medium resistance and very low resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
A3.215/ IR.MIR.KR.Lhyp.Sab[15]	*S. spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock	Medium (based on low resistance and medium resilience)	Confidence is medium as the assessment is based on some peer reviewed papers but also relies on grey literature and relies on similar pressures on the feature.

Significance of residual effect

9.9.15 The MarESA assessments identify that the confidence for the sensitivity of the biotope 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231)' to abrasion/disturbance is low. The low confidence is associated with a low quality of evidence and the applicability of evidence. Based on this low confidence assessment and to apply a precautionary approach to this biotope, its sensitivity is to be classified as **'**high' rather than 'medium'.

9.9.16 The direct impact of temporary habitat disturbance will represent a local spatial extent, short term intermittent impact, affecting a relatively small portion of the benthic subtidal habitats in the PEIR Assessment Boundary. Most benthic receptors are known to have a medium to high degree of tolerance to this impact, based on MarESA assessments. It is predicted that the sensitivity of the receptors is worst-case **high**, and the magnitude is **minor** for subtidal and **negligible** for intertidal receptors. The short-term and localised nature of this impact and the

13 https://www.marlin.ac.uk/habitats/detail/74
14 https://www.marlin.ac.uk/habitats/detail/152
15 https://www.marlin.ac.uk/habitats/detail/144

tolerance and recoverability of the majority of the benthic receptors, the significance of the residual effect is deemed **minor adverse significance**, which is **not significant** in EIA terms.

9.9.17 Whilst a specific mitigation measure has not been embedded within the design of the Proposed Development at this stage, there are a suite of measures available currently being explored with which it will be possible to reduce the magnitude, and therefore significance of effect, particularly in relation to piddocks. For this impact the measures available include constraining the installation method to minimise the area of physical impact, and development of a reinstatement plan to ensure any disturbed bedrock feature is appropriately stored during installation and reinstated following installation. The latter method of reinstatement was previously employed on the existing Rampion 1 offshore wind farm and is considered proven and therefore with a high likelihood of successfully reducing the magnitude and effect significance.

Temporary increase in suspended sediment and sediment deposition in the Rampion 2 array area and offshore cable corridor

Magnitude of impact

9.9.18 Temporary localised increases in SSC and associated sediment deposition are expected from foundation and cable installation works and seabed preparation works (including sandwave clearance). This assessment should be read in conjunction with **Chapter 6** and **Appendix 6.3 Coastal processes technical report: Impact assessment, Volume 4** which provides a full description of the offshore physical environment assessment.

9.9.19 Background surface SSCs values within the study area typically range between 10 to 20mg/l during winter months and generally less than 4mg/l during the summer period. Surface turbidity is relatively low across the offshore array area, with monthly averaged concentrations typically less than 5mg/l across the whole year (Cefas, 2016).

9.9.20 **Table 9-13** presents the maximum assessment assumptions associated with increases in SSC and deposition. The maximum design scenario for SSC and deposition during the construction phase of the Proposed Development will result in the total release of approximately 2,906,248m^3 of sediment and drill fluid in the PEIR Assessment Boundary. **Table 9-19** details the maximum sediment plume distance and the peak increases in SSC and deposition that could occur because of construction activities.

Table 9-19 Temporary increases in SSC and sediment deposition as a result of construction activities at the Proposed Development

Construction Impact	Location	Maximum sediment plume distance	Details of increase in SSC and deposition
Sandwave clearance **Seabed preparation for foundations** **(overspill during active dredging using a trailing suction hopper dredger)**	Offshore export cable corridor and array area	16km (springs) and 8km (neaps)	1) Within small distances (<50m) of the dredger, SSC associated with overspill at the water surface during active dredging can be in the order of thousands to low tens of thousands of mg/l, reducing rapidly with time and distance (through settlement and dispersion) to the order of hundreds or tens of mg/l. 2) All SSC effects associated with overspill of sands during active dredging are expected to be spatially limited to within 400 to 700m of the dredger, and temporally limited to the period of active dredging plus 10 to 25 minutes afterwards (depending on the local water depth and current speed). Effects associated with gravels are expected to be more limited (up to 100m and 1 to 5 minutes). 3) At 2km downstream during or shortly after active dredging, the concentration of any fine sediments persisting in suspension is expected to be less than approximately 100mg/l; at 5km downstream, this may have reduced to approximately 10mg/l. Concentrations of suspended fines will continue to reduce gradually over time through dispersion, to less than measurable levels (<10mg/l) within two to three days. 4) The maximum expected average local thickness of deposition in the case of predominantly gravelly sediments is 10cm over an area of 1,125m^2, or 30cm over an area of 350m^2. 5) The maximum expected average local thickness of deposition in the case of predominantly sandy sediments is 1 to 2cm over an area of 4,000 to 16,000m^2. 6) Fines are expected to become widely dispersed and so will not resettle with measurable thickness locally.

Construction Impact	Location	Maximum sediment plume distance	Details of increase in SSC and deposition
Sandwave clearance **Seabed preparation for foundations** **(spoil disposal from a trailing suction hopper dredger)**	Offshore export cable corridor and array area	16km (springs) and 8km (neaps)	1) Approximately 90 percent of the total spoil volume in the hopper will descend directly to the seabed as a high density discrete unit in the 'active phase' of the plume. This does not directly cause any meaningful change of SSC. The remaining 10 percent of material will form a more diffuse suspension in the 'passive phase' of the plume. 2) Within a few tens of metres, at the time of spoil release, very high passive phase plume concentrations are expected, up to hundreds of thousands to millions of mg/l initially, reducing to thousands of mg/l as the plume diffuses to a size of 100m or larger. 3) All SSC effects associated with sands and gravels in the passive phase of the plume are expected to be spatially limited to within 400 to 700m of the dredger, and temporally limited to 10 to 25 minutes following release (depending on the local water depth and current speed). Effects associated with gravels are expected to be more limited (up to 100m and 1 to 5 minutes). 4) The concentration of any fine sediments persisting in suspension will vary in proportion to the dimensions of the plume as it is dispersed over time. A plume with a small footprint (100m) may have a maximum concentration in the order of thousands of mg/l, but when dispersed to a larger footprint (1000m) may have a maximum concentration in the order of low tens of mg/l. Concentrations of suspended fines will continue to reduce gradually over time through dispersion and deposition, to less than measurable levels (<10mg/l) within two to three days. 5) The final distribution of sediment on the seabed from the active phase cannot be predicted in advance, but the total volume, and therefore the area of effect for a given average thickness, is limited. If the average local thickness of deposition is 5cm, the maximum area of effect per

Construction Impact	Location	Maximum sediment plume distance	Details of increase in SSC and deposition
			spoil disposal event is approximately 198,000m^2, equivalent to a 500m diameter circle; if the average local thickness of deposition is 30cm, the maximum area of effect per spoil disposal event is approximately 33,000m^2, equivalent to a 200m diameter circle. In all cases, a relatively thicker deposit will have a smaller footprint and a relatively larger footprint will require a smaller average thickness. 6) Sands and gravels in the passive phase will also be advected by any tidal currents present as they settle to the seabed, and so may or may not overlap the main active phase deposit. The additional deposit may contribute or may add up to approximately 10 percent to the area of effect for the given average thicknesses above, or 10 percent additional thickness for the same area, or a proportional combination of the two. 7) Fines in the passive phase are expected to become widely dispersed and so will not resettle with measurable thickness locally.
Offshore trenching for cables	Offshore export cable corridor and array area	16km (springs) and 8km (neaps)	1) Within 5m of active trenching, very high plume concentrations are expected. SSC could be hundreds of thousands to millions of mg/l. 2) Within 100 to 200m downstream from active trenching (depending on the initial height of ejection and the local current speed) in a relatively narrow plume (up to tens of metres wide), mainly resuspended sands and gravels will cause high SSC in the order of thousands to tens of thousands of mg/l. However, the majority of such coarser sediments are expected to resettle to the seabed (reducing or ending any associated plume effects) within approximately 2 to 5 minutes of resuspension. 3) At 2km downstream during or shortly after active trenching, the concentration of any fine sediments persisting in suspension is expected to be less than approximately 100mg/l; at 5km downstream, this may have reduced to approximately 50mg/l. Concentrations of suspended

Construction Impact	Location	Maximum sediment plume distance	Details of increase in SSC and deposition
			fines will continue to reduce gradually over time through dispersion, to less than measurable levels (<10mg/l) within two to three days. 4) The maximum expected average local thickness of deposition in the case of predominantly gravelly sediments is 30 to 60cm, over an area up to 5 to 10m downstream, along the length of the trench. 5) The maximum expected average local thickness of deposition in the case of predominantly sandy sediments is 3 to 6cm, over an area up to 100 to 200m downstream, along the length of the trench. 6) Fines are expected to become widely dispersed and so will not resettle with measurable thickness locally.
HDD subtidal pit preparations	Offshore export cable corridor	16km (springs) and 8km (neaps)	1) Within 5m of active pit preparation (using dredging or trenching type techniques), very high plume concentrations are expected. SSC could be hundreds of thousands to millions of mg/l, but decreasing rapidly with distance, and with time following cessation of active works. 2) Within 100 to 200m downstream from active pit preparation (depending on the method and rate of excavation and the local current speed) in a relatively narrow plume (up to tens of metres wide), mainly resuspended sands and gravels will cause high SSC in the order of hundreds to thousands or tens of thousands of mg/l. However, the majority of such coarser sediments are expected to resettle to the seabed (reducing or ending any associated plume effects) within approximately 2 to 5 minutes of resuspension. 3) At 2km downstream during or shortly after active trenching, the concentration of any fine sediments persisting in suspension is expected to be less than approximately 100mg/l; at 5km downstream, this may have reduced to approximately 50mg/l. Concentrations of suspended

Construction Impact	Location	Maximum sediment plume distance	Details of increase in SSC and deposition
			fines will continue to reduce gradually over time through dispersion, to less than measurable levels (<10mg/l) within two to three days. 4) The material excavated from the subtidal pits will be temporarily stored, either sidecast nearby or moved into a nearby spoil disposal area (for example, the array area). The thickness and extent of the deposit will be variable depending on the method and nature of the deposition, but will be relatively small, in proportion to the total volume of the pits being excavated. The material in storage may be subject to redistribution by naturally occurring sediment transport during the storage period. 5) Any fully resuspended fines are expected to become widely dispersed and so will not resettle with measurable thickness locally.
Drilling at foundations	Array area	16km (springs) and 8km (neaps)	1) Within small distances (<50m) of the drilling, SSC associated with overspill at the water surface during active drilling can be in the order of thousands to low tens of thousands of mg/l, reducing rapidly with time and distance (through settlement and dispersion) to the order of hundreds or tens of mg/l. 2) All SSC effects associated with overspill of sands during active dredging are expected to be spatially limited to within 400 to 700m of the dredger, and temporally limited to the period of active dredging plus 10 to 25 minutes afterwards (depending on the local water depth and current speed). Effects associated with gravels are expected to be more limited (up to 100m and 1 to 5 minutes). 3) At 2km downstream during or shortly after active dredging, the concentration of any fine sediments persisting in suspension is expected to be less than approximately 1000mg/l; at 5km downstream, this may have reduced to approximately 300mg/l. Concentrations of suspended

Construction Impact	Location	Maximum sediment plume distance	Details of increase in SSC and deposition
			fines will continue to reduce gradually over time through dispersion, to less than measurable levels (<10mg/l) within two to three days. 4) Deposition thicknesses are comparable to and no more than described for spoil disposal from a trailing suction hopper dredger.

9.9.21 To summarise the information presented in **Table 9-19**, sediment plumes caused by seabed preparation and installation activities are expected to go beyond the 15km tidal excursion buffer, with plumes expected to occur over a maximum distance of 16km (spring) from the source. Sediment plumes are expected to quickly dissipate after cessation of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels. Sediment deposition will consist primarily of coarser sediments deposited close to the source, with a small proportion of silt deposition (reducing exponentially from source).

9.9.22 Taking the above into consideration, the impact of increased SSC and deposition from construction activities is expected to be short-term, intermittent and of relatively localised extent (approximately one tidal excursion) and reversible. All biotopes and VERs are distributed widely throughout the eastern English Channel, and therefore taking the wider environment into context, the magnitude of the impact on all VERs is assessed as being **minor**.

9.9.23 Increased SSC and deposition are likely to occur where the offshore export cable corridor is in relatively close proximity to the Kingmere MCZ. Any fine material being dispersed by construction works is likely to be widely distributed and will quickly form part of the background concentration of Suspended Particulate Matter (SPM) in the nearshore and therefore is unlikely to settle in measurable thickness locally. Furthermore, approximately 1,248m^3 of bentonite drill fluid will be released in a relatively short period of time (minutes to hours) in relation to the four HDD punch out locations for the four export cables. The duration and footprint of the temporary bentonite plume will be small in absolute and relative terms (for example order of <10mg/l over footprints larger than 500m over a period of days; or, order of tens to low hundreds of mg/l over footprints less than 500m over a period of minutes to one hour). Therefore, bentonite is not expected to accumulate anywhere in measurable thicknesses. Moreover, 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. Overall, the magnitude of impact on these protected features is therefore, considered to be **minor**.

9.9.24 Therefore, the magnitude of temporary increase in suspended sediment and sediment deposition relating from construction activities at the Proposed Development will have on benthic subtidal receptors is considered to be **minor**, indicating that the potential is for localised disturbance and/or loss of habitat that does not threaten the long-term viability of the resource.

Sensitivity or value of receptor

9.9.25 All biotopes identified within the PEIR Assessment Boundary have been assessed according to the MarESA criteria as ‘not sensitive’ to having a ‘medium’ sensitivity to a disturbance of this nature (**Table 9-20**). The habitats identified are naturally subject to sedimentation and scour and characterising species are therefore likely to tolerate intermittent episodes of sediment movement and deposition. Where heavy deposition is likely to occur, this will result in complete burial of the characterising species and the effect of this pressure will be mediated by the

length of exposure to the deposit. Although, as described in **Table 9-19**, this is only likely to occur is small discreet areas.

9.9.26 The biotope 'piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231)' have been identified as having a 'medium' sensitivity to both light and heavy smothering, as per the MarESA assessment. Piddocks are essentially sedentary and as siphons are relatively short, siltation from fine sediments that add to existing silt layers could be lethal. However, they are expected to fully recover within two to ten years where the resource has not been completely impacted.

9.9.27 The biotope '*S. spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock (A3.215)' was assessed as having a 'medium' sensitivity to changes in SSC and heavy smothering, as per the MarESA assessment. *S. spinulosa* does not photosynthesise and therefore no effects are predicted to this species from a decrease in clarity resulting from a change in one rank on the water framework directive scale for example from clear (<10mg/l) to intermediate (10 to 100mg/l) or intermediate to medium (100 to 300mg/l). However, an increase in turbidity is likely to reduce the abundance of the *L. hyperborean* canopy if the impact was persistent. Where heavy deposits persist underlying flora and fauna of this biotope are likely to occur. However, the biotope is expected to fully recover within two to ten years for both changes in SSC and heavy smothering.

9.9.28 As detailed within the baseline characterisation (**Section 9.6**), comparable habitats are distributed within the wider region and eastern English Channel. Therefore, given the relatively small spatial scales for the total disturbance outlined above, temporary increases in SSC and sediment deposition as a result of construction activities are not expected to undermine regional ecosystem functions or diminish biodiversity.

9.9.29 Subtidal chalk is a protected feature of the Kingmere MCZ which is located adjacent to the proposed PEIR Assessment Boundary offshore export cable corridor. Impacts on the representative biotope 'piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231)', are discussed above. However, on account of the national importance attributed to this feature it has been given a 'high' sensitivity to temporary increases in SSC and sediment deposition. The same precautionary sensitivity value has been allocated to the moderate energy infralittoral rock and thin mixed sediments feature of the Kingmere MCZ, although this habitat feature is likely to be less sensitive to a disturbance of this nature.

9.9.30 Protected features of the Pagham Harbour MCZ, which is located at the furthest extent of the secondary ZOI, includes seagrass beds. According to the evidence presented in the MarESA assessment, seagrass beds have a 'medium' to 'high' sensitivity to temporary increases in SSC and sediment deposition[16]. However, based on the distance of the MCZ from the PEIR Assessment Boundary and the limited impact that is likely to occur, a precautionary sensitivity of 'medium' has been attributed to this feature.

9.9.31 Protected species of the Pagham Harbour MCZ include the Defolin's lagoon snail (*C. armoricum*) and the lagoon sand shrimp (*G. insensibilis*). *C. armoricum*

16 https://www.marlin.ac.uk/habitats/detail/257

inhabits loose shingle where sea water percolates and where soft flocculent silty material is present but leaving plenty space subject to gently flowing water[17]. Therefore, increases in fine sediments might reduce the suitability of the habitat to support this species (Little *et al*., 1989). However, based on the distance of this protected species from the PEIR Assessment Boundary and the limited impact that is likely to occur, a precautionary sensitivity of 'medium' has been attributed to this feature.

9.9.32 Changes in suspended solids are not likely to directly affect *G. insensibilis*[18]. However, limited water movement in the closed lagoon habitat where this species is found could result in any sediment deposits remaining in-situ, causing smothering. As discussed above, based on the distance of this protected species from the PEIR Assessment Boundary and the limited impact that is likely to occur, a precautionary sensitivity of 'medium' has been attributed to this feature.

9.9.33 The sensitivity of the benthic subtidal features found within the PEIR Assessment Boundary benthic subtidal ecology study area is therefore considered to be at worst-case **high**, reflecting the conservation status of the nearby Kingmere MCZ feature. However, the receptor that has been afforded this higher protection 'Piddocks with a sparse associated fauna in

9.9.34 sublittoral very soft chalk or clay (A4.231)' has some ability to tolerate the potential impacts and could potentially recover to an acceptable status over a two to ten-year period.

Table 9-20 MarESA assessment for the benthic subtidal habitats for temporary increase in SSC and sediment deposition (changes in suspended solids, smothering and siltation rate)

Biotope code (JNCC and EUNIS codes)	Biotope name	MarESA sensitivity assessment	Assessment confidence
A5.141/ SS.SCS.CCS.SpiB	*S. triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	1) Not sensitive to changes in SSC; 2) Not sensitive to light smothering (<5cm); and 3) Low sensitivity to heavy smothering (5 to 30cm).	Confidence is high for the SSC assessment as assessment is based on peer reviewed papers. Confidence is medium for smothering and siltation, as the assessment is based on peer reviewed papers, although was based on similar pressures on the feature.
A5.142/ SS.SCS.CCS.MedLumVen	*M. fragilis*, *Lumbrineris* spp. and venerid	1) Low sensitivity to changes in SSC;	Confidence is low for the SSC assessment as assessment is based on

[17] https://www.marlin.ac.uk/species/detail/1166
[18] https://www.marlin.ac.uk/species/detail/1142

Biotope code (JNCC and EUNIS codes)	Biotope name	MarESA sensitivity assessment	Assessment confidence
	bivalves in circalittoral coarse sand or gravel	2) Not sensitive to light smothering (<5cm); and 3) Low sensitivity to heavy smothering (5 to 30cm).	expert judgement. Confidence is low to medium for smothering and siltation. Confidence in the quality of the evidence is high for the smothering assessments, although the applicability and agreement between the evidence is low.
A5.231/ SS.SSa.IFiSa.IMoSa	Infralittoral mobile clean sand with sparse fauna	1) Low sensitivity to changes in SSC; 2) Not sensitive to light smothering (<5cm); and 3) Low sensitivity to heavy smothering (5 to 30cm).	Confidence is low for the SSC assessment as assessment is based on expert judgement. Confidence is high for the SSC assessment as assessment is based on peer reviewed papers.
A5.431/ SS.SMx.IMx.CreAsAn	*C. fornicata* with ascidians and anenomes on infralittoral coarse mixed sediment	1) Not sensitive to changes in SSC; 2) Low sensitivity to light smothering (<5cm); and 3) Low sensitivity to heavy smothering (5 to 30cm).	Confidence is medium for the SSC assessment as the assessment is based on peer reviewed papers, although was based on similar pressures on the feature. Confidence is low for the smothering assessments as the assessment is based on expert judgement.
A5.444/ SS.SMx.CMx.FluHyd	*F. foliacea* and *H. falcata* on tide-swept circalittoral mixed sediment	1) Not sensitive to changes in SSC; 2) Not sensitive to light smothering (<5cm); and 3) Low sensitivity to heavy smothering (5 to 30cm).	Confidence is low for the SSC assessment as assessment is based on expert judgement. Confidence is medium for the smothering assessments as the assessment is based on some peer reviewed papers but relies heavily

Biotope code (JNCC and EUNIS codes)	Biotope name	MarESA sensitivity assessment	Assessment confidence
			on grey literature or expert judgement.
A4.231/ CR.MCR.SfR.Pid	Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay	1) Not sensitive to changes in SSC; 2) Medium to light smothering (<5cm); and 3) Medium sensitivity to heavy smothering (5 to 30cm).	Confidence is low for the SSC assessment as assessment is based on expert judgement. Confidence is low to medium for smothering and siltation. Confidence in the quality of the evidence is medium for the smothering assessments, although the applicability and agreement between the evidence is low.
A3.215/ IR.MIR.KR.Lhyp.Sab	*S. spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock	1) Medium sensitivity to changes in SSC; 2) Not sensitive to light smothering (<5cm); and 3) Medium sensitivity to heavy smothering (5 to 30cm).	Confidence is medium for the SSC assessment as the assessment is based on some peer reviewed papers but relies heavily on grey literature and was based on similar pressures on the feature. Confidence is medium for smothering and siltation.

Significance of residual effect

9.9.35 The indirect impact of increases in SSC and associated sediment deposition will represent a temporary and short-term intermittent impact, affecting a relatively small portion of the benthic subtidal habitats in the PEIR Assessment Boundary benthic ecology study area. Most benthic receptors are known to have a medium to high degree of tolerance to this impact, based on MarESA assessments. It is predicted that the sensitivity of the receptors is worst-case **high**, and the magnitude is **minor**. The short-term and localised nature of the higher SSCs and deposition rates and the tolerance and recoverability of the majority of the benthic receptors, the significance of effect is deemed **minor adverse significance**, which is **not significant** in EIA terms.

9.9.36 The MarESA assessments identify that some aspects of the confidence for the sensitivity of the specified habitats to changes in SSC and for sediment deposition

(smothering) is low. For these habitats, the low confidence score for the sensitivity assessment is associated with the resistance assessment rather than the resilience assessment. The significance of effect has been assessed based on the lowest resistance score of medium and resilience of medium as part of the sensitivity assessments. Therefore, while the confidence score is low, the assessment is using the most conservative sensitivity. As such, the assessment of the significance of effects as **not significant,** is considered to be robust.

Temporary increase in suspended sediment and sediment deposition in the in the intertidal area

Magnitude of impact

9.9.37 Temporary increases in SSC and associated sediment deposition in the intertidal area are expected from the cable installation works. **Chapter 6** provides an assessment of the impacts on marine processes including the development and fate of suspended sediments and seabed deposition.

9.9.38 The maximum design scenario sediment for the temporary floatation pits (which is to be below MLWS, outwith the intertidal zone) is a total of 275,000m^3 for up to four floatation pits per export cable. Excavated spoil from the floatation pits is likely to be taken to a temporary offshore storage location. Any fine material being dispersed from the floatation pits during excavation is likely to be widely dispersed and quickly form part of the background concentration of SSC along the nearshore. The magnitude of impact resulting from temporarily elevated levels of siltation in the intertidal is expected to be discernible.

9.9.39 Therefore, the magnitude of temporary increase in suspended sediment and sediment deposition relating to construction activities at the Proposed Development will have on benthic intertidal receptors is considered to be **negligible**, indicating that the potential is for barely discernible change for any length that does not threaten the long-term viability of the resource.

Sensitivity or value of receptor

9.9.40 All biotopes identified within the PEIR Assessment Boundary have been assessed according to the MarESA criteria as ‘not sensitive’ to having a ‘low’ sensitivity to a disturbance of this nature. The habitats identified are naturally subject to sedimentation and exposure and characterising species are therefore likely to tolerate intermittent episodes of sediment movement and deposition.

9.9.41 Hydrolittoral soft rock outcrops that were identified within the intertidal as a worst-case scenario are likely to have the same sensitivity to light smothering as identified by the biotope ‘piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231)’ (**Table 9-20**), which classifies the biotope as having a medium sensitivity to an impact of this nature.

9.9.42 Protected intertidal habitats of the Solent and Dorset Coast and Pagham Harbour SPA include mudflats and saltmarsh are not expected to be impacted due to the negligible magnitude recorded for this temporary impact. However, have been classified as having a ‘medium’ sensitivity due to their protection status.

9.9.43 The sensitivity of the benthic intertidal features found within the PEIR Assessment Boundary benthic intertidal ecology study area is therefore considered to be at worst-case **medium**, reflecting the conservation status of the nearby Solent and Dorset Coast and Pagham Harbour intertidal features. However, the receptors that has been afforded this higher protection have a high resilience and resistance to light changes in SSC and smothering.

Table 9-21 MarESA assessment for the benthic intertidal habitats for temporary increase in SSC and sediment deposition (changes in suspended solids, smothering and siltation rate)

Biotope code (JNCC and EUNIS codes)	Biotope name	MarESA sensitivity assessment	Assessment confidence
A1.45/ LR.FLR.Eph[19]	Ephemeral green or red seaweeds (freshwater or sand-influenced) on non-mobile substrata	1) Low sensitivity to changes in SSC; and 2) Low sensitivity to light smothering (<5cm).	Confidence is low for the SSC assessment as assessment is based on expert judgement. Confidence is medium for the smothering assessment as the assessment is based on some peer reviewed papers but relies heavily on grey literature or expert judgement.
A2.111/ LS.LCS.Sh.BarSh[20]	Barren littoral shingle	1) Not sensitive to changes in SSC; and 2) Not sensitive to light smothering (<5cm).	Confidence is low for both assessments. The quality of the evidence is high in both instances however the assessment is based on a similar pressure.
A2.245/ LS.LSa.MuSa.Lan[21]	*L. conchilega* in littoral sand	1) Not sensitive to changes in SSC; and 2) Not sensitive to light smothering (<5cm).	Confidence is low for the SSC assessment as assessment is based on expert judgement. Confidence is high for the for the smothering assessment as it is based on peer reviewed papers.

19 https://www.marlin.ac.uk/habitats/detail/241
20 https://www.marlin.ac.uk/habitats/detail/143
21 https://www.marlin.ac.uk/habitats/detail/195

Significance of residual effect

9.9.44 The indirect impact of increases in SSC and associated sediment deposition will represent a discernible impact on intertidal features recorded within the PEIR Assessment Boundary. Intertidal receptors recorded within the PEIR Assessment Boundary are recorded as being 'not sensitive' to having a 'medium' sensitivity to changes in SSC and light smothering (<5cm), based on MarESA assessments. The sensitivity of the benthic subtidal features found within the PEIR Assessment Boundary benthic subtidal ecology study area is considered to be at worst-case **medium**. The magnitude is **negligible**. The effect is therefore **negligible adverse significance**, which is **not significant** in EIA terms.

9.9.45 The MarESA assessments identify that some aspects of the confidence for the sensitivity of the specified habitats to changes in SSC and for sediment deposition (smothering) is low. For these habitats, the low confidence score for the sensitivity assessment is associated with the resistance assessment rather than the resilience assessment, which has a high confidence. Since the evidence agrees in terms of direction and magnitude of the impact this is a conservative and robust assessment

Direct and indirect seabed disturbances leading to the release of sediment contaminants

Magnitude of impact

9.9.46 There is the potential for sediment bound contaminants, such as metals, hydrocarbons, and organic pollutants, to be released into the water column and lead to an effect on benthic ecology receptors, as a result of construction activities and associated sediment mobilisation.

9.9.47 Evidence from the nearby IFA-2 interconnector suggests that the area is not heavily contaminated. IFA-2 is situated at a minimum distance of 300m west of the Proposed Development. Contaminated sediment surveys undertaken for IFA-2 detected arsenic at two sites, located approximately 10km west of the Proposed Development, and measurable amounts of Dibutyltin (DBT) and Tributyltin (TBT) at the mouth of Southampton Water (IFA-2, 2016).

9.9.48 The assessment of contaminants undertaken during the Rampion 1 offshore wind farm baseline characterisation, which covers part of the PEIR Assessment Boundary and wider benthic subtidal ecology study area, revealed that the levels of contaminants within the sediments were generally low, suggesting sediments will not present any concern for seabed disturbance. However, eleven of the sites sampled supported levels of contaminants in excess of Action Level 1 for Arsenic and Chromium, at four of the sites (EMU Limited, 2011). The results of the sediment contaminant survey that has been undertaken across PEIR Assessment Boundary were not available for inclusion within this PEIR assessment but will be fully reported within the final ES.

9.9.49 Following disturbance as a result of construction activities, the majority of re-suspended sediments are expected to be deposited within the immediate vicinity of the works. The release of contaminants from the small proportion of fine sediments is likely to be rapidly dispersed with the tide and/or currents and

therefore increased bioavailability resulting in adverse eco-toxicological effects are not expected.

9.9.50 Therefore, the magnitude of the impact is considered to be **negligible**, indicating that any release of sediment contamination is likely to be discernible over a very small area of the receptor, which does not threaten benthic subtidal ecology features, undermine regional ecosystem functions or diminish biodiversity.

Sensitivity or value of receptor

9.9.51 The sensitivity of benthic species to toxic pollutants that may be disturbed is deemed to be **high**, which is considered precautionary and reflects the lack of evidence on individual receptors and biotopes. A sensitivity of high describes the habitat or species as exhibiting 'None' or 'low' resistance (tolerance) to an external factor and is expected to recover only over very extended timescales, for example greater than 25 years or not all (**Table 9-15**).

Significance of residual effect

9.9.52 The direct and indirect impact of seabed disturbances leading to the release of sediment contaminants will represent a discernible impact on benthic subtidal habitats in the PEIR Assessment Boundary benthic subtidal ecology study area. The sensitivity of the benthic subtidal features found within the PEIR Assessment Boundary benthic subtidal ecology study area is considered to be at worst-case **high** and the magnitude is **negligible**. The effect is therefore **minor adverse significance**, which is not significant in EIA terms.

Increased risk of introduction or spread of Marine INNS may affect benthic ecology and biodiversity

Magnitude of impact

9.9.53 There is a risk that through increased vessel movements during construction will contribute to the risk of introduction or spread of Marine INNS through ballast water discharge (Eno *et al*., 1997). As presented in **Table 9-13**, there will be up to 2,636 round trips to port during the construction phase. Impacts associated with introduction of hard substrate is discussed within **Section 9.10**. However, the movement of commercial vessels is common throughout the region (**Chapter 13: Shipping and navigation**) and this provides an existing and potentially more likely method of transport for Marine INNS species (due to the higher variety of ports and passage routes).

9.9.54 As detailed within **Table 9-14**, embedded environmental measures which include an Outline PEMMP with a biosecurity plan (C-95) will ensure that the risk of potential introduction and spread of Marine INNS from increased vessel activity is minimised.

9.9.55 It should be noted that there is a wide-spread presence of Marine INNS across the eastern English Channel, which is evident from the predicted presence of the biotope '*Crepidula fornicata* with ascidians and anemones on infralittoral coarse mixed sediment (A5.431)' across the near shore portion of the PEIR Assessment Boundary (**Figure 9-4, Volume 3**). The Marine INNS *C. fornicata* has successfully

established to an extent that it outcompetes indigenous species causing large scale habitat changes across the wider south coast (EMU Limited, 2012), with Interconnexion France-Angleterre 2 interconnector (IFA-2) recording *C. fornicata* as one of the most common biotopes in the nearshore area (IFA-2, 2016). Demonstrating that the region is not a pristine environment in terms of the absence of Marine INNS.

9.9.56 Therefore, the magnitude of the impact that construction activities will have to the introduction or spread of Marine INNS is considered to be **negligible**, indicating that there will be a discernible change for any length of time, over a small area of the receptor that does not threaten benthic subtidal ecology features, undermine regional ecosystem functions or diminish biodiversity.

Sensitivity or value of receptor

9.9.57 The sensitivity of benthic biotopes within the PEIR Assessment boundary to the introduction or spread of Marine INNS is deemed to be 'not-sensitive' to having a 'high' sensitivity to an impact of this nature, according to the MarESA criteria (**Table 9-22**). The sensitivity of nearby MCZ features is also regarded as high given their protection status. Therefore, the sensitivity is considered to be **high**, reflecting that at worst-case benthic receptors have 'none' or 'low' resistance (tolerance) to an impact of this nature.

Table 9-22 MarESA assessment for the benthic subtidal habitats for introduction or spread of Marine INNS

Biotope code (JNCC and EUNIS codes)	Biotope name	MarESA sensitivity assessment	Assessment confidence
A5.141/ SS.SCS.CCS.SpiB	*S. triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles	Not sensitive (based on a high resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
A5.142/ SS.SCS.CCS.MedLumVen	*M. fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel	High (based on a high resistance and high resilience)	Confidence is high as the assessment is based on peer reviewed papers and the assessment is based on the same pressures acting on the same type of feature in the UK.
A5.231/ SS.SSa.IFiSa.ImoSa	Infralittoral mobile clean sand with sparse fauna	Not sensitive (based on a high resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and

Biotope code (JNCC and EUNIS codes)	Biotope name	MarESA sensitivity assessment	Assessment confidence
			therefore a baseline is not available.
A5.431/ SS.SMx.IMx.CreAsAn	*C. fornicata* with ascidians and anenomes on infralittoral coarse mixed sediment	This biotope is dominated by *C. fornicata*, which is itself an Invasive Non-Indigenous Species. This pressure is therefore 'Not relevant'	Not relevant
A5.444/ SS.SMx.CMx.FluHyd	*F. foliacea* and *H. falcata* on tide-swept circalittoral mixed sediment	The high levels of scour in this biotope will limit the establishment of all but the most scour resistant Marine INNS from this biotope and no direct evidence was found for effects of INNIS on this biotope. There is currently n evidence on which to assess this pressure	No evidence
A4.231/ CR.MCR.SfR.Pid	Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay	Not sensitive (based on a high resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
A3.215/ IR.MIR.KR.Lhyp.Sab	*S. spinulosa* with kelp and red seaweeds on sand-influenced infralittoral rock	High sensitivity (based on low resistance and high resilience)	Confidence is high as the assessment is based on peer reviewed papers, although the assessment was based on similar pressures on the feature.

Significance of residual effect

9.9.58 The Proposed Development embedded mitigation (as shown in **Table 9-14**) include measures to avoid the introduction or spread of Marine INNS through the implementation of the Outline PEMMP (C-95) which will be secured through the

DCO, to minimise the disturbance to benthic receptors, overall, it is predicted that the sensitivity of the receptor is **high**, and the magnitude is **negligible**. The residual effect is of **minor adverse significance**, which is **not significant** in EIA terms.

9.9.59 The MarESA assessments identify that some aspects of the confidence for the sensitivity of the specified habitats to increased risk of introduction or spread of Marine INNS is low. For these habitats, this is a result of lack of available evidence with the assessment based on expert judgement. However, as the sensitivity of the receptors have been classified as worst-case high, this can be considered a conservative and robust assessment.

Indirect disturbance arising from the accidental release of pollutants

Magnitude of impact

9.9.60 There is a risk that indirect disturbance arising from the accidental release of pollutants such as synthetic compounds, heavy metal and hydrocarbon contamination resulting from offshore infrastructure installation, approximately 2,636 return trips anticipated to port by construction vessels over the construction period and machinery use and vehicle movement in the intertidal could lead to an adverse effect on benthic subtidal and intertidal ecology receptors.

9.9.61 As detailed within **Table 9-14**, embedded environmental measures which include an Outline MPCP (C–53) will act to safeguard the marine environment and provide mitigation measures in the event of an accidental pollution event arising from offshore operations relating to the Proposed Development, ensuring that the risk of an accidental pollution event is minimised.

9.9.62 Therefore, the magnitude of the impact that construction activities will have to the release of pollutants is considered to be **negligible**, indicating that there will be a discernible change for any length of time, over a small area of the receptor that does not threaten benthic subtidal ecology features, undermine regional ecosystem functions or diminish biodiversity.

Sensitivity or value of receptor

9.9.63 The sensitivity of benthic species to toxic pollutants that may be released because of construction activities is deemed to be **high**, which is considered precautionary and reflects the lack of evidence on individual receptors and biotopes. A sensitivity of high describes the habitat or species as exhibiting ‘None’ or ‘low’ resistance (tolerance) to an external factor and is expected to recover only over very extended timescales, for example greater than 25 years or not all (**Table 9-15**).

Significance of residual effect

9.9.64 The Proposed Development embedded mitigation (as shown in **Table 9-14**) include measures to safeguard the marine environment and provide mitigation measures in the event of an accidental pollution event arising from offshore operations relating to the Proposed Development (C-53) which will be secured through DCO, to minimise the disturbance to benthic receptors. Overall, it is predicted that the sensitivity of the benthic subtidal and intertidal receptors found

within the PEIR Assessment Boundary benthic subtidal ecology study area is **high** and the magnitude is **negligible**. The residual effect is therefore **minor adverse significance**, which is **not significant** in EIA terms.

Indirect disturbance from increased noise and vibration from construction activities

Magnitude of impact

9.9.65 The piling of the WTG foundations will result in the generation of underwater noise which will extend out from the source, travelling both through the water column and through the sediment.

9.9.66 It is acknowledged that marine invertebrates are likely to suffer injurious and possibly lethal effects from anthropogenic high intensity noise (for instance piling). However, it is not possible to assess the impact of this in a meaningful way at this stage without any modelling currently available for these species or any studies focusing on polychaetes as the dominant taxa surrounding PEIR Assessment Boundary.

9.9.67 Furthermore, while it is possible that noise from piling may have similar effects on the eggs/larvae of benthic invertebrates, the area of ensonification for which this happens is in the order of metres from the piling location and consequently, the magnitude of this impact is likely to be discernible.

9.9.68 Therefore, the magnitude of the impact that construction activities relating to the Proposed Development will have on benthic subtidal receptors is considered to be **negligible**, indicating that the potential is for indiscernible over a small area of the receptor and the disturbance does not threaten the long-term viability of the resource.

Sensitivity or value of receptor

9.9.69 The available literature on the impact of noise and vibration on benthic species is increasing. However, the current available agreed metrics for noise modelling do not comprehensively incorporate the impacts of particle movement, which is of greater importance when considering the impacts on benthic species, rather than sound pressure which has been used so far (Hawkins and Popper, 2016). Additionally, the majority of studies have so far focused on crustaceans or molluscs (for example Edmonds *et al*., 2016, Roberts *et al*., 2016, Roberts and Elliott, 2017), and less is understood about the impacts on the polychaetes that dominate the benthic habitats predicted across the PEIR Assessment Boundary.

9.9.70 A study by Solan (2016) resulted in high levels of intra-specific variability in physiological responses to underwater broadband sound fields that resemble offshore shipping and construction activity the study provided evidence that exposing between the bivalve clam, *Ruditapes philippinarum*, the decapod, *Nephrops norvegicus* and, the brittlestar, *Amphiura filiformis*. The study concluded that such anthropogenic sound fields may have ecosystem consequences as a result. Murchy *et al.* (2019) conducted a met-analysis study on the behavioural and physiological impacts of shipping noise on invertebrates and found that noise had a significant effect on the size. However, five taxa were examined and of

these, the classes Cephalopoda and Gastropoda were negatively affected whilst Bivalvia was positive.

9.9.71 The scarcity of studies carried out with benthic receptors severely constrains the present understanding of noise pollution. Further studies are needed to reveal in detail the causes for the detected impacts in other species in the few limited studies that are available. As a result of the scarcity of available evidence for the impacts of noise on benthic invertebrates, in particular polychaetes, the sensitivity of benthic receptors in considered to be **high**.

Significance of residual effect

9.9.72 The indirect disturbance from increased noise and vibration from construction activities represents a discernible impact on benthic subtidal habitats in the PEIR Assessment Boundary benthic subtidal ecology study area. The sensitivity of the benthic subtidal features found within the PEIR Assessment Boundary benthic subtidal ecology study area is considered to be at worst-case **high** and the magnitude is **negligible**. The residual effect is therefore **minor adverse significance**, which is **not significant** in EIA terms.

9.10 Preliminary assessment: Operation and maintenance phase

Long-term habitat loss/alteration from the presence of foundations, scour protection and cable protection

Magnitude of impact

9.10.1 The presence of foundations and the associated scour protection, along with the cable protection measures used at cable crossings and areas where cable burial is not possible, will lead to a change from a sedimentary habitat to one characterised by hard substrate. This will be either a long-term habitat loss (for the approximate 30-year design life duration of the Proposed Development) or a permanent change and is therefore considered an impact of the operational phase of the development and potentially beyond. It is assessed here as habitat loss and a potential adverse effect (due to the potential shift in the baseline condition), although it is noted that this also comprises potential beneficial effects, providing new habitats for different faunal assemblages to colonise, resulting in a likely increase in biodiversity and biomass.

9.10.2 **Table 9-13** identifies the maximum design scenario for foundation, scour and cable protection footprint. The total habitat loss arising from these components will be 1.12km^2, which equates to approximately 0.3 percent of the PEIR Assessment Boundary.

9.10.3 As detailed in **Section 9.9**, the biotope 'Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay (A4.231)' is present within the array area specifically in relation to Worthing Lumps LWS(see **Table 9-11**) and this biotope has been identified within the geophysical survey (Gardline, 2020) and the predictive habitat model (see **Table 9-9** and **paragraph 9.6.9**) in relation to the

offshore export cable corridor. While the impact will comprise a long-term or permanent change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected is highly localised. As the habitats and characterising biotopes are not geographically restricted to the PEIR Assessment Boundary and are generally widespread throughout the wider region, the loss of these habitats is assessed as discernible and the magnitude is assessed as **minor**, indicating that the loss of habitat does not threaten the long-term viability of the benthic resource within the PEIR Assessment Boundary.

9.10.4 No long-term habitat loss will occur in the intertidal area of the PEIR Assessment Boundary offshore export cable corridor as cable protection will not be used in this area.

Sensitivity or value of receptor

9.10.5 All biotopes identified within the PEIR Assessment Boundary have been assessed according to the MarESA criteria as having no resistance to long-term or permanent habitat loss/change, with recovery assessed as very low as the change at the pressure benchmark is at worst case permanent. The sensitivity of subtidal receptors is therefore considered to be at worst-case **high** according to the EIA assessment values.

Significance of residual effect

9.10.6 Artificial rock and hard substratum will alter the character of the biotopes recorded within the PEIR Assessment Boundary leading to reclassification and the loss of the existing communities. However, while the impact will comprise a long-term or permanent change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected is highly localised. Overall, it is predicted that the sensitivity of the receptor is **high**, and the magnitude is **minor**. As the habitats and characterising biotopes are not geographically restricted to the PEIR Assessment Boundary and are widespread throughout the eastern English Channel region the loss of these habitats is assessed as barely discernible and the residual effect is considered to be of **minor adverse significance**, which is **not significant** in EIA terms.

9.10.7 Whilst at this stage mitigation to reduce the impact magnitude has not been embedded within the design of the Proposed Development at this stage, there is regional precedent for successful mitigation being feasible. The feasibility of mitigating construction phase impacts is anticipated to reduce the impact magnitude and therefore significance of effect, particularly in relation to piddocks, and these measures are anticipated to equally reduce the potential for long term habitat loss being realised in the operational phase of the Proposed Development. For this impact the measures available include consideration of the installation method to minimise the area of physical impact, and development of a reinstatement plan to ensure any disturbed bedrock feature is appropriately stored during installation and reinstated following installation. The latter method of reinstatement was previously employed on the existing Rampion 1 offshore wind farm and is considered proven and therefore with a high likelihood of successfully reducing the magnitude and effect significance.

Temporary habitat disturbance from jack-up vessels and cable maintenance activities

Magnitude of impact

9.10.8 The total maximum area of temporary subtidal habitat loss will arise from the use of jack-up vessels for operational and maintenance activities as well as from cable maintenance and cable repair. A total of up to 5.33km^2 of temporary habitat disturbance is predicted to arise over the approximate 30-year design life of the Proposed Development (equating to approximately 1.62 percent of the PEIR Assessment Boundary). Given that habitats and characterising biotopes are not geographically restricted to the PEIR Assessment Boundary and are generally widespread throughout the eastern English Channel region, impacts from individual operation and maintenance activities will represent a very small footprint compared to their overall extent.

9.10.9 Cable repair works will require de-burial and re-burial of a cable or cable sections and along with cable preventative maintenance, including re-burial, will consequently result in increases in SSC and sediment deposition. However, the impacts from these works will be spread over the approximate 30-year period of operation and maintenance activities with only a limited number of activities occurring within any one year.

9.10.10 Therefore, the magnitude of the impact that temporary habitat disturbance from jack-up vessels and cable maintenance activities relating to the Proposed Development will have on benthic subtidal receptors is considered to be **minor**, indicating that the disturbance of habitat does not threaten the long-term viability of the benthic resource within the PEIR Assessment Boundary.

Sensitivity or value of receptor

9.10.11 As detailed within **paragraph 9.9.8** to **paragraph 9.9.14**, the habitats directly affected by temporary habitat loss/disturbance have a worst-case sensitivity of **high** to a disturbance of this nature, with the MarESA assessment also presented in detail. **Paragraph 9.9.25** to **paragraph 9.9.34**, detail that the habitats indirectly affected by increased SSC and deposition have a worst-case **high** sensitivity to the expected levels of SSC and deposition, with the MarESA assessment also presented in detail.

Significance of residual effect

9.10.12 The direct impact of temporary habitat disturbance will represent a local spatial extent and/or short-term intermittent impact, affecting a relatively small portion of the benthic subtidal habitats in the PEIR Assessment Boundary. Most benthic receptors are known to have a medium to high degree of tolerance to this impact, based on MarESA assessments. It is predicted that the sensitivity of the receptors is worst-case **high**, and the magnitude is **minor**. The short-term and/or localised nature of this impact and the tolerance and recoverability of the majority of the benthic receptors, the significance of the residual effect is deemed **minor adverse significance**, which is **not significant** in EIA terms.

Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities

Magnitude of impact

9.10.13 The presence of foundations, scour protection and cable protection material may introduce changes to the local hydrodynamic and wave regime (**Table 9-13**), resulting in changes to the sediment transport pathways and associated effects on benthic ecology. Scour and increases in flow rates can change the characteristics of the sediment potentially making the habitat less suitable for some species.

9.10.14 The use of correctly designed scour protection at foundations and sufficiently buried cables (see C-44, **Table 9-14**) will prevent scour occurring (see **Chapter 6**, **Section 6.8.22**). Scour will therefore only occur if and where scour protection has not been applied.

9.10.15 The exact form of cable protection to be used will depend upon local ground conditions, hydrodynamic processes, and the selected cable protection contractor. However, the final choice will include one or more of the following concrete 'mattresses', rock placement, geotextile bags filled with stone, rock or gravel, polyethylene or steel pipe half shells, or sheathes and bags of grout, concrete, or another substance that cures hard over time. Where cable protection is used, some scouring is predicted to occur throughout the operational phase at these features. The extent of this scouring is predicted to be local, occurring around the perimeter of rock berms.

9.10.16 The Coastal processes assessment (**Chapter 6**) has determined that the impacts on hydrodynamic and wave regimes will be not significant and will therefore not result in any significant changes to sediment transport (**Chapter 6**) and consequently will not have any significant impacts on benthic ecology. The magnitude of this impact is therefore considered to be **negligible.**

Sensitivity or value of receptor

9.10.17 As detailed within **paragraph 9.9.8** to **paragraph 9.9.14**, the habitats directly affected by abrasion/disturbance have a worst-case sensitivity of high to a disturbance of this nature, with the MarESA assessment also presented in detail. **Paragraph 9.9.25** to **paragraph 9.9.34**, detail that the habitats indirectly affected by increased SSC and deposition have a worst-case **high** sensitivity to the expected levels of SSC and deposition, with the MarESA assessment also presented in detail.

Significance of residual effect

9.10.18 The Proposed Development embedded mitigation (as shown in **Table 9-14**) include the development of an Outline Scour Protection Management Plan (SPMP), to prevent scour occurring at foundations and at buried cable (C–44), which will be secured through DCO, to minimise the disturbance to benthic receptors. Overall, it is predicted that the sensitivity of the benthic subtidal and intertidal receptors found within the PEIR Assessment Boundary benthic subtidal ecology study area is **high** and the magnitude is **negligible**. The residual effect is

therefore **minor adverse significance**, which is **not significant** in EIA terms.

Colonisation of the WTGs and scour/cable protection may affect benthic ecology and biodiversity

Magnitude of impact

9.10.19 The introduction of hard substrate will change the type of available habitats within the PEIR Assessment Boundary. However, the amount of introduced substrate is relatively small at approximately 1.36km^2, which accounts for approximately 0.4 percent of the total PEIR Assessment Boundary.

9.10.20 Hard substrate habitats are not rare within the PEIR Assessment Boundary which is dominated by both sedimentary habitats, coarser sediments and rocky outcrops. The introduction of hard substrate, and associated increases in biodiversity, will alter sedimentary biotopes that characterise the area at the location of the introduction of the Proposed Development infrastructure and will be long term, lasting for the duration of the development. Any effects on benthic subtidal ecology, arising from the introduction of hard substrates will likely be localised to the PEIR Assessment Boundary array area and offshore export cable corridor (where cable protection is laid).

9.10.21 The impact is therefore predicted to be of local spatial extent, long-term duration but reversable once the infrastructure is removed, although not all introduced hard substrate is likely to be removed, with cable and scour protection remaining in-situ. Therefore, the magnitude of the impact is considered to be **minor**, as the habitats and characterising biotopes are not geographically restricted and are typically common and widespread throughout the wider region and the loss of these habitats is assessed as barely discernible.

Sensitivity or value of receptor

9.10.22 The introduction of new hard substrate will represent a potential shift in the baseline condition within a small proportion of the PEIR Assessment Boundary. Potential beneficial effects that may occur are associated with the likely increase in biodiversity and biomass, as has been observed at the Egmond aan Zee Offshore Windfarm (Lindeboom *et al*., 2011). Individual species with the potential to benefit from the introduction of hard substrate due to increased substrate for attachment are those which are typical of rocky habitats environments.

9.10.23 The species potentially introduced may also have indirect and adverse effects through increased predation on, or competition with, neighbouring soft sediment species. However, such effects are difficult to predict. The increased biodiversity associated with the structures could provide benefits at higher trophic levels as the benthic organisms colonising the structures provide an additional food source. Studies at the Horns Rev Offshore Windfarm in Denmark provided evidence that offshore wind farm structures are used as successful nursery habitats for the edible crab *C. pagurus* (BioConsult, 2006). However, any direct benefits are only likely to occur on a very localised basis (for instance near the infrastructure).

9.10.24 Given the presence of epifaunal species and colonising fauna within discrete parts of the PEIR Assessment Boundary (for instance associated with coarser sediment

and rocky habitats), it is predicted that colonisation of hard substrates by common species such as bryozoans and ascidians will occur.

9.10.25 The sediment biotopes likely to be affected are deemed to be of low vulnerability to an impact of this nature. Recoverability following removal of the infrastructure is expected to be high although not all introduced hard substrate is likely to be removed, with cable and scour protection remaining in-situ. The sensitivity of these receptors is therefore, considered to be at worst case **high**, in areas where infrastructure is not removed.

Significance of residual effect

9.10.26 Any beneficial effects associated with an increase in biodiversity will be highly localised in nature and is not regarded as mitigation for the loss of habitat associated with the installation of these structures. The introduction of hard structures such as scour protection can lead to an increase in biomass and biodiversity which may be considered beneficial, but it also represents a change from the baseline environment which may be considered adverse.

9.10.27 Overall, it is predicted that the sensitivity of the receptor is **high** and the magnitude is **minor**. While the impact will comprise a permanent change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected and any associated increases and/or changes in biodiversity will be highly localised. Given that the benthic habitats that characterise the PEIR Assessment Boundary are not geographically restricted to within the proposed development area and are typically widespread throughout the wider eastern English Channel region (as described in **Section 9.6**), the predicted change in species composition and biodiversity in discreet areas are not expected to threaten the long-term viability of the resource. The residual effect is considered to be of **minor adverse significance**, which is **not significant** in EIA terms.

Increased risk of introduction or spread of Marine INNS due to presence of infrastructure and vessel movements (for example the discharge of ballast water) may affect benthic ecology and biodiversity

Magnitude of impact

9.10.28 There is a risk that the introduction of hard substrate into a sedimentary habitat will enable the colonisation of the introduced substrate by invasive/non-indigenous species that might otherwise not have had a suitable habitat for colonisation, thereby enabling their spread. This along with the movement of operation and maintenance vessels in and out of the PEIR Assessment Boundary has the potential to impact upon benthic ecology and biodiversity locally and in the broader region.

9.10.29 As presented in **Table 9-13**, up to 1.36km^2 of new hard substrate habitat will be introduced into the PEIR Assessment Boundary, which has the potential to provide new habitat for colonisation by Marine INNS.

9.10.30 In addition to this there will be an estimated total of 33,390 vessel return trips during the operation and maintenance phase of the Proposed Development. The majority of these return trips (32,850) comprise of crew transfer vessel journeys.

As these crew transfer vessel trips will originate from local operations ports to the Proposed Development, the risk of Marine INNS introductions are minimal. However, the movement of commercial vessels is common throughout the region (**Chapter 13**) and this provides an existing and potentially more likely method of transport for Marine INNS species (due to the higher variety of ports and passage routes).

9.10.31 It should be noted that there is a wide-spread presence of Marine INNS across the eastern English Channel, which is evident from the biotope '*Crepidula fornicata* with ascidians and anemones on infralittoral coarse mixed sediment (A5.431)' which is predicted to occur across the PEIR Assessment Boundary. The Marine INNS *C. fornicata* has successfully established to an extent that it outcompetes indigenous species causing large scale habitat changes across the wider south coast (EMU Limited, 2012). Furthermore, there is extensive areas of hard substrate recorded within the benthic subtidal ecology study area (**Section 9.6**), so the introduction of artificial hard substrate will not interrupt a pristine sedimentary habitat.

9.10.32 As detailed within **Table 9-14**, embedded environmental measures which include an Outline PEMMP with a biosecurity plan (C-95) will, however, ensure that the risk of potential introduction and spread of Marine INNS will be minimised.

9.10.33 The magnitude of the impact that construction activities will have to the introduction or spread of Marine INNS is considered to be **minor**, indicating that there will be a discernible change for any length of time, over a small area of the receptor that does not threaten benthic subtidal ecology features, undermine regional ecosystem functions or diminish biodiversity.

Sensitivity or value of receptor

9.10.34 As described in **paragraph 9.9.57**, benthic biotopes within the PEIR Assessment boundary to the introduction or spread of Marine INNS is deemed to be 'not-sensitive' to having a 'high' to an impact of this nature, according to the MarESA criteria. The sensitivity of nearby MCZ features is also regarded as high given their protection status. Therefore, the sensitivity is considered to be **high**, reflecting that those benthic receptors have 'none' or 'low' resistance (tolerance) to an impact of this nature.

Significance of residual effect

9.10.35 The Proposed Development embedded mitigation (as shown in **Table 9-14**) include measures to avoid the introduction or spread of Marine INNS through the implementation of the Outline PEMMP (C-95) which will be secured through DCO, to minimise the disturbance to benthic receptors, overall, it is predicted that the sensitivity of the receptor is **high**, and the magnitude is **minor**. The movement of commercial vessels is common throughout the region and hard substrates are already prevalent throughout the region, the significance of the residual effect is deemed **minor adverse significance**, which is **not significant** in EIA terms.

Indirect disturbance arising from the accidental release of pollutants

Magnitude of impact

9.10.36 There is a risk that indirect disturbance arising from the accidental release of pollutants such as synthetic compounds, heavy metal and hydrocarbon contamination resulting from up to 116 WTGs and up to three offshore substations. Accidental pollution may also result from up to 33,390 vessel return trips over the approximate 30-year design lifetime, which could lead to an adverse effect on benthic subtidal and intertidal ecology receptors.

9.10.37 As detailed within **Table 9-14**, embedded environmental measures which include an Outline MPCP (C–53) will act to safeguard the marine environment and provide mitigation measures in the event of an accidental pollution event arising from offshore operations relating to the Proposed Development, ensuring that the risk of an accidental pollution event is minimised.

9.10.38 Therefore, the magnitude of the impact that operation and maintenance activities will have to the release of pollutants is considered to be **negligible**, indicating that there will be a discernible change for any length of time, over a small area of the receptor that does not threaten benthic subtidal ecology features, undermine regional ecosystem functions or diminish biodiversity.

Sensitivity or value of receptor

9.10.39 The sensitivity of benthic species to toxic pollutants that may be released as a result of operation and maintenance activities is deemed to be **high**, which is considered precautionary and reflects the lack of evidence on individual receptors and biotopes. A sensitivity of high describes the habitat or species as exhibiting ‘None’ or ‘low’ resistance (tolerance) to an external factor and is expected to recover only over very extended timescales, for example greater than 25 years or not all (**Table 9-15**).

Significance of residual effect

9.10.40 The Proposed Development embedded mitigation (as shown in **Table 9-14**) include measures to safeguard the marine environment and provide mitigation measures in the event of an accidental pollution event arising from offshore operations relating to Proposed Development (C-53) which will be secured through DCO, to minimise the disturbance to benthic receptors. Overall, it is predicted that the sensitivity of the benthic subtidal and intertidal receptors found within the PEIR Assessment Boundary benthic subtidal ecology study area is **high** and the magnitude is **negligible**. The residual effect is therefore **minor adverse significance**, which is **not significant** in EIA terms.

Indirect disturbance arising from EMF generated by the current flowing through the cables buried to less than 1.5m below the surface

Magnitude of impact

9.10.41 EMF are generated by the current that passes through an electric cable. It is known that EMF can be detected by fish and elasmobranchs and it is thought that any benthic invertebrates can also detect EMF. Three types of fields are generated by underwater electric cables: electric fields (E-fields), magnetic fields (B-fields) and induced electric fields (iE-fields). Standard industry practice is for the cables used to have sufficient shielding to contain the E-fields generated and the cable system descriptions for the inter-array and export cables have abided by this (**Chapter 4**). Shielding and/or burial does not reduce the B-fields and it is these fields that allow the formation of iE-fields. As such, further reference here to EMF is limited to B-fields and associated iE-fields.

9.10.42 Impacts from changes in EMFs arising from cables, are not considered to result in a significant effect on benthic subtidal and intertidal receptors. EMFs are likely to be generated by subsea cables and detectable above background levels in close proximity to the cables. Although burial does not mask EMFs it increases the distance between species that may be affected by EMFs and the source. As the cable will be buried or protected, as detailed within **Table 9-14** (embedded environmental measures C-41, C-43 and C-45), any behavioural responses are likely to be mitigated.

9.10.43 It is considered unlikely that EMFs will result in a significant behavioural response that will cause a change in benthic communities within the benthic subtidal ecology study area and that any potential negative effects will be confined to a localised area surrounding the cables. Therefore, the magnitude of the impact considered to be **negligible**, indicating that any behavioural response of benthic fauna is likely to be discernible or barely discernible over a very small area, that does not threaten benthic subtidal ecology features, undermine regional ecosystem functions or diminish biodiversity.

Sensitivity or value of receptor

9.10.44 The MarESA sensitivity assessments do not consider there to be sufficient evidence to support assessments of impacts of EMF on benthic and intertidal habitats; therefore, a desktop study has been undertaken to describe the typical responses of benthic invertebrates.

9.10.45 Typically, the impacts of EMF on marine organisms have focused on electrically sensitive fish and elasmobranchs, with little research focusing on benthic invertebrates, with the few studies using invertebrates focusing on crustaceans (for example Woodruff *et al*., 2012). Furthermore, many studies contradict each other or provide inconclusive results (Switzer and Meggitt, 2010), further reducing the available evidence.

9.10.46 However, evidence of sensing, responding to, or orienting to natural magnetic field cues has been shown for invertebrates including molluscs and arthropods (Lohman and Willows, 1987; Ugolini and Pezzani, 1995; Ugolini, 2006; Boles and Lohmann, 2003). A study by Scott *et al*. (2019) reported that edible crabs (*C.*

pagurus) exposed to EMF in the laboratory at the strength predicted around sub-sea cables resulted in a clear attraction of the crabs to EMF and significantly reduced their time spent roaming. This suggests that the natural roaming behaviour, where individuals will actively seek food and/or mates has been overridden by an attraction to the source of the EMF. The EMF had no effect on stress-related parameters, such as respiration rate or activity level, but the results predict that in benthic areas where there is increased EMFs, there will be an increase in the abundance of *C. pagurus* present.

9.10.47 A laboratory study assessing the effects of environmentally realistic, low-frequency B-field exposure on the behaviour and physiology of the common ragworm (*Hediste diversicolor*) did not find any evidence of avoidance or attraction behaviours (Jakubowska *et al*., 2019). The polychaetes did, however, exhibit enhanced burrowing activity when exposed to the B-field, with plausible consequences for their metabolism; however, knowledge about the biological relevance of this response is currently absent (Jakubowska *et al*., 2019).

9.10.48 One recent study examined the difference in invertebrate communities along an energised and nearby unenergised surface laid cables and this identified that there were no functional differences between the communities on and around the cables up to three years after installation (Love *et al*., 2016). This study also identified that the EMF levels reduce to background levels generally within one metre of the cable. This supports evidence collected from Nysted Wind Farm at Rødsand, in Denmark, which while the study focused on fish the conclusions should be valid for mobile invertebrates, that determined that there was no change in the overall distribution that could be attributed to the presence of the cables (Hvidt *et al*., 2004).

9.10.49 For invertebrate receptor species, it is difficult to translate the patchwork of knowledge about individual-level EMF effects into assessments of biologically or ecologically significant impacts on populations (Boehlert and Gill, 2010). However, given the evidence presented, it is predicted that EMFs have no significant impact on mobile or sessile benthic invertebrates, including if the cable is surface laid.

9.10.50 The sensitivity of benthic receptors is therefore considered to be **low**, reflecting that the receptor has a high resistance and ability to tolerate the impacts of EMF over the approximate 30-year operational lifetime of the Proposed Development.

Significance of residual effect

9.10.51 The Proposed Development embedded mitigation (as shown in **Table 9-14**) include measures to bury or protect cables (C-41, C-43 and C-45) any behavioural responses of benthic receptors are likely to be mitigated. Overall, it is predicted that the sensitivity of the benthic subtidal and intertidal receptors found within the PEIR Assessment Boundary is **low** and the magnitude is **negligible**. The residual effect is therefore **negligible adverse significance**, which is **not significant** in EIA terms.

9.11 Preliminary assessment: Decommissioning phase

Temporary habitat disturbance from decommissioning of foundations, cable and rock protection

9.11.1 The nature and extent of temporary habitat loss/disturbance during decommissioning is assumed (for the purposes of this assessment) to be similar to that described for the equivalent activities during the construction phase in **paragraph 9.9.2** to **paragraph 9.9.7**. unless otherwise stated.

9.11.2 The maximum design scenario has assumed the same quantitative requirements for sandwave clearance and boulder clearance activities, prior to decommissioning, as that required during the construction phase, although this is also likely to be over-precautionary.

9.11.3 Decommissioning has the potential to cause temporary loss of, or disturbance to, benthic habitats within the PEIR Assessment Boundary, similar to those described during the construction phase. However, as seabed preparation works will not be required, the magnitude of this impact will be lower than during the construction phase.

9.11.4 The details of the proposed decommissioning process will be included within the Decommissioning Programme which will be developed and updated throughout the lifetime of the Proposed Development to account for changing best practice.

9.11.5 The magnitude of the impact and the sensitivities of the benthic habitats to temporary habitat disturbance are as described for the construction phase (described in detail in **paragraph 9.9.2** to **paragraph 9.9.7**).

Significance of residual effect

9.11.6 Based on the assessment undertaken for construction (which represents the maximum design scenario), it is predicted that the maximum sensitivity of benthic receptors is **high** and the magnitude is **minor**. The short-term and localised nature of this impact and the tolerance and recoverability of the majority of the benthic receptors, the significance of residual effect is deemed **minor adverse significance**, which is **not significant** in EIA terms.

Temporary increase in suspended sediment and sediment deposition from decommissioning of foundations, cables and rock protection

Overview

9.11.7 The nature and extent of temporary increase in suspended sediment and sediment deposition during decommissioning is assumed (for the purposes of this assessment) to be similar to that described for the equivalent activities during the construction phase in **paragraph 9.9.18** to **paragraph 9.9.24** unless otherwise stated (for instance activities involved in the decommissioning process that give rise to impacts that are similar to those arising from the construction process such as sandwave clearance, cable installation and drilling at foundations).

9.11.8 The maximum design scenario has assumed the same quantitative requirements for sandwave clearance, prior to decommissioning, as that required during the construction phase, although this is also likely to be over-precautionary.

9.11.9 Decommissioning has the potential to cause temporary increase in suspended sediment and sediment deposition within the PEIR Assessment Boundary, similar to those described during the construction phase. However, as seabed preparation works will not be required, the magnitude of this impact will be lower than during the construction phase.

9.11.10 The details of the proposed decommissioning process will be included within the Decommissioning Programme which will be developed and updated throughout the lifetime of the Proposed Development to account for changing best practice.

9.11.11 The magnitude of the impact and the sensitivities of the benthic habitats to temporary increase in suspended sediment and sediment deposition are as described for the construction phase (described in detail in **paragraph 9.9.18** to **paragraph 9.9.24**).

Significance of residual effect

9.11.12 Based on the assessment undertaken for construction (which represents the maximum design scenario), it is predicted that the maximum sensitivity of benthic receptors is **high** and the magnitude is **minor**. The short-term and localised nature of the higher SSCs and deposition rates and the tolerance and recoverability of the majority of the benthic receptors, the significance of the residual effect is deemed **minor adverse significance**, which is **not significant** in EIA terms.

Direct and indirect seabed disturbances leading to the release of sediment contaminants

Overview

9.11.13 The nature and extent of direct and indirect seabed disturbances leading to the release of sediment contaminants during decommissioning is assumed (for the purposes of this assessment) to be similar to that described for the equivalent activities during the construction phase in **paragraph 9.9.46** to **paragraph 9.9.50**, unless otherwise stated.

9.11.14 The details of the proposed decommissioning process will be included within the Decommissioning Programme which will be developed and updated throughout the lifetime of the Proposed Development to account for changing best practice.

9.11.15 The magnitude of the impact and the sensitivities of the benthic habitats to temporary increase in suspended sediment and sediment deposition are as described for the construction phase (described in detail in **paragraph 9.9.18** to **paragraph 9.9.24**).

Significance of residual effect

9.11.16 Based on the assessment undertaken for construction (which represents the maximum design scenario), it is predicted that the maximum sensitivity of benthic

receptors is at worst-case **high** and the magnitude is **negligible**. The residual effect is therefore **minor adverse significance**, which is **not significant** in EIA terms.

Increased risk of introduction or spread of Marine INNS may affect benthic ecology and biodiversity

Overview

9.11.17 The nature and extent of increased risk of introduction or spread of Marine INNS is assumed (for the purposes of this assessment) to be similar to that described for the equivalent activities during the construction phase in **paragraph 9.9.53** to **paragraph 9.9.56**, unless otherwise stated (for instance vessel movements).

9.11.18 The details of the proposed decommissioning process will be included within the Decommissioning Programme which will be developed and updated throughout the lifetime of the Proposed Development to account for changing best practice.

9.11.19 The magnitude of the impact and the sensitivities of the benthic habitats to the introduction or spread of Marine INNS are as described for the construction phase (described in detail in **paragraph 9.9.18** to **paragraph 9.9.24**).

Significance of residual effect

9.11.20 Based on the assessment undertaken for construction (which represents the maximum design scenario), it is predicted that the maximum sensitivity of benthic receptors is at worst-case **high** and the magnitude is **negligible**. The residual effect is therefore **minor adverse significance**, which is **not significant** in EIA terms.

Indirect disturbance arising from the accidental release of pollutants

Overview

9.11.21 The nature and extent of indirect disturbance arising from the accidental release of pollutants is assumed (for the purposes of this assessment) to be similar to that described for the equivalent activities during the construction phase in **paragraph 9.9.60** to **paragraph 9.9.62**, (for instance synthetic compound, heavy metal and hydrocarbon contamination)

9.11.22 The details of the proposed decommissioning process will be included within the Decommissioning Programme which will be developed and updated throughout the lifetime of the Proposed Development to account for changing best practice.

9.11.23 The magnitude of the impact and the sensitivities of the benthic habitats to the introduction or spread of Marine INNS are as described for the construction phase (described in detail in **paragraph 9.9.60** to **paragraph 9.9.62**).

Significance of residual effect

9.11.24 The Proposed Development embedded mitigation (as shown in **Table 9-13**) include measures to safeguard the marine environment and provide mitigation

measures in the event of an accidental pollution event arising from offshore operations relating to the Proposed Development (C-53) which will be secured through DCO, to minimise the disturbance to benthic receptors. Overall, it is predicted that the sensitivity of the benthic subtidal and intertidal receptors found within the PEIR Assessment Boundary benthic subtidal ecology study area is **high** and the magnitude is **negligible**. The residual effect is therefore **minor adverse significance**, which is **not significant** in EIA terms.

9.12 Preliminary assessment: Cumulative effects

Approach

9.12.1 A preliminary cumulative effects assessment (CEA) has been carried out for the Proposed Development which examines the result from the combined impacts of the Proposed Development 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**.

9.12.2 The offshore screening approach is based on PINS Advice Note Seventeen (PINS, 2019b), with relevant components of the RenewableUK (RenewableUK, 2013) accepted guidance, which includes aspects specific to the marine elements of an offshore wind farm, addressing the need to consider mobile wide-ranging species (foraging species, migratory routes etc).

Cumulative effects assessment

9.12.3 For benthic subtidal and intertidal ecology, a ZOI (as described in **Section 9.4: Scope of assessment** and shown in **Figure 9.9, Volume 3** has been applied for the CEA to ensure direct and indirect cumulative effects can be appropriately identified and assessed. The ZOI has been determined as the largest distance over which an impact may occur, for the purpose of the benthic subtidal and intertidal ecology assessment, this is defined over the distance which increased SSC and deposition may occur and therefore extends 15km around the array area PEIR Assessment Boundary and 10km surrounding the offshore export cable corridor PEIR Assessment Boundary area of search. As detailed in **paragraph 9.9.19** sediment plumes caused by seabed preparation and installation activities are expected to go beyond the 15km tidal excursion buffer, with plumes expected to occur over a maximum distance of 16km (spring) from the source. However, sediment plumes are expected to quickly dissipate after cessation of the activities, due to settling and wider dispersion with the concentrations reducing quickly over time to background levels.

9.12.4 A short list of other developments that may interact with the Proposed Development ZOIs during their construction, operation and maintenance or decommissioning is presented in **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.

9.12.5 A tiering structure has been used for screening and assessment of other developments as in accordance with PINS Advice Note Seventeen (**Chapter 5**). Definitions of Tiers are set out in **Table 5-3** of **Chapter 5: Approach to EIA, Volume 4**. Where other projects are expected to be completed before construction of the Proposed Development and the effects of those projects are fully determined, effects arising from them are considered as part of the baseline and may be considered as part of both the construction and operational assessment.

9.12.6 Only those developments in the short list that fall within the benthic subtidal and intertidal ecology ZOI have the potential to result in cumulative effects with the Proposed Development. The benthic, subtidal and intertidal ecology ZOI is shown in **Chapter 5**, **Figure 5.1, Volume 3**. All developments falling outside the benthic subtidal and intertidal ecology ZOI are excluded from this assessment. Furthermore, the following types of other development have the potential to result in cumulative effects on benthic subtidal and intertidal ecology.

- sub-sea cables and pipelines (telecom and power cables);
- aggregate production areas;
- offshore wind farms; and
- telecom cables.

9.12.7 On the basis of the above, the following specific other developments (as presented within **Table 9-23**) contained within the short list in **Appendix 5.4, Volume 4** are scoped into this CEA. It should be noted that developments which are proposed or under construction, at the time of writing this chapter, are included in the table below due to lack of certainty around any ongoing effect.

Table 9-23 Developments to be considered as part of the CEA

ID (Figure 5.4.1)	Development type	Project	Status	Confidence in assessment	Tier	Distance to Proposed Development offshore export cable corridor (km)	Distance to Proposed Development array area (km)
C1	Cable	AQUIND (UK to France)	Proposed (assumed offshore installation in 2022)	High – Third-party project details published in the public domain and confirmed as being 'accurate' by the developer.	1	5.4	0
A396/1	Aggregates	396/1 Inner Owers – Tarmac Marine Ltd	Active (end date 07/07/2030)	High – Third-party project details published in the public domain and confirmed as being 'accurate' by the developer.	1	0.1	0
A396/2	Aggregates	396/2 Inner Owers – Tarmac Marine Ltd	Active (end date 07/07/2030)	High – Third-party project details published in the public domain and confirmed as being 'accurate' by the developer.	1	2	3.5

ID (Figure 5.4.1)	Development type	Project	Status	Confidence in assessment	Tier	Distance to Proposed Development offshore export cable corridor (km)	Distance to Proposed Development array area (km)
A435/1	Aggregates	435/1 Inner Owers – Hanson Aggregates Marine Ltd	Active (end date 07/07/2030)	High – Third-party project details published in the public domain and confirmed as being 'accurate' by the developer.	1	0.7	0.1
A435/2	Aggregates	435/2 Inner Owers – Hanson Aggregates Marine Ltd	Active (end date 07/07/2030)	High – Third-party project details published in the public domain and confirmed as being 'accurate' by the developer.	1	2.3	0.7
A453	Aggregates	453 Owers Extension – CEMEX UK Marine Ltd.	Active (end date 31/03/2032)	High – Third-party project details published in the public domain and confirmed as being 'accurate' by the developer.	1	0.5	5.5
A488	Aggregates	488 Inner Owers	Active	High – Third-party project details	1	0.6	3.9

ID (Figure 5.4.1)	Development type	Project	Status	Confidence in assessment	Tier	Distance to Proposed Development offshore export cable corridor (km)	Distance to Proposed Development array area (km)
		North – Tarmac Marine Ltd.	(end date 07/07/2030)	published in the public domain and confirmed as being 'accurate' by the developer.			
A395/1	Aggregates	395/1 Off Selsey Bill – Aggregate Industries UK Ltd.	Active (end date 05/03/2028)	High – Third-party project details published in the public domain and confirmed as being 'accurate' by the developer.	1	20.2	15

9.12.8 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.

9.12.9 The cumulative Project Design Envelope is described in the following table (**Table 9-24**).

Table 9-24 Cumulative maximum design scenario for benthic subtidal and intertidal ecology

Potential impact	Scenario	Justification
Construction		
Cumulative temporary increases in SSC and associated sediment deposition	Maximum design scenario as described for the construction of the Proposed Development assessed cumulatively with the following projects within the benthic subtidal ecology study area: **Tier 1:** 1) Construction phase of AQUIND interconnector cables. 2) Operation of aggregate licence areas (396/1, 396/2, 435/1, 435/2, 453, 488, 395/1). **Tier 2:** No Tier 2 projects identified. **Tier 3:** No Tier 3 projects identified.	Maximum cumulative increases in SSC and smothering is calculated within the PEIR Assessment Boundary benthic ecology study area (further detail is presented in **paragraph 9.10.13** to **paragraph 9.10.16**).
Operation and Maintenance		
Cumulative long-term habitat loss/ change from the presence of foundations, scour protection and cable protection	Maximum design scenario as described for the construction of the Proposed Development assessed cumulatively with the following projects within the benthic subtidal ecology study area: **Tier 1:** 1) operation and maintenance of operational cables (AQUIND). **Tier 2:** No Tier 2 projects identified.	Maximum cumulative long-term habitat loss/change as a result of the presence of foundations, scour protection and cable protection is calculated within the PEIR Assessment Boundary benthic subtidal ecology study area. There is no exact indication where cable and scour protection will occur,

Potential impact	Scenario	Justification
	Tier 3: No Tier 3 projects identified.	therefore as a very precautionary measure this assessment will assume the total for each project will occur in the PEIR Assessment Boundary benthic subtidal ecology study area (further detail is presented in **paragraph 9.12.19** to **paragraph 9.12.25**).
Cumulative changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities.	Maximum design scenario as described for the construction of the Proposed Development assessed cumulatively with the following projects within the benthic subtidal ecology study area: **Tier 1:** 1) operation and maintenance of operational cables (AQUIND). **Tier 2:** No Tier 2 projects identified. **Tier 3:** 2) No Tier 3 projects identified.	The maximum design scenario of these projects have the potential to result in cumulative changes to seabed habitats arising from effects on physical processes, which in turn has the potential to impact benthic communities. Further detail is presented in **paragraph 9.12.19** to **paragraph 9.12.25**, and are also detailed in **Chapter 6**

9.12.10 A description of the significance of cumulative effects upon benthic and intertidal ecology arising from each identified impact is given below. The cumulative effects assessment has been based on information available in the ESs for the other developments where these are available; it is noted that the other development parameters quoted within these ESs are often refined during the determination period and in the post-consent phase such that the final schemes built out may have a reduced impact compared to what has been concluded in the ES.

9.12.11 The other developments considered in this CEA are illustrated in **Figure 9.9, Volume 3**.

Cumulative temporary increases in SSC and associated sediment deposition during construction

9.12.12 There is potential for cumulative increases in SSC and associated deposition as a result of construction activities associated with the Proposed Development and other developments (**Table 9-24**). For the purposes of this assessment, this additive impact has been assessed within the benthic subtidal ecology ZOI, which extends 15km around the array area boundary and 10km surrounding the offshore export cable corridor, representing the maximum tidal excursion in the area, and

therefore the furthest distance sediments can travel from the site. The other developments identified in Tier 1 are the AQUIND interconnector cables and aggregate licence areas 396/1, 396/2, 435/1, 435/2, 453, 488 and 395/1. There are no Tier 2 or Tier 3 projects.

9.12.13 The AQUIND interconnector cable is located with the PEIR Assessment Boundary array area and it is assumed that construction will coincide with the construction of the Proposed Development. From kilometre point 21 to 109 the worst-case scenario for increased SSC is considered to be surface release of up to 1,754,000m^3 of sediment (AQUIND Limited, 2019). Cumulatively with the Proposed Development construction this may result in the disturbance and deposition of up to 4,645,000m^3 of sediment. However, only a small portion of the AQUIND interconnector cable intersects with the PEIR Assessment Boundary (9.34km of cable) with a total of 24.72km overlapping the benthic subtidal ecology study area, and therefore the maximum amount of sediment released cumulatively with the Proposed Development will be considerably less. Any cable maintenance repairs undertaken within the operational phase of the developments will be short term, intermittent and localised to the site and therefore cumulative impacts are expected to be minimal. Additionally, due to the naturally dynamic environment of the site, any sediment released from these operations during the construction and operational phases of the development will likely be dispersed in the faster flows. Therefore, taking this into consideration, there are not predicted to be any significant cumulative impacts from the construction or operation of the AQUIND interconnector cable.

9.12.14 Aggregate licence areas 396/1, 396/2, 435/1, 435/2, 453, 488 and 395/1 will be operational during the construction of the Proposed Development, therefore the potential for cumulative temporary increases in SSC and sediment deposition from these active dredge operations. The target material at these marine aggregate areas is sands and gravels and characteristically, the aggregate deposits in the MAREA region contain 1 to 3 percent mud (silt and clay) in situ and therefore the suspended sediment concentrations in the overflow from dredging vessels are relatively low compared to other regions of the UK (EMU Limited, 2012). As part of the Rampion 1 offshore wind farm ES changes to seabed sediment thickness as a result of combined foundation installation and aggregate extraction works were modelled as part of the impact assessment (ABPMer, 2012). The modelling predicted that bed level changes of up to around 1mm could occur; however, it was expected that this sediment will be widely remobilised. The addition of 1mm of sediment is not anticipated to cause any significant impacts to benthos associated with the PEIR Assessment Boundary. ABPMer (2012) also considered that there was only a minimal potential for of any interaction between suspended sediment from export cable installation and aggregate extraction. Similar observations are anticipated for the Proposed Development. Therefore, no significant cumulative effects are predicted.

9.12.15 Cumulative effects can also be considered in terms of duration of exposure from multiple projects which do not overlap but happen consecutively. However, as the effects from the majority of the projects will be short-lived, there are likely to be significant temporal gaps between the discrete construction and maintenance events, which will have localised effects. As aggregate activities are not considered to cause a significant cumulative increase to SSC and deposition and as a result of the ‘not sensitive’ to ‘high’ sensitivity of benthic receptors in PEIR

Assessment Boundary benthic ecology study area (**paragraph 9.9.35** and **paragraph 9.9.36**), cumulative effects in terms of duration of exposure are not expected.

9.12.16 The cumulative impacts of increased SSC and sediment deposition is considered to be **minor**, indicating that the potential is for localised disturbance that does not threaten the long-term viability of the resource.

9.12.17 Full discussion of the sensitivity of benthic ecology receptors to increased SSC and sediment deposition is discussed in **paragraph 9.9.35** and **paragraph 9.9.36** which conclude that most benthic receptors have a not sensitive' to 'medium' sensitivity to increased SSC and deposition. The maximum sensitivity of receptors in the area is therefore assessed as **high**.

9.12.18 The indirect impact of increases in SSC and associated sediment deposition will represent a temporary and short-term intermittent impact, affecting a relatively small portion of the benthic subtidal habitats in the PEIR Assessment Boundary benthic ecology study area. It is predicted that the sensitivity of the receptors is worst-case **high**, and the magnitude is **mino**r. The short-term and localised nature of the higher SSCs and deposition rates and the tolerance and recoverability of the majority of the benthic receptors, the significance of the residual effect is deemed **minor adverse significance**, which is **not significant** in EIA terms.

Cumulative long-term habitat loss/change from the presence of foundations, scour protection and cable protection during operation and maintenance

9.12.19 Cumulative long-term habitat loss is predicted to occur as a result of the presence of the Proposed Development infrastructure, offshore wind farms which are consented and cables within the representative benthic subtidal ecology ZOI. Long term habitat loss may result from the physical presence of foundations, scour protection and cable protection, which are assumed to be in place for the lifetime of the relevant offshore wind and cable project and potentially beyond the lifetime of these projects. The CEA has been based on information available within ESs where available and it is noted that the project parameters quoted in ESs are often refined during the determination period of the application or post consent. The assessments presented within this assessment are therefore considered to be conservative, with the level of impact on benthic ecology expected to be reduced from those presented here.

9.12.20 As presented in **Table 9-25** the predicted cumulative long-term habitat loss from all Tier 1 projects is estimated to be estimated to be 1.67km^2 which equates to 0.51 percent of the PEIR Assessment Boundary benthic ecology study area. No Tier 2 or 3 projects are identified. As previously discussed, some of these projects do not fully overlap with the PEIR Assessment Boundary benthic ecology study area, therefore the total long-term habitat loss we should be considering as part of this assessment is likely to be significantly less. Comparable habitats are widely distributed in the English Channel (**Section 9.6**) so this loss is not predicted to diminish regional ecosystem functions.

9.12.21 While the cumulative impact of from long-term habitat loss will comprise a long-term or permanent change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected is highly localised. As the habitats and characterising biotopes are common and

widespread throughout the wider region, the loss of these habitats is assessed as discernible and the magnitude is assessed as **minor**, indicating that the loss of habitat does not threaten the long-term viability of the benthic resource.

9.12.22 As previously discussed in **paragraph 9.10.5**, the sensitivity of benthic ecology receptors to long-term or permanent habitat loss/change concludes that all benthic receptors have no resistance to long-term or permanent habitat loss/change, with recovery assessed as very low as the change at the pressure benchmark is at worst case permanent. The sensitivity of subtidal receptors is therefore considered to be at worst-case **high** according to the EIA assessment values.

9.12.23 Artificial rock and hard substratum will alter the character of the biotopes recorded within the benthic subtidal ecology study area leading to reclassification and the loss of the existing communities. However, while the impact will comprise a long-term or permanent change in seabed habitat within the footprint of the artificial hard substratum, the footprint of the area affected is highly localised. Furthermore, as the habitats and characterising biotopes are common and widespread throughout the wider region the loss of these habitats is assessed as barely discernible. Overall, it is predicted that the sensitivity of the receptor is **high**, and the magnitude is **minor**. As the habitats and characterising biotopes are not geographically restricted to the benthic subtidal ecology study area and are generally widespread throughout the eastern English Channel region, the loss of these habitats is assessed as barely discernible and the residual effect is considered to be of **minor adverse significance**, which is **not significant** in EIA terms.

Table 9-25 Cumulative magnitude of impact for long-term habitat loss/change from the presence of foundations, scour protection and cable protection

Other development	Total predicted long-term habitat loss (km^2)	Source
PEIR Assessment Boundary (array and export cable)	0.97	**Chapter 4**
AQUIND interconnector cable	0.7 (maximum area/footprint of original habitat loss due to non-burial cable protection over the entirety of the 109km cable – approximately 54km of which is within the 15km buffer of the PEIR Assessment Boundary).	Total habitat loss taken from ES (AQUIND Limited, 2019)
Total Tier 1 Projects:	1.67	

Cumulative changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities during operation and maintenance

9.12.24 The cumulative presence of offshore structures associated with the Proposed Development and other developments in the region have the potential to introduce changes to the local hydrodynamic and wave regime, resulting in cumulative changes to the sediment transport pathways and associated effects on benthic ecology. For the purpose of this assessment, this additive impact has been assessed within the representative PEIR Assessment Boundary benthic subtidal ecology ZOI. The other developments identified for under Tier 1 are the AQUIND interconnector cables. There are no Tier 2 or Tier 3 projects.

9.12.25 The coastal processes assessment (**Chapter 6**) has determined that the impacts on hydrodynamic and wave regimes from cumulative impacts will be not significant and will therefore not result in any significant changes to sediment transport and consequently will not have any significant adverse impacts on benthic ecology.

9.13 Transboundary effects

9.13.1 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). The screening exercise identified that there was no potential for significant transboundary effects to occur in relation to benthic and intertidal ecology.

9.14 Inter-related effects

9.14.1 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, or group of receptors. The potential inter-related effects that could arise in relation to benthic and intertidal ecology are presented in **Table 9-26**. Such inter-related effects include both:

- Proposed Development lifetime effects: for instance, 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.
- 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.

Table 9-26 Inter-related effects assessment for benthic subtidal and intertidal ecology.

Project phase(s)	Nature of inter-related effect	Assessment alone	Inter-related effects assessment
Proposed Development-lifetime effects			
Construction, operation and maintenance and decommissioning	Temporary habitat loss across all three project phases	Impacts were assessed as being Not Significant in the construction, operation and maintenance and decommissioning phases.	When habitat loss or disturbance is considered additively across all phases, although the total area of habitat affected is larger, the habitats affected are widespread. Furthermore, most benthic habitats are predicted to recover to the baseline condition within two to ten years. Therefore, across the Proposed Development lifetime, the effects on benthic ecology receptors are not anticipated to in such a way as to result in combined effects of greater significance than the assessments presented for each individual phase. There will therefore be no inter-related effects of greater significance compared to the impacts considered alone.
Construction and decommissioning	Indirect impacts to benthic ecology as a result of the temporary increase in SSC and sediment deposition.	As pathways, there is limited potential for inter-related effects to occur upon marine processes. Impacts were assessed as being Not Significant in the construction and decommissioning phases.	The majority of the seabed disturbance (resulting in the highest SSC and sediment deposition) will occur during the construction and decommissioning phases, with any effects being short-lived. Due to this, and the recoverability of the species and habitats affected, the interaction of these impacts across all stages of the development is not predicted to result in an effect of any greater significance than those assessed in the individual project phases.
Receptor-led effects			

Project phase(s)	Nature of inter-related effect	Assessment alone	Inter-related effects assessment
Inter-related effects from the interaction of increased SSC and sediment deposition and habitat loss/disturbance	There is the potential for spatial and temporal interactions between the effects arising from habitat loss/disturbance and increases SSC and sediment deposition during the Proposed Development lifetime. The greatest potential for inter-related effects is predicted to occur through the interaction of both temporary and permanent habitat loss/disturbance from foundation installation/jack-up vessels/anchor placement/scour, indirect habitat disturbance due to sediment deposition and indirect effects of changes in physical processes due the presence of infrastructure in the operational offshore wind farm. With respect to this interaction, these individual impacts were assigned a **minor adverse significance** as standalone impacts and although potential combined impacts may arise (for instance spatial, and temporal overlap of direct habitat disturbance), it is predicted that this will not be any more significant than the individual impacts in isolation. This is because the combined amount of habitat potentially affected will be very limited, the biotypes affected are not geographically restricted to the PEIR Assessment Boundary, and where temporary disturbance occurs, full recovery of the benthos is predicted for most habitats. In addition, any effects due to changes in the physical processes are likely to be limited, both in extent and in magnitude, with receptors having low sensitivity to the scale of changes predicted. As such, these interactions are predicted to be no greater in significance than that for the individual effects assessed in isolation.		

9.14.2 Overall, the inter-related assessment for the Proposed Development does not identify any significant inter-related effects that were not already covered by the topic-specific assessment set out in the preceding chapters. However, certain individual effects were identified that did interact with each other whilst not leading to any greater significance of effect.

9.15 Summary of residual effects

9.15.1 **Table 9-27** presents a summary of the preliminary assessment of significant impacts, any relevant embedded environmental measures and residual effects on benthic subtidal and intertidal ecology receptors.

Table 9-27 Summary of preliminary assessment of residual effects

Activity and impact	Magnitude of impact	Receptor and sensitivity or value	Embedded environmental measures	Preliminary assessment of residual effect (significance)
Construction				
Temporary habitat disturbance in the Rampion 2 array area and offshore cable corridor from construction activities	Minor	Low – High	N/A	**Minor adverse (not significant)**
Temporary increase in suspended sediment and sediment deposition in the Rampion 2 array area and offshore cable corridor	Minor	Not sensitive – High	N/A	**Minor adverse (not significant)**
Temporary increase in SSC and sediment deposition in the intertidal area	Negligible	Not sensitive – Medium	N/A	**Negligible adverse (not significant)**
Direct and indirect seabed disturbances leading to the release of sediment contaminants	Negligible	High	N/A	**Minor adverse (not significant)**
Increased risk of introduction or spread of Marine INNS may affect benthic ecology and biodiversity	Negligible	High	C-95	**Minor adverse (not significant)**
Indirect disturbance arising from the accidental release of pollutants	Negligible	High	C-53	**Minor adverse (not significant)**
Indirect disturbance from increased noise and vibration from construction activities	Negligible	High	N/A	**Minor adverse (not significant)**
Operation and maintenance				

Activity and impact	Magnitude of impact	Receptor and sensitivity or value	Embedded environmental measures	Preliminary assessment of residual effect (significance)
Long-term habitat loss/alteration from the presence of foundations, scour protection and cable protection	Minor	High	N/A	**Minor adverse (not significant)**
Temporary habitat disturbance from jack-up vessels and cable maintenance activities	Minor	Low – High	N/A	**Minor adverse (not significant)**
Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic communities	Negligible	Not sensitive – High	N/A	**Minor adverse (not significant)**
Colonisation of the WTGs and scour/cable protection may affect benthic ecology and biodiversity	Minor	High	N/A	**Minor adverse (not significant)**
Increased risk of introduction or spread of Marine INNS due to presence of infrastructure and vessel movements (for example the discharge of ballast water) may affect benthic ecology and biodiversity	Negligible	High	C-95	**Minor adverse (not significant)**
Indirect disturbance arising from the accidental release of pollutants	Negligible	High	C-53	**Minor adverse (not significant)**

Activity and impact	Magnitude of impact	Receptor and sensitivity or value	Embedded environmental measures	Preliminary assessment of residual effect (significance)
Indirect disturbance arising from EMF generated by the current flowing through the cables buried to less than 1.5m below the surface	Negligible	Low	C-41, C-43, and C-45	**Negligible adverse (not significant)**
Decommissioning				
Temporary habitat disturbance from decommissioning of foundations, cables and rock protection	Minor	Low – High	N/A	**Minor adverse (not significant)**
Temporary increase in suspended sediment and sediment deposition from decommissioning of foundations, cables and rock protection	Minor	Not sensitive – High	N/A	**Minor adverse (not significant)**
Direct and indirect seabed disturbances leading to the release of sediment contaminants	Negligible	High	N/A	**Minor adverse (not significant)**
Increased risk of introduction or spread of Marine INNS may affect benthic ecology and biodiversity	Negligible	High	C-95	**Minor adverse (not significant)**
Indirect disturbance arising from the accidental release of pollutants	Negligible	High	C-53	**Minor adverse (not significant)**

9.16 Further work to be undertaken for ES

Introduction

9.16.1 Further work that will be undertaken to support the benthic subtidal and intertidal ecology assessment and presented within the ES is set out below.

Baseline

9.16.2 The ES baseline will be updated to include the site-specific subtidal data that has been collected across the Proposed Development, as detailed within **paragraph 9.5.3** to **paragraph 9.5.7**. The predictive habitat model will also be updated to include the site-specific ground-truthing results which will subsequently produce a final high confidence EUNIS map, which will be available for inclusion into the ES.

Assessment

9.16.3 The assessment methodology will be consistent with the Scoping stage methodology and the PEIR methodology as presented in **Section 9.8**. The methodology will be informed by the baseline and, where appropriate, will be revised as necessary following any updates to the baseline data.

Consultation and engagement

9.16.4 Further consultation and engagement that will be undertaken to inform the benthic subtidal and intertidal ecology assessment and presented within the ES. As detailed in **Section 9.3** under ETG engagement the following stakeholders: the MMO, Cefas, Natural England, Environment Agency, The Wildlife Trust and Sussex Wildlife Trust, will addresses any issues that may arise, through ongoing consultation as part of the EPP Steering Group and Benthic subtidal and Intertidal Ecology ETG to confirm that the assessment is satisfactory.

Environmental measures

9.16.5 Further environmental measures that will be considered, incorporated into the design of the Proposed Development, and presented within the ES are set out in **Table 9-28**. As the design plan regarding the decommissioning phase is not complete, a Decommissioning Plan has not yet been developed.

Table 9-28 Further environmental measures.

Receptor	Changes and effects	Environmental measures and influence on assessment
An offshore Decommissioning Plan, including consideration on benthic ecology	It is expected that the embedded environmental measures as presented in **Table 9-14** will be applied	No changes are expected on the assessment.

Receptor	Changes and effects	Environmental measures and influence on assessment
receptors, will be developed prior to decommissioning	in the Decommissioning Plan.	

9.17 Glossary of terms and abbreviations

Table 9-29 Glossary of terms and abbreviations

Term (acronym)	Definition
Aspect	Used to refer to the individual environmental topics.
BAP	Biodiversity Action Plan
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.
Benthic ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Biotope	A region of habitat associated with a particular ecological community.
Centre for Environment Fisheries and Aquaculture Science (Cefas)	The Government's marine and freshwater science experts, advising the UK government and overseas partners.
CIEEM	Chartered Institute of Ecology and Environmental Management
Climate Change	A change in the state of the climate that can be identified (for example, by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes, to external forcing or to persistent

Term (acronym)	Definition
	anthropogenic changes in the composition of the atmosphere, ocean or in land use.
Coastal processes	The processes that interact to control the physical characteristics of a natural environment, for example: winds; waves; currents; water levels; sediment transport; turbidity; coastline, beach and seabed morphology.
Crustacea	Arthropod of the large, mainly aquatic group Crustacea, such as a crab, lobster, shrimp, or barnacle.
Cumulative Effects assessment (CEA)	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.
Cumulative impact	Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the Proposed Development.
Development Consent Order (DCO)	This is the means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects, under the Planning Act 2008.
DCO Application	An application for consent to undertake a Nationally Significant Infrastructure Project made to the Planning Inspectorate (PINS) 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.
Drop Down Video (DDV)	A survey method in which imagery of habitat is collected, used predominantly to survey marine environment.
Ecological feature	Ecological feature is the term used to refer to biodiversity receptors. This term is taken directly from Ecological Impact Assessment guidance from the Chartered Institute of Ecology and Environmental Management.
EECMHM	Eastern English Channel Marine Habitat Map
EEA	European Economic Area
EIA Regulations 2017	The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.

Term (acronym)	Definition
	The EIA regulations require that the effects of a project, where these are likely to have a significant effect on the environment, are taken into account in the decision-making process for the project.
Electromagnetic field (EMF)	An electromagnetic field is an electric and magnetic force field that surrounds a moving electric charge.
Enhancement	A measure that is over and above what is required to mitigate the adverse effects of a project.
Environment Agency	A non-departmental public body, with responsibilities relating to the protection and enhancement of the environment in England
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 Statement (ES)	The written output presenting the full findings of the Environmental Impact Assessment.
ETG	Expert Topic Group
EUNIS habitat classification	A pan-European system which facilitates the harmonised description and classification of all types of habitat, through the use of criteria for habitat identification.
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
FEPA	Food and Environment Protection Act
Formal consultation	Formal consultation refers to statutory consultation that is required under Section 42 and Section 47 of the Planning Act 2008 with the relevant consultation bodies and the public on the preliminary environmental information.
Future baseline	Refers to the situation in future years without the Proposed Development.
Geophysical	Relating to the physics of the earth.
Habitats Regulations	EC Council Directive 92/43/EEC, known as the Habitats Directive, was transposed in the UK by the Habitats Regulations 1994 (as amended). The Habitats Regulations apply to UK land and territorial waters and

Term (acronym)	Definition
	act to ensure biodiversity of natural habitats and of wild flora and fauna through a range of measures including designation of SACs.
Habitat Regulation Assessment (HRA)	The assessment of the impacts of implementing a plan or policy on a European Site, the purpose being to consider the impacts of a project against conservation objectives of the site and to ascertain whether it would adversely affect the integrity of the site.
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).
IEEM	Institute for Ecology and Environmental Management
Impact	The change 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. Often used to describe effects on landscape character that are not directly impacted by the Proposed Development such as effects on perceptual characteristics and qualities of the landscape.
Informal consultation	Informal consultation refers to the voluntary consultation that RED undertake in addition to the formal consultation requirements.
INNS	Invasive Non-Native Species
Inshore	The sea up to two miles from the coast
Intertidal	The area of the shoreline which is covered at high tide and uncovered at low tide.
Iterative design	A process by which the design is repeated to make improvements, solve problems, respond to environmental measures and engage local communities and statutory stakeholders.

Term (acronym)	Definition
Joint Nature Conservation Committee (JNCC)	JNCC is the public body that advises the UK Government and devolved administrations on UK-wide and international nature conservation.
Key characteristics	Those combinations of elements which are particularly important to the current character of the landscape and help to give an area its particularly distinctive sense of place.
Likely Significant Effects (LSE)	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.
Local Wildlife Site (LWS)	Local Wildlife Sites are non-statutory designations conferred by local planning authorities and given weight through local planning policy. These sites are selected through a selection of criteria (criteria are area dependent) aimed at identifying "substantive nature conservation value".
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.
MALSF	The Marine Aggregate Levy Sustainability Fund.
MarLIN	Marine Life Information Network
MarESA	Marine Evidence based Sensitivity Assessment
Marine aggregates	Marine dredged sand and/or gravel.
Marine Conservation Zone (MCZ)	A Marine Conservation Zone (MCZ) is a type of marine nature reserve in UK waters. They were established under the Marine and Coastal Access Act (2009) and are areas designated with the aim to protect nationally important, rare or threatened habitats and species.
Marine Management Organisation (MMO)	MMO is an executive non-departmental public body, sponsored by the Department for Environment, Food & Rural Affairs. MMO license, regulate and plan marine activities in the seas around England so that they're carried out in a sustainable way.
MBES	Multi-beam Echo Sounder

Term (acronym)	Definition
MCCIP	Marine Climate change Impacts Partnership
MHWS	Mean High-Water Spring
MLWS	Mean Low-Water Springs
MPA	Marine Protected Area
MPCP	Marine Pollution Contingency Plan
MSFD	Marine Strategy Framework Directive
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.
Natural England	The government advisor for the natural environment in England.
NERC	Natural Environment and Rural Communities
NPS	National Policy Statement
Nursery habitat	Habitats where high numbers of juveniles of a species occur, having a greater level of productivity per unit area than other juvenile habitats.
OEL	Ocean Ecology Limited
OESEA3	Offshore Energy Strategic Environmental Assessment 3
Offshore	The sea further than two miles from the coast.
Offshore Wind Farm	An offshore wind farm is a group of WTGs in the same location (offshore) in the sea which are used to produce electricity.
PEMMP	Project Environmental Monitoring and Management Plan
PEIR	Preliminary Environmental Information Report
Planning Act 2008	The legislative framework for the process of approving major new infrastructure projects.
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.
Rampion 1	The existing Rampion Offshore Wind Farm located in the English Channel in off the south coast of England.
Ramsar site	Areas designated by the UK Government under the International Ramsar Convention (the Convention on Wetlands of International Importance) 1971.
Receptor	There 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.
RED	Rampion Extension Development Limited
SBES	Single-beam Echo Sounder
Scoping Report	A report that presents the findings of an initial stage in the Environmental Impact Assessment process.
Scour	A localised sediment erosion feature caused by local enhancement of flow speed and turbulence due to interaction with an obstacle.
Secretary of State (SoS)	The body who makes the decision to grant development consent.
Sediment deposition	Settlement of sediment in suspension back to the seabed, causing a localised accumulation.
Sediment transport	The movement of sediment by natural processes, as individual grains or as a collective volume

Term (acronym)	Definition
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.
Significance	A measure of the importance of the environmental effect, defined by criteria specific to the environmental aspect.
Significant effect	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 and the type of effect. Where possible significant effects should be mitigated. The significance of an effect gives an indication as to the degree of importance (based on the magnitude of the effect and the sensitivity of the receptor) that should be attached to the impact described. Whether or not an effect should be considered significant is not absolute and requires the application of professional judgement. Significant – 'noteworthy, of considerable amount or effect or importance, not insignificant or negligible' (The Concise Oxford Dictionary). Those levels and types of landscape and visual effect likely to have a major or important/noteworthy or special effect of which a decision maker should take particular note.
SSS	Side Scan Sonar
Site of Special Scientific Interest (SSSI)	Sites designated at the national level under the Wildlife & Countryside Act 1981 (as amended). They are a series of sites that are designated to protect the best examples of significant natural habitats and populations of species.
Source	A substance that is in, on or under the land and has the potential to cause harm or to cause pollution of controlled waters.
Special Area of Conservation (SAC)	International designation implemented under the Habitats Regulations for the protection of habitats and (non-bird) species. Sites designated to protect habitats and species on Annexes I and II of the Habitats Directive. Sufficient habitat to maintain favourable conservation status of the particular feature in each member state needs to be identified and designated.

Term (acronym)	Definition
Special Protection Area (SPA)	Sites designated under EU Directive (79/409/EEC) to protect habitats of migratory birds and certain threatened birds under the Birds Directive.
Stakeholder	Person or organisation with a specific interest (commercial, professional or personal) in a particular issue.
Study area	Area where potential impacts from the Proposed Development could occur, as defined for each aspect.
Spatial Scope	Spatial scope is the area over which changes to the environment are predicted to occur as a consequence of a Proposed Development.
Subtidal	The region of shallow waters which are below the level of low tide.
Suspended sediment concentration (SSC)	The mass concentration (mass/volume) of sediment in suspension
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.
Tidal excursion buffer	The greatest distance and direction that water carrying an impact might be carried during one mean spring tide, from a given location or area.
Transboundary effects	Assessment of changes to the environment caused by the combined effect of past, present and future human activities and natural processes on other European Economic Area Member States.
The Applicant	Rampion Extension Development Limited (RED)
The Proposed Development/Rampion 2	The onshore and offshore infrastructure associated with the offshore wind farm comprising of installed capacity of up to 1,200MW, located in the English Channel in off the south coast of England.
UAV	Unmanned Aerial Vehicle
VER	Valued Ecological Receptor
Wave regime	The characteristic patterns and statistics of variation in waves for a given location or area.
WTG	Wind Turbine Generator

Term (acronym)	Definition
Zone of Influence (ZOI)	The area surrounding the Proposed Development which could result in likely significant effects

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