DOGGER BANK D WIND FARM

Preliminary Environmental Information Report

Volume 1
Chapter 10 Benthic and Intertidal Ecology

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Table of Contents

10 Benthic and Intertidal Ecology 5
10.1 Introduction 5
10.2 Policy and Legislation 5
10.2.1 National Policy Statements 5
10.2.2 Other Policy and Legislation 5
10.3 Consultation 10
10.4 Basis of the Assessment 11
10.4.1 Study Area 11
10.4.2 Scope of the Assessment 13
10.4.3 Embedded Mitigation Measures 14
10.4.4 Realistic Worst-Case Scenarios 16
10.5 Assessment Methodology 22
10.5.1 Guidance Documents 22
10.5.2 Data and Information Sources 22
10.5.3 Impact Assessment Methodology 23
10.5.4 Cumulative Effect Assessment Methodology 26
10.5.5 Transboundary Effect Assessment Methodology 26
10.5.6 Assumptions and Limitations 26
10.6 Baseline Environment 27
10.6.1 Existing Baseline 27
10.6.2 Predicted Future Baseline 42
10.7 Assessment of Effects 42
10.7.1 Potential Effects during Construction 43
10.7.2 Potential Effects during Operation 51
10.7.3 Potential Effects during Decommissioning 57
10.8 Cumulative Effects 58
10.8.1 Screening for Potential Cumulative Effects 58
10.8.2 Screening for Other Plans / Projects 58
10.8.3 Assessment of Cumulative Effects 62
10.9 Transboundary Effects 66
10.10 Inter-Relationships and Effect Interactions 66
10.10.1 Inter-Relationships 66
10.10.2 Interactions 67
10.11 Monitoring Measures 71
10.12 Summary 71
10.13 Next Steps 71
References 74
List of Figures, Tables and Plates 80
List of Acronyms 81

List of Appendices

Appendix	Title
Appendix 10.1	Consultation Responses for Benthic and Intertidal Ecology
Appendix 10.2	Intertidal Ecology Survey Report
Appendix 10.3	Benthic Ecology Baseline Characterisation Report
Appendix 10.4	Array Area Habitat Mapping

Glossary

Term	Definition
Additional Mitigation	Measures identified through the EIA process that are required as further action to avoid, prevent, reduce or, if possible, offset likely significant adverse effects to acceptable levels (also known as secondary (foreseeable) mitigation). All additional mitigation measures adopted by the Project are provided in the Commitments Register.
Array Area	The area within which the wind turbines, inter-array cables and offshore platform(s) will be located.
Commitment	Refers to any embedded mitigation and additional mitigation, enhancement or monitoring measures identified through the EIA process and those identified outside the EIA process such as through stakeholder engagement and design evolution. All commitments adopted by the Project are provided in the Commitments Register.
DBD	Dogger Bank D (DBD) Offshore Wind Farm, also referred to as the Project in this PEIR.
Deemed Marine Licence (DML)	A consent required under the Marine and Coastal Access Act 2009 for certain activities undertaken within the UK marine area, which may be granted as part of the Development Consent Order.
Design	All of the decisions that shape a development throughout its design and pre-construction, construction / commissioning, operation and, where relevant, decommissioning phases.
Development Consent Order (DCO)	A consent required under Section 37 of the Planning Act 2008 to authorise the development of a Nationally Significant Infrastructure Project, which is granted by the relevant Secretary of State following an application to the Planning Inspectorate.
Effect	An effect is the consequence of an impact when considered in combination with the receptor’s sensitivity / value / importance, defined in terms of significance.
Embedded Mitigation	Embedded mitigation includes: • Measures that form an inherent part of the project design evolution such as modifications to the location or design of the development made during the pre-application phase (also known as primary (inherent) mitigation); and • Measures that will occur regardless of the EIA process as they are imposed by other existing legislative requirements or are considered as standard or best practice to manage commonly occurring environmental impacts (also known as tertiary (inexorable) mitigation). All embedded mitigation measures adopted by the Project are provided in the Commitments Register.

Term	Definition
Enhancement	Measures committed to by the Project to create or enhance positive benefits to the environment or communities, as a result of the Project. All enhancement measures adopted by the Project are provided in the Commitments Register.
Environmental Impact Assessment (EIA)	A process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information and includes the publication of an Environmental Statement.
Environmental Statement (ES)	A document reporting the findings of the EIA which describes the measures proposed to mitigate any likely significant effects.
Evidence Plan Process (EPP)	A voluntary consultation process with technical stakeholders which includes a Steering Group and Expert Topic Group (ETG) meetings to encourage upfront agreement on the nature, volume and range of supporting evidence required to inform the EIA and HRA process.
Expert Topic Group (ETG)	A forum for targeted technical engagement with relevant stakeholders through the EPP.
Impact	A change resulting from an activity associated with the Project, defined in terms of magnitude.
Inter-Array Cables	Cables which link the wind turbines to the offshore platform(s).
Landfall	The area on the coastline, south-east of Skipsea, at which the offshore export cables are brought ashore, connecting to the onshore export cables at the transition joint bay above Mean High Water Springs.
Mitigation	Any action or process designed to avoid, prevent, reduce or, if possible, offset potentially significant adverse effects of a development. All mitigation measures adopted by the Project are provided in the Commitments Register.
Mitigation Hierarchy	A systematic approach to guide decision-making and prioritise mitigation design. The hierarchy comprises four stages in order of preference and effectiveness: avoid, prevent, reduce and offset.
Monitoring	Measures to ensure the systematic and ongoing collection, analysis and evaluation of data related to the implementation and performance of a development. Monitoring can be undertaken to monitor conditions in the future to verify any environmental effects identified by the EIA, the effectiveness of mitigation or enhancement measures or ensure remedial action are taken should adverse effects above a set threshold occur. All monitoring measures adopted by the Project are provided in the Commitments Register.

Term	Definition
Offshore Development Area	The area in which all offshore infrastructure associated with the Project will be located, including any temporary works area during construction, which extends seaward of Mean High Water Springs. There is an overlap with the Onshore Development Area in the intertidal zone.
Offshore Export Cable Corridor (ECC)	The area within which the offshore export cables will be located, extending from the DBD Array Area to Mean High Water Springs at the landfall.
Offshore Export Cables	Cables which bring electricity from the offshore platform(s) to the transition joint bay at landfall.
Offshore Platform(s)	Fixed structures located within the DBD Array Area that contain electrical equipment to aggregate and, where required, convert the power from the wind turbines, into a more suitable voltage for transmission through the export cables to the Onshore Converter Station. Such structures could include (but are not limited to): Offshore Converter Station(s) and an Offshore Switching Station.
Project Design Envelope	A range of design parameters defined where appropriate to enable the identification and assessment of likely significant effects arising from a project's worst-case scenario. The Project Design Envelope incorporates flexibility and addresses uncertainty in the DCO application and will be further refined during the EIA process.
Safety Zones	A statutory, temporary marine zone demarcated for safety purposes around a possibly hazardous offshore installation or works / construction area.
Scoping Opinion	A written opinion issued by the Planning Inspectorate on behalf of the Secretary of State regarding the scope and level of detail of the information to be provided in the Applicant's Environmental Statement. The Scoping Opinion for the Project was adopted by the Secretary of State on 02 August 2024.
Scoping Report	A request by the Applicant made to the Planning Inspectorate for a Scoping Opinion on behalf of the Secretary of State. The Scoping Report for the Project was submitted to the Secretary of State on 24 June 2024.
Scour Protection	Protective materials used to avoid sediment erosion from the base of the wind turbine foundations and offshore platform foundations due to water flow.
Study Areas	A geographical area and / or temporal limit defined for each EIA topic to identify sensitive receptors and assess the relevant likely significant effects.
The Applicant	SSE Renewables and Equinor acting through 'Doggerbank Offshore Wind Farm Project 4 Projco Limited'.
The Project	Dogger Bank D Offshore Wind Farm Project, also referred to as DBD in this PEIR.

Term	Definition
Transition Joint Bay (TJB)	An underground structure at the landfall that houses the joints between the offshore and onshore export cables.
Trenchless Techniques	Trenchless cable or duct installation methods used to bring offshore export cables ashore at landfall, facilitate crossing major onshore obstacles such as roads, railways and watercourses and where trenching may not be suitable. Trenchless techniques included in the Project Design Envelope include Horizontal Directional Drilling (HDD), auger boring, micro-tunnelling, pipe jacking / ramming and Direct Pipe.
Wind Turbines	Power generating devices located within the DBD Array Area that convert kinetic energy from wind into electricity.

10 Benthic and Intertidal Ecology

10.1 Introduction

1. This chapter of the Preliminary Environmental Information Report (PEIR) presents the preliminary results of the Environmental Impact Assessment (EIA) of the Dogger Bank D Offshore Wind Farm Project (herein 'the Project' or 'DBD') on benthic and intertidal ecology.

2. **Chapter 4 Project Description** provides a description of the key infrastructure components which form part of the Project and the associated construction, operation and maintenance (O&M), and decommissioning activities.

3. The primary purpose of the PEIR is to support the statutory consultation activities required for a Development Consent Order (DCO) application under the Planning Act 2008. The information presented in this PEIR chapter is based on the baseline characterisation and assessment work undertaken to date. The feedback from the statutory consultation will be used to inform the final design where appropriate and presented in an Environmental Statement (ES), which will be submitted with the DCO application.

4. This PEIR chapter:

- Describes the baseline environment relating to benthic and intertidal ecology;
- Presents an assessment of the likely significant effects on benthic and intertidal ecology during the construction, O&M, and decommissioning phases of the Project;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Sets out proposed mitigation measures to avoid, prevent reduce or, if possible, offset potential significant adverse environmental effects identified during the EIA process and, where relevant, monitoring measures or enhancement measures to create or enhance positive effects.

5. This chapter should be read in conjunction with the following related chapters. Inter-relationships are discussed further in **Section 10.10**:

- **Chapter 8 Marine and Physical Processes**;
- **Chapter 9 Marine Water and Sediment Quality**; and
- **Chapter 11 Fish and Shellfish Ecology**.

6. Additional information to support the benthic and intertidal ecology assessment includes:

- **Volume 2, Appendix 10.1 Consultation Responses for Benthic and Intertidal Ecology**;
- **Volume 2, Appendix 10.2 Intertidal Ecology Survey Report**;
- **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**; and
- **Volume 2, Appendix 10.4 Array Area Habitat Mapping**.

10.2 Policy and Legislation

10.2.1 National Policy Statements

7. Planning policy on energy Nationally Significant Infrastructure Projects (NSIP) is set out in the National Policy Statements (NPS). The following NPS are relevant to the benthic and intertidal ecology assessment:

- Overarching NPS for Energy (EN-1) (DESNZ, 2023a); and
- NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023b).

8. The benthic and intertidal ecology chapter has been prepared with reference to specific requirements in the above NPS. The relevant parts of the NPS are summarised in **Table 10-1**, along with how and where they have been considered in this chapter.

10.2.2 Other Policy and Legislation

9. Other policy and legislation relevant to the benthic and intertidal ecology assessment is summarised in the following sections.

10. In addition to the NPS, there are a number of pieces of policy and guidance applicable to the assessment of benthic and intertidal ecology. These include:

- National:
  - The Marine Policy Statement (MPS) (HM Government, 2011).
- Regional:
  - East Inshore and East Offshore Marine Plans (DEFRA, 2014); and
  - North-east Inshore and North-east Offshore Marine Plan (DEFRA, 2021).

Table 10-1 Summary of Relevant National Policy Statement Requirements for Benthic and Intertidal Ecology

NPS Reference and Requirement	How and Where Considered in the PEIR
NPS for Energy (EN-1)	
Paragraph 5.4.17: "Where the development is subject to EIA the applicant should ensure that the ES clearly sets out any effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance (including those outside England), on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity, including irreplaceable habitats."	Relevant designated sites are discussed in **Section 10.6.1.4** and the likely significant effects on the associated benthic and intertidal ecology is assessed in **Section 10.7**. In addition, a Report to Inform Appropriate Assessment (RIAA) and Marine Conservation Zone (MCZ) Assessment will be included with the DCO.
NPS for Renewable Energy Infrastructure (EN-3)	
Paragraph 2.8.91: "Applicants must undertake a detailed assessment of the offshore ecological, biodiversity and physical impacts of their proposed development, for all phases of the lifespan of that development, in accordance with the appropriate policy for offshore wind farm EIAs, Habitat Regulations Assessments (HRAs) and MCZ assessments (See Sections 4.3 and 5.4 of EN-1)."	**Section 10.7** provides an assessment of the impacts associated with the full project lifespan, including construction, O&M, and decommissioning. Further policy of relevance to benthic and intertidal ecology is outlined in **Section 10.2** and other relevant policy of relevance to the Project is discussed in **Chapter 3 Policy and Legislative Context**.
Paragraph 2.8.101: "The construction, operation and decommissioning of offshore energy infrastructure (including the preparation and installation of the cable route and any electricity networks infrastructure can affect the following elements of the physical offshore environment, which can have knock on impacts on other biodiversity receptors: • Water quality – disturbance of the seabed sediments or release of contaminants can result in direct or indirect effects on habitats and biodiversity, as well as on fish stocks thus affecting the fishing industry; • Waves and tides – the presence of the turbines can cause indirect effects through change to wave climate and tidal currents on flood and coastal erosion risk management, marine ecology and biodiversity, marine archaeology and potentially coastal recreation activities; • Scour effect – the presence of wind turbines and other infrastructure can result in a change in the water movements within the immediate vicinity of the infrastructure, resulting in scour (localised seabed erosion) around the structures. This can indirectly affect navigation channels for marine vessels, marine archaeology and impact biodiversity and seabed habitats; • Sediment transport – the resultant movement of sediments, such as sand across the seabed or in the water column, can indirectly affect navigation channels for marine vessels, could affect sediment supply to sensitive coastal sites and impact biodiversity and seabed habitats; • Suspended solids – the release of sediment during construction, operation and decommissioning can cause indirect effects on marine ecology and biodiversity; • Sandwaves – the modification / clearance of sandwaves can cause direct physical (such as in affecting unknown archaeological remains) and ecological effects both at the seabed and within the water column due to disturbance and suspension of sediment, and potentially indirect effects (e.g. changes to seabed morphology in water depths where waves can influence the seabed, which can in turn affect wave climate and sediment transport); and • Water column – wind turbine structures can also affect water column features such as tidal mixing fronts or stratification due to a change in hydrodynamics and turbulence around structures."	The effects on physical processes and water quality are assessed in **Chapter 8 Marine Physical Processes** and **Chapter 9 Marine Water and Sediment Quality**, respectively. The conclusions of these assessments have informed the impact assessment for benthic and intertidal ecology and are discussed for the relevant impacts in **Section 10.7**.

<table>
<tr><th>NPS Reference and Requirement</th><th>How and Where Considered in the PEIR</th></tr>
<tr><td>Paragraph 2.8.118:
“Export cable and other offshore transmission routes will cross the intertidal / coastal zone resulting in habitat loss, morphological change and temporary disturbance of intertidal flora and fauna.”</td><td rowspan="2">The Applicant has committed to trenchless techniques, such as Horizontal Directional Drilling (HDD), under the intertidal zone at Landfall and therefore there will be no direct habitat loss, disturbance or change to intertidal flora and fauna. Potential indirect impacts due to nearshore works are discussed in Section 10.7.1.1.2.</td></tr>
<tr><td>Paragraph 2.8.119:
“Applicant assessment of the effects of installing offshore transmission infrastructure across the intertidal / coastal zone should demonstrate compliance with mitigation measures in any relevant plan-level HRA including those prepared by The Crown Estate as part of its leasing round, and include information, where relevant, about:
• Any alternative landfall sites that have been considered by the applicant during the design phase and an explanation for the final choice;
• Any alternative cable installation methods that have been considered by the applicant during the design phase and an explanation for the final choice;
• Potential loss of habitat;
• Disturbance during cable installation, maintenance / repairs and removal (decommissioning);
• Increased suspended sediment loads in the intertidal zone during installation and maintenance / repairs;
• Potential risk from invasive and nonnative species;
• Predicted rates at which the intertidal zone might recover from temporary effects, based on existing monitoring data; and
• Protected sites.”</td></tr>
<tr><td>Paragraph 2.8.122:
“Offshore wind construction, maintenance and decommissioning activities can cause loss and temporary disturbance of subtidal habitat and benthic ecology.”</td><td>Temporary disturbance is assessed in Section 10.7.1.1 and Section 10.7.2.1. Habitat loss / alteration is assessed in Section 10.7.2.2.</td></tr>
<tr><td>Paragraph 2.8.123:
“The applicant should demonstrate compliance with mitigation measures identified by The Crown Estate in any plan-level HRA produced as part of its leasing round.”</td><td>The Applicant has committed to mitigation measures in accordance with The Crown Estate’s cable route protocol. Chapter 4 Site Selection and Assessment of Alternatives provides evidence of The Crown Estate’s cable route protocol used to minimise impacts to the subtidal environment, in particular the avoidance of designated sites, where possible.</td></tr>
</table>

NPS Reference and Requirement	How and Where Considered in the PEIR
Paragraph 2.8.126: “Applicant assessment of the effects on the subtidal environment should include: • Loss of habitat due to foundation type including associated seabed preparation, predicted scour, scour protection and altered sedimentary processes, e.g. sandwave / boulder / UXO clearance; • Environmental appraisal of inter-array and other offshore transmission and installation / maintenance methods, including predicted loss of habitat due to predicted scour and scour / cable protection and sandwave / boulder / UXO clearance; • Habitat disturbance from construction and maintenance / repair vessels’ extendable legs and anchors; • Increased suspended sediment loads during construction and from maintenance / repairs; • Predicted rates at which the subtidal zone might recover from temporary effects; • Potential impacts from EMF on benthic fauna; • Potential impacts upon natural ecosystem functioning; • Protected sites; and • Potential for invasive / non-native species introduction.”	**Section 10.4.4** provides the worst-case scenario for the various parameters of the Project which have been included in the assessment, including foundations, seabed preparation e.g. sandwave / boulder / UXO clearance, scour protection, vessel legs and anchors, cables and cable protection. Assessment of the impacts of these worst-case scenarios is provided in **Section 10.7** for all phases of the Project.
Paragraph 2.8.221: “Applicants must develop an ecological monitoring programme to monitor impacts during the preconstruction, construction and operational phases to identify the actual impacts caused by the project and compare them to what was predicted in the EIA / HRA.”	An **Outline Benthic Monitoring Plan** (OBMP) will be provided with the ES application and a summary of potential monitoring requirements associated with benthic and intertidal ecology are discussed in the **Outline Project Environmental Management and Monitoring Plan (PEMP)** (document reference 8.6).
Paragraph 2.8.222: “Should impacts be greater than those predicted, an adaptive management process may need to be implemented, and additional mitigation required, to ensure that so far as possible the effects are brought back within the range of those predicted.”	An **In-Principle Monitoring Plan** will be provided with the DCO application at the ES stage and a summary of potential monitoring requirements associated with benthic and intertidal ecology are discussed in **Outline PEMP** (document reference 8.6).
Paragraph 2.8.224: “Applicants are expected to have considered the best ecological outcomes in terms of potential mitigation. These might include: • Avoidance of areas sensitive to physical effects; • Consideration of micro-siting of both the array and cables; • Alignment and density of the array; • Design of foundations; • Ensuring that sediment moved is retained as locally as possible; • The burying of cables to a necessary depth; • Using scour protection techniques around offshore structures to prevent scour effects or designing turbines to withstand scour, so scour protection is not required or is minimised.”	Mitigation commitments, embedded in the project design are described in **Section 10.4.3**. In addition, **Volume 2, Appendix 6.3 Commitments Register** is provided with this PEIR and will be provided with the DCO application at the ES stage.
Paragraph 2.8.226: “Effects on intertidal / coastal habitat cannot be avoided entirely.”	The Applicant has committed to trenchless techniques under the intertidal zone at Landfall and therefore direct impacts have been avoided.

NPS Reference and Requirement	How and Where Considered in the PEIR
Paragraph 2.8.227: "Landfall and cable installation and decommissioning methods should be designed appropriately to minimise effects on intertidal / coastal habitats, taking into account other constraints."	The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. Decommissioning arrangements will be detailed in a Decommissioning Plan, which will be prepared in accordance with the Energy Act 2004. An assessment of the worst-case scenario for decommissioning works is provided in **Section 10.7.2**.

10.2.2.1 National

11. The Marine Policy Statement (HM Government, 2011) (discussed further in **Chapter 3 Policy and Legislative Context**) provides a high-level approach to marine planning and general principles for decision making that contribute to the NPS objectives. It also sets out the framework for environmental, social and economic considerations that need to be taken into account in marine planning. The high-level objective 'Living within environmental limits' covers points relevant to benthic ecology, and requires that:

- Biodiversity is protected, conserved and where appropriate recovered and loss has been halted;
- Healthy marine and coastal habitats occur across their natural range and are able to support strong, biodiverse biological communities and the functioning of healthy, resilient and adaptable marine ecosystems; and
- Our oceans support viable populations of representative, rare, vulnerable, and valued species.

10.2.2.2 Regional

12. England currently has eleven marine plan areas (Marine Management Organisation (MMO), 2014a); those relevant to the Project are the East Inshore, North-east Inshore, East Offshore and North-east Offshore. The East Inshore and East Offshore Marine Plans (DEFRA, 2014) contain two objectives stated below, which are of relevance to benthic ecology, as they cover policies and commitments on the wider ecosystem set out in the MPS:

- Objective 6: 'To have a healthy, resilient and adaptable marine ecosystem in the East Marine Plan areas'; and
- Objective 7: 'To protect, conserve and, where appropriate, recover biodiversity that is in or dependent upon the East marine plan areas'.

13. The North-east Inshore and Offshore Marine Plan also contains objectives that help deliver the high-level objectives set out in the MPS:

- Objective 2: 'The marine environment and its resources are used to maximise sustainable activity, prosperity and opportunities for all, now and in the future';
- Objective 3: 'Marine businesses are taking long-term strategic decisions and managing risks effectively. They are competitive and operating efficiently';
- Objective 4: 'Marine businesses are acting in a way which respects environmental limits and is socially responsible. This is rewarded in the marketplace';
- Objective 6: 'The use of the marine environment is benefiting society as a whole, contributing to resilient and cohesive communities that can adapt to coastal erosion and flood risk, as well as contributing to physical and mental wellbeing';
- Objective 7: 'The coast, seas, oceans and their resources are safe to use';
- Objective 11: 'Biodiversity is protected, conserved and, where appropriate, recovered, and loss has been halted';
- Objective 12: 'Healthy marine and coastal habitats occur across their natural range and are able to support strong, biodiverse biological communities and the functioning of healthy, resilient and adaptable marine ecosystems'; and
- Objective 13: 'Our oceans support viable populations of representative, rare, vulnerable, and valued species'.

14. How these objectives have been considered within the PEIR are discussed within **Chapter 3 Policy and Legislative Context**, where further context is provided.

15. Other guidance on the requirements for wind farm studies are provided in the documents listed below:

- MMO (2014) Review of Post-Consent Offshore Wind Farm Monitoring Data Associated with Licence Conditions, with input from the British Trust for Ornithology (BTO), National Physical Laboratory (NPL) and the Sea Mammal Research Unit (SMRU);
- Cefas (2010) Strategic Review of Offshore Wind Farm Monitoring Data Associated with Food and Environment Protection Act (FEPA) licence conditions, with input from the Food and Environment Research Agency and the SMRU;
- Defra (2005) Nature Conservation Guidance on Offshore Windfarm Development. A guidance note on the implications of the EC Wild Birds and Habitats Directives for developers undertaking offshore windfarm developments. Version R1.9.13; and
- Cefas (2004) Offshore Wind Farms: Guidance Note for Environmental Impact Assessment in Respect of FEPA 1985 and CPA requirements: Version 2.

16. Further detail is provided in **Chapter 3 Policy and Legislative Context**.

10.3 Consultation

17. Topic-specific consultation in relation to benthic and intertidal ecology has been undertaken in line with the process set out in **Chapter 7 Consultation**. A Scoping Opinion from the Planning Inspectorate was received on 2nd August 2024, which has informed the scope of the assessment presented within this chapter (as outlined in **Section 10.4.2**).

18. Feedback received through the ongoing Evidence Plan Process in relation to Expert Topic Group (ETG) meetings and wider technical consultation meetings with relevant stakeholders has also been considered in the preparation of this chapter. Details of technical consultation undertaken to date on benthic and intertidal ecology are provided in **Table 10-2**.

Table 10-2 Technical Consultation Undertaken to Date on Benthic and Intertidal Ecology

Meeting	Stakeholder(s)	Date(s) of Meeting	Purpose of Meeting
ETG Meetings			
ETG1 (MPP, Fish and Benthic)	Natural England MMO Environment Agency MarineSpace Cefas Inshore Fisheries and Conservation Authority (IFCA)	13/09/2023	Discussion and feedback on approach to EIA with agreements requested for: • Study area chosen; • Approach to data collection; and • Impacts scoped in.
	Natural England MMO Cefas	22/07/2024	Discussion, feedback and agreements on approach of marine physical processes modelling and baseline reporting.
	Natural England MMO Environment Agency Cefas	30/10/2024	Discussion and feedback on approach to EIA with agreements requested for: • Study area chosen; • Approach to data collection; and • Impacts scoped in.

19. **Volume 2, Appendix 8.1 Consultation Responses on Benthic and Intertidal Ecology** summarises how consultation responses received to date are addressed in this chapter.

20. This chapter will be updated based on refinements made to the Project Design Envelope and to consider, where appropriate, stakeholder feedback on the PEIR. The updated chapter will form part of the Environmental Statement to be submitted with the DCO Application.

10.4 Basis of the Assessment

21. The following sections establish the basis of the assessment of likely significant effects, which is defined by the Study Area(s), assessment scope, and realistic worst-case scenarios. This section should be read in conjunction with **Volume 2, Appendix 1.2 Guide to PEIR, Volume 2, Appendix 6.2 Impacts Register** and **Volume 2, Appendix 6.3 Commitments Register.**

10.4.1 Study Area

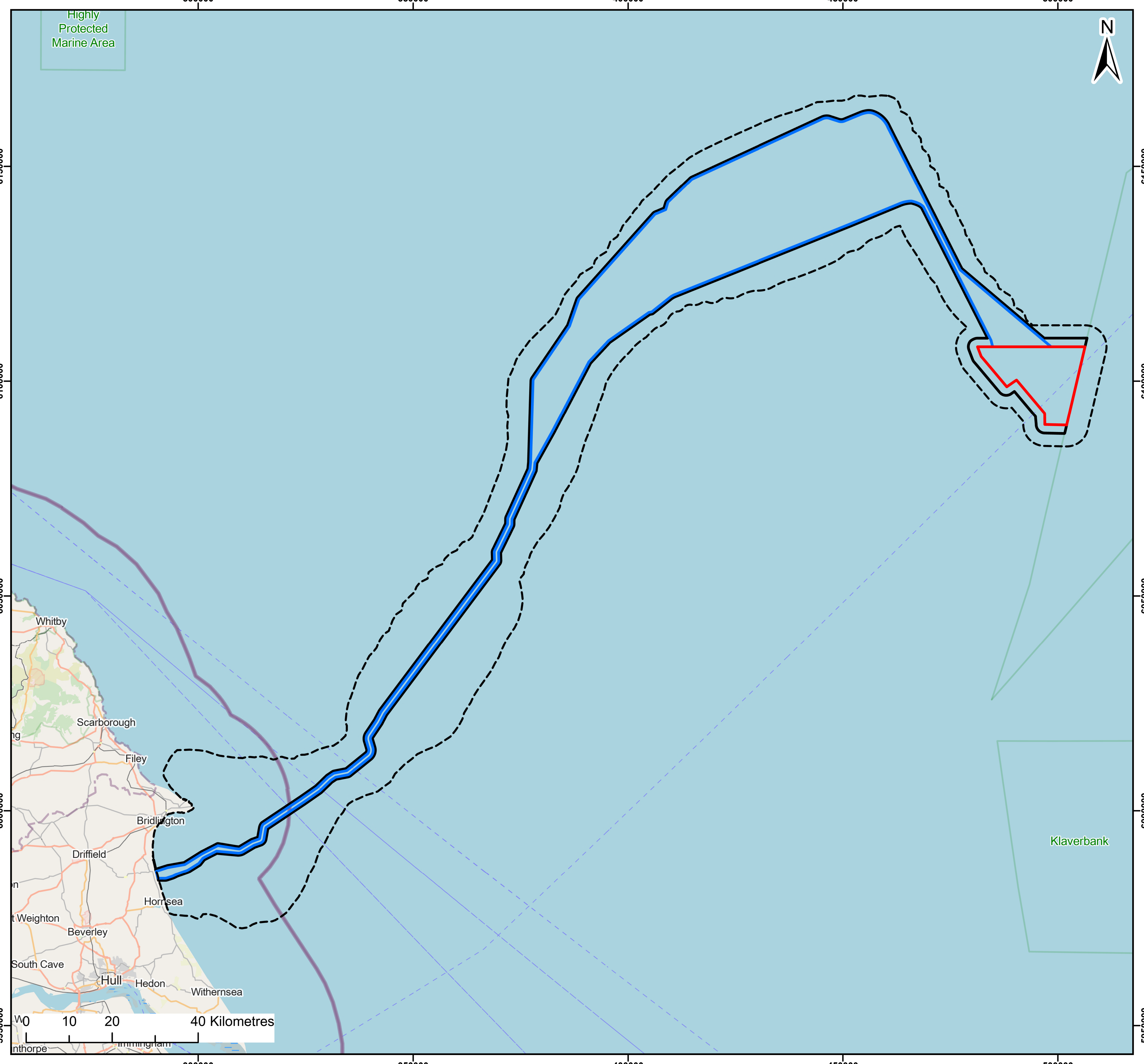
22. The benthic and intertidal ecology study area (presented on **Figure 10-1**) has been defined based on the potential zone of influence (ZOI) of the Project in relation to this receptor group. The ZOI used for this chapter is based on the modelling conducted for **Chapter 8 Marine Physical Processes**. The extent of the marine physical processes study area has been consulted on as part of the first and second ETG meetings with stakeholders (**Appendix 8.1 Consultation Responses for Benthic and Intertidal Ecology**). Based on feedback from Natural England, a ZOI is defined for each potential effect. These are:

- 'Zone of Influence tide' for changes to tidal currents (and changes to suspended sediment concentration) defined using tidal ellipse data corroborated with outputs from the hydrodynamic modelling;
- 'Zone of Influence wave' for changes to wave regime will be defined by the outputs from wave modelling; and
- 'Zone of Influence coast' for changes to sediment transport at the coast. The offshore ZOI is determined by the closure depth, the onshore ZOI by coastal erosion / shoreline retreat and the longshore ZOI on sediment sources, sinks, availability, transport rates and the tidal ellipse.

23. Although a ZOI has been created for each individual potential effects, consideration is also given to how the zones interact with each other (e.g. wave-current interactions). In this way, an anticipated maximum ZOI is identified which informs the marine physical processes study area extent (**Figure 8.1** – the three ZOIs and the overall study area extent).

24. For the CEA, a range of 28km (i.e. one maximum tidal excursion ellipse (14km) that is doubled to consider overlap with other projects, see **Section 8.6.1.5** in **Chapter 8 Marine Physical Processes**) from the Offshore Development Area has been used to provide a conservative search area for the screening of plans and projects which have potential to interact with the impacts of the Project.

25. The intertidal study area is the area between mean high-water springs (MHWS) and mean low water springs (MLWS) at landfall.



Legend:

- Dogger Bank D Array Area
- Offshore Development Area
- Offshore Export Cable Corridor
- Benthic and Intertidal Ecology Study Area

Source: © Haskoning DHV UK Ltd, 2025;
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Project: Dogger Bank D Offshore Wind Farm

DOGGER BANK WIND FARM

Title: Benthic and Intertidal Ecology Study Area

Figure:	10-1	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0575		
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	11/04/2025	JH	AB	A3	1:900,000

Co-ordinate system: WGS 1984 UTM Zone 31N

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26. The study area for the intertidal assessment is focused on the one potential landfall area under consideration for the Project. As detailed in **Chapter 5 Site Selection and Consideration of Alternatives**, trenchless techniques will be used to install the export cables where the exit pits are at a suitable depth below lowest astronomical tide (LAT) for the Project (see CO23 in **Table 10-4**). As such, direct impacts on the intertidal are not expected in relation to the installation of exit pits.

10.4.2 Scope of the Assessment

27. A number of impacts have been scoped out of the benthic and intertidal ecology assessment. These impacts are outlined in **Volume 2, Appendix 6.2 Impacts and Effects Register**, along with supporting justification and are in line with the Scoping Opinion and the project description outlined in **Chapter 4 Project Description**. A description of how the Impacts and Effects Register should be used alongside the PEIR chapter is provided in **Chapter 6 Environmental Impact Assessment Methodology**.

28. Impacts scoped into the assessment relating to benthic and intertidal ecology are outlined in **Table 10-3** and discussed further in **Section 10.7**.

Table 10-3 Benthic and Intertidal Ecology – Impacts Scoped into the Assessment

Impact ID	Impact and Project Activity	Rationale
Construction		
BEN-C-01	Temporary habitat loss / physical disturbance from installation of foundations, cables, seabed preparation, sandwave levelling and indentations on the seabed from jack-up vessels.	The use of construction equipment and the creation of foundations and seabed preparation will lead to temporary habitat loss and physical disturbance of the seabed.
BEN-C-03	Increased SSC and sediment re-deposition from installation of foundations, cables and any erosion or other protection.	Disturbance of the seabed caused by construction work will cause suspended sediment and re-deposition.
BEN-C-05	Remobilisation of contaminated sediments from installation of export cables into the seabed.	All stages of the Project have the potential to cause temporary habitat loss / physical disturbance.
BEN-C-07	Disturbance from noise and vibration from pile driving during construction activities, UXO clearance.	All stages of the Project have the potential to cause temporary habitat loss / physical disturbance.
Operation and Maintenance		
BEN-O-01	Temporary habitat loss / physical disturbance from maintenance activities, cable repairs and reburial.	Maintenance activities may disturb the seabed leading to temporary habitat loss or physical disturbance. For example, conducting repairs on the inter-array cables, where they must be brought to the surface and then re-laid, will disturb the seabed.
BEN-O-02	Habitat loss / alteration from presence of foundations, cable / scour protection, any erosion or other protection.	The presence of foundations and scour protection on the seabed and cable protection would result in a relatively small footprint of lost habitat in the context of the habitat from the surrounding region. The level of effect will be dependent upon the habitat type in question, the scarcity of said habitat in the wider area and the presence of a species that are reliant on that habitat.
BEN-O-03	Increased SSC and sediment re-deposition from operation and maintenance activities.	Maintenance activities causing increased suspended sediment concentrations and associated sediment settlement have the potential to cause indirect effects, and result in a change in predation success for species reliant on hunting by sight. This is particularly true for species of limited mobility and those species that have specific substrate requirements.
BEN-O-05	Remobilisation of contaminated sediments - offshore ECC during operation and maintenance activities.	There is potential for existing contaminants within the sediments to be remobilised during scour and routine maintenance in the offshore ECC (see **Chapter 9 Marine Water and Sediment Quality**).
BEN-O-07	Disturbance from noise and vibration from vessel activity and presence of operational wind turbines.	The main source of underwater noise during operation (in addition to ambient noise) originates from the wind turbine gearbox and generator, in addition to any surface vessels undertaking O&M activities. Whilst elevated noise levels from operational turbines are likely to be restricted to the area immediately surrounding the turbines, this impact is scoped in for further consideration.

Impact ID	Impact and Project Activity	Rationale
BEN-O-08	Interactions of EMFs from presence of operational cables.	In areas where it is not possible to bury cables to the target burial depth of 3.5m (e.g. at crossings or in hard substrate) there may be sections of surface laid cables with cable protection. The EMF of these cables may have the potential to interact with electro- or magneto- sensitive species.
BEN-O-11	Colonisation of introduced substrate from presence of sub-sea structures, including foundation structures.	Concrete and steel structures may be colonised by a range of benthic invertebrate species, potentially increasing ecological diversity and with the potential to act as fish aggregating devices.
Decommissioning		
BEN-D-01	Temporary habitat loss / physical disturbance due to removal of foundations and cables in the seabed.	Decommissioning impacts are scoped in; however, details of offshore decommissioning activities are not known at this stage. As discussed in **Section 10.7.3**, decommissioning impacts will be assessed in detail through the Offshore Decommissioning Programme (see **Table 10-4** Commitment ID CO21) where relevant, which will be developed prior to the commencement of offshore decommissioning works. In this assessment, it is assumed that most decommissioning activities would be the reverse of their construction counterparts, and that their impacts would be of similar nature to, and no worse than, those identified during the construction phase.
BEN-D-02	Habitat loss / alteration due to removal of foundations and cables.	
BEN-D-03	Increased suspended sediments and sediment re-deposition due to removal of foundations, cables and any erosion or other protection.	
BEN-D-05	Remobilisation of contaminated sediments - offshore ECC due to removal of foundations in the seabed.	
BEN-D-07	Underwater noise and vibration caused byremoval of foundations in the seabed.	
BEN-D-11	Colonisation of introduced substrate through removal of infrastructure in the seabed.	

10.4.3 Embedded Mitigation Measures

29. The Project has made several commitments to avoid, prevent, reduce or, if possible, offset potential adverse environmental effects through mitigation measures embedded into the evolution of the Project's design envelope. These embedded mitigation measures include actions that will be undertaken to meet other existing legislative requirements and those considered to be standard or best practice to manage commonly occurring environmental effects. The assessment of likely significant effects has therefore been undertaken on the assumption that these measures are adopted during the construction, operation and decommissioning phases.

30. **Table 10-4** identifies proposed embedded mitigation measures that are relevant to the benthic and intertidal ecology assessment.

31. **Volume 2, Appendix 6.3 Commitments Register** is provided at PEIR stage to provide stakeholders with an early opportunity to review and comment on the proposed commitments. Proposed commitments may evolve during the pre-application phase as the EIA progresses and in response to refinements to the Project's design envelope and stakeholder feedback. The final commitments will be confirmed in the Commitments Register submitted along with the DCO application

32. Full details of all commitments made by the Project are provided within the Commitments Register in **Volume 2, Appendix 6.3 Commitments Register**. A description of how the Commitments Register should be used alongside the PEIR chapter is provided in **Volume 2, Appendix 1.2 Guide to PEIR** and **Chapter 6 Environmental Impact Assessment Methodology**. In addition, a list of draft outline management plans which are submitted with the PEIR for consultation is provided in **Section 1.10** of **Chapter 1 Introduction.** These documents will be further refined and submitted along with the DCO application. See **Volume 2, Appendix 1.2 Guide to PEIR** for a list of all PEIR documents.

33. The Commitments Register is provided at PEIR stage to provide stakeholders with an early opportunity to review and comment on the proposed commitments. Proposed commitments may evolve during the pre-application phase as the EIA progresses and in response to refinements to the Project's design envelope and stakeholder feedback. The final commitments will be confirmed in the Commitments Register submitted with the DCO application.

34. An Outline PEMP is submitted with the PEIR application, which details measures relevant to benthic and intertidal ecology. Indicative embedded mitigation measures included in the plan are summarised below in **Table 10-4.**

Table 10-4 Embedded Mitigation Measures Relevant to Benthic and Intertidal Ecology

Commitment ID	Proposed Commitment	How the Commitment Will be Secured	Relevance to Benthic and Intertidal Ecology Assessment	Relevance to Impact ID
C022	A piling Marine Mammal Mitigation Protocol (MMMP) will be provided in accordance with the Outline MMMP and will be implemented during construction. The piling MMMP will include details of the embedded mitigation, for the soft-start and ramp-up, as well as details of the proposed mitigation zone and any additional mitigation measures required in order to minimise potential impacts of any physical injury or permanent threshold shift (PTS), for example, the activation of an Acoustic Deterrent Device (ADD) prior to the soft-start, as much as is practicable.	DML Condition - Marine Mammal Mitigation Protocol	Limits any effects associated with noise from piling activities	BEN-C-07, BEN-O-07, BEN-D-07
CO23	At the landfall, trenchless installation techniques will be implemented and exit pits will be located beyond Mean Low Water Springs (MLWS). Installation will be at a suitable depth below the base of the cliff to avoid potential impacts to the Withow Gap Site of Special Scientific Interest (SSSI).	DCO Requirement - Code of Construction Practice	Limits any effects associated with the intertidal zone.	BEN-C-01, BEN-O-01, BEN-D-01, BEN-C-02, BEN-O-02, BEN-D-02, BEN-C-03, BEN-O-03, BEN-D-03, BEN-C-05, BEN-D-05, BEN-O-08, BEN-O-11, BEN-D-11
CO24	A Cable Specification and Installation Plan will be provided and submitted for approval prior to offshore construction. The Cable Specification and Installation Plan will detail the methods used for construction of offshore export and inter-array cables. Where possible, cable burial will be the preferred method for cable protection. Where cable protection is required, this will be minimised so far as is feasible. All cable protection will adhere to the requirements of Marine Guidance Note (MGN) 654 with respect to changes greater than 5% to the under-keel clearance in consultation with the Maritime and Coastguard Agency (MCA) and Trinity House. Any damage, destruction or decay of cables must be notified to the MCA, Trinity House, Kingfisher and UK Hydrographic Office (UKHO) no later than 24 hours after being discovered.	DML Condition - Cable Specification and Installation Plan	Limits the effects associated with cable protection as the first option will always be cable burial, therefore reducing the effect of physical disturbance to benthic habitats.	BEN-C-01, BEN-O-01, BEN-D-01, BEN-C-02, BEN-O-02, BEN-D-02, BEN-C-03, BEN-O-03, BEN-D-03, BEN-C-05, BEN-D-05, BEN-O-08, BEN-O-11, BEN-D-11
CO26	Micro-siting of the offshore cables will be used to minimise the requirement for seabed preparation as far as is practicable.	DML Condition - Cable Specification and Installation Plan	Limits the effects associated with cable protection as the first option will always be cable burial, therefore reducing the effect of physical disturbance to benthic habitats.	BEN-C-01, BEN-O-01, BEN-D-01, BEN-C-02, BEN-O-02, BEN-D-02, BEN-C-03, BEN-O-03, BEN-D-03, BEN-C-05, BEN-D-05, BEN-O-08, BEN-O-11, BEN-D-11
CO28	An Offshore Operations and Maintenance Plan (O&M) will be provided prior to commencement of operation and will outline the reasonably foreseeable O&M offshore activities.	DML Condition - Offshore Operations and Maintenance Plan	Limits any effect associated with the O&M stage of the Project on benthic and intertidal habitats.	BEN-O-01, BEN-O-02, BEN-O-03, BEN-O-08, BEN-O-11
CO29	An In-Principle Monitoring Plan (IPMP) will be provided in accordance with the Outline IPMP for relevant marine receptors, providing for relevant monitoring requirements during the construction and O&M phases.	DML Condition - In Principle Monitoring Plan	Limits any effect associated with the O&M stage of the Project on benthic and intertidal habitats.	BEN-O-01, BEN-O-02, BEN-O-03, BEN-O-08, BEN-O-11

Table 10-5 Indicative Embedded Mitigation Measures Included in the Outline PEMP

Measures to be Included: Outline PEMP
Pre-construction surveys would be undertaken in advance of any cable and foundation installation works. The methodology of the pre-construction surveys would be agreed with the MMO and Natural England.
The offshore ECC was selected in consultation with key stakeholders to select route options which minimised impacts on designated sites, such as minimising the overall length within the Dogger Bank Special Area of Conservation (SAC). The Applicant has also committed to minimising external cable protection, where possible, along the entirety of the offshore ECC.
Any seabed material arising from the activities within the DBD Array Area would also likely be disposed of within the Array Area, as the Project would look to dispose of sediment near the area of disturbance where it would be in a similar environment. This is the same for material arising from the activities associated with the Offshore ECC where material would be disposed of in the Offshore ECC.
Reasonable endeavours will be made to bury Offshore Export Cables, thereby reducing electromagnetic fields and the need for surface cable protection. A Cable Specification and Installation Plan (CSIP), including a Cable Burial Risk Assessment would be submitted post-consent which would detail the anticipated export cable protection requirements. As part of the final CSIP a detailed cable laying plan providing details of the need, type, sources, quantity and installation methods for scour protection and cable protection (where required) would also be provided.
The risk of spreading INNS would be mitigated by compliance with the following relevant regulations and guidance: • International Convention for the Prevention of Pollution from Ships (MARPOL). The MARPOL sets out appropriate vessel maintenance; • The Environmental Damage (Prevention and Remediation) (England) Regulations 2015, which set out a polluter pays principle where the operators who cause a risk of significant damage or cause significant damage to land, water or biodiversity would have the responsibility to prevent damage occurring, or if the damage does occur would have the duty to reinstate the environment to the original condition; and • The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention), which provide global regulations to control the transfer of potentially invasive species. Post-construction surveys will also be required to be carried out, through the dML conditions, the scope of which will include survey of INNS.

10.4.4 Realistic Worst-Case Scenarios

35. To provide a precautionary, but robust, assessment at this stage of the Project's development process, a realistic worst-case scenario has been defined in **Table 10-6** for each impact scoped into the assessment (as outlined in **Section 10.7**). The realistic worst-case scenarios are derived from the range of parameters included in the design envelope. They ensure that the assessment of likely significant effects is based on the maximum potential impact on the environment. Should an alternative development scenario be taken forward in the final design of the Project, the resulting effects would not be greater in effect significance. Further details on the Project Design Envelope are provided in **Chapter 6 Environmental Impact Assessment Methodology**.

36. Following the PEIR publication, further design refinements will be made based on ongoing engineering studies and considerations of the EIA and stakeholder feedback. Therefore, realistic worst-case scenarios presented in the PEIR may be updated in the ES. The design envelope will be refined where possible to retain design flexibility only where it is needed.

Table 10-6 Realistic Worst-Case Scenarios for Impacts on Benthic and Intertidal Ecology

<table>
<tr><th>Impact ID</th><th>Impact and Project Activity</th><th>Realistic Worst-Case Scenario</th><th>Rationale</th></tr>
<tr><td colspan="4">Construction</td></tr>
<tr><td>BEN-C-01</td><td>Temporary habitat loss / physical disturbance</td><td>Array Area:
Maximum scour protection area per foundation including structure footprint for suction buckets of 14,314m^2 x 113 wind turbine generators (WTG)) = 1,617,482m^2.
Two Offshore Platforms (OPs) with monopile foundations (25,000m^2 per monopile foundation including scour protection) = 50,000m^2.
Inter-array cable seabed sand wave levelling and installation including seabed preparation activities (35m width x 400km length of inter-array cables) = 14,000,000m^2.
Vessel jack up assuming 5 jack-up locations per WTG / OP (400m^2 per jack up leg x 6 legs x 5 jack up operations per WTG x 115 for WTG / OP) = 1,380,000m^2.
Anchoring during WTG installation (based on 16 anchors x 100m^2 footprint x 113 (1 anchoring events per 113 WTG)) = 180,800m^2.
Anchoring during OP installation (based on 34 anchors per OP x 100m^2 footprint x 2 OPs) = 6,800m^2.
Anchoring during inter-array cable installation (based on 6 anchors x 100m^2 x 11.3 anchoring events x 2 vessels) = 13,560m^2.
Worst case scenario total disturbance footprint in the Array Area = 17,248,642m^2.
Export cable (includes portion within Array Area and Landfall):
Maximum temporary disturbance for seabed preparation within the offshore ECC = 16,608,000m^2:
Maximum total export cable trench length of 400km x 2 trenches;
Maximum width of temporary disturbance is approximately 15m from installation methods and 35m from sand wave levelling on 28.8% of cable route;
Disturbance from sand wave levelling (35m width x 230.4km (28.8% of the 800km export cable) = 8,064,000m^2; and
Disturbance from installation including seabed preparation activities (15m trench width x 569.6km (71.2% of the 800km export cable) = 8,544,000m^2.
Anchoring during offshore export cable installation (based on 6 anchors x 100m^2 x 24 anchoring events) = 14,400m^2.
Landfall (trenchless exit pits):
Number of trenchless duct installations = 3 (includes 2 + 1 spare) and the size of each exit pit – 100m length x 25m width. Maximum extent of temporary disturbance for exit pits = 7,500m^2.
Anchoring during trenchless technique exit installation (based on 6 anchors x 100m^2 x 12 anchoring events) = 7,200m^2.
Trenchless transition bore spacing = Up to 600mm.
Worst-case scenario total disturbance footprint in the offshore ECC – 16,637,100m^2.
Total disturbance footprint – 33,885,742m^2.</td><td>Temporary habitat loss / physical disturbance relates to seabed preparation and installation activities.

The persistent / permanent footprint of infrastructure is assessed as an O&M phase impact.

The worse case scenario for OP is two small platforms as opposed to one large platform, both in terms of extent and volumes, hence only the worst case parameters shown.

It has been assumed for the worst case that 100% of the inter-array cable would require sand wave levelling. It has therefore been assumed that as the sand wave levelling corridor is 100%, the installation footprint falls within that corridor, therefore no additional disturbance would arise.

The sand wave levelling width and/or the installation width also include the following activities:
Boulder clearance;
Route clearance pre-lay grapnel run (PLGR);
Crossing preparation; and
Archaeological surveys / investigation / relocation.</td></tr>
</table>

Impact ID	Impact and Project Activity	Realistic Worst-Case Scenario	Rationale
BEN-C-03	Increased suspended sediments and sediment re-deposition	**Array Area:** • Seabed preparation volume for a single turbine foundation (suction bucket foundation plus scour protection footprint 14,314m^2 x 2.5m levelling depth) = 35,785m^3. • Seabed preparation volume for 113 turbine foundations = 4,043,705m^3. • Seabed preparation volume for two offshore platform foundations (monopile foundation plus scour protection footprint 25,000m^2 x 4m levelling depth x 2 OPs) = 200,000m^3. • Inter-array cable sand wave levelling (35m width x 400km length of inter-array cables x 4m maximum burial depth) = 56,000,000m^3. • Inter-array cable installation (5m width x 400km length of inter-array cable x 3.5m depth) = 7,000,000m^3. • Worst-case scenario volume for Array Area = 67,243,705m^3. NB, drill arising would not occur in the event that suction bucket is used and therefore the following parameters cannot be added to the maximum sand wave levelling for suction bucket described above. • Drill arisings at 50% of WTGs (60m average drill depth x 254.5m^2 drill area (18m drill diameter) x 57 WTGs (rounded up 50%)) = 870,390m^3. • Drill arisings from two OPs (100m average drill depth x 176.7m^2 drill area (15m drill diameter). Based on maximum 12 piles, 50% requiring drilling) = 106,020m^3. • Total drill arisings = 976,410m^3. **Export cable (includes portion within Array Area and Landfall):** • Displaced sediment volume during sand wave levelling for Offshore Export Cable installation = 32,256,000m^3 (230,400m length x 4m depth x 35m width). • Displaced sediment volume during trenching for Offshore Export Cable installation = 14,000,000m^3 (800,000m length x 3.5m depth x 5m width). • Landfall (trenchless exit pits): ○ Number of trenchless duct installations = 3 (includes 2 + 1 spare) and size of each exit pit – 100m length x 25m width x 3.5m depth. Total volume of sediment disturbed by exit pits – 26,250m^3. • Worst-case scenario volume for export cables (sand wave levelling + trenching for offshore export cable installation + trenchless exit pits) = 46,282,500m^3. **Overall Total:** • Worst-case total for Project = **113,525,955m^3**.	Seabed preparation (dredging using a trailing suction hopper dredger and installation of a bedding and levelling layer) may be required. The worst-case scenario assumes that sediment would be dredged and returned to the water column at the sea surface during disposal from the dredger vessel. Sand wave levelling may be required prior to offshore cable installation. Any excavated sediment due to sand wave levelling would be disposed of within the offshore development area, meaning there will be no net loss of sediment from the site. It is assumed 100% of inter-array cables will require sand wave levelling. As installation (trenching) results in further disturbance though within the same footprint is an additional activity resulting in movement of sediment and is considered in the modelling scenario. The worse case scenario for OP is two small platforms as opposed to one large platform, both in terms of extent and volumes, hence only the worst case parameters shown. The offshore trenchless technique exit location will be subtidal in 1m to 8m water depth. Sediment displacement is included in the totals for the export cable.
BEN-C-05	Remobilisation of contaminated sediments (if present – offshore ECC)	Maximum suspension of sediments as described above. No contaminated sediments were recorded exceeding any Action Levels (ALs) within the offshore development area. See **Section 9.6.1.1** in **Chapter 9 Marine Water and Sediment Quality** for more detail.	

Impact ID	Impact and Project Activity	Realistic Worst-Case Scenario	Rationale
BEN-C-07	Underwater noise and vibration	**Maximum hammer energy:** • 5,000kJ (pin-piles). • 8,000kJ (monopiles). Starting hammer energies of 10% would be used for 20 minutes • Ramp up will then be undertaken for the next 60 minutes up to the maximum hammer energy.	Piling soft-start and ramp-up durations to be finalized at later stages of the Project and values assumed for current modelling purposes does not preclude use of shorter durations in future project stages.
Operation and Maintenance			
BEN-O-01	Temporary habitat loss / physical disturbance	**Array Area:** • Seabed disturbance from jacking-up activities over the Project's lifetime (7 visits for WTG over lifetime x (400m^2 per jack up leg x 6 legs x 5 jack up operations per WTG) = 84,000m^2. • Inter-array cable repairs - seabed disturbance over the Project's lifetime (15 visits over project lifetime x 1,000m (distance per year) x 15m width of seabed preparation) = 225,000m^2. • Inter-array cable reburial - seabed disturbance over the Project's lifetime (35 visits over project lifetime (1 per year) x 2,000m (distance per year) x 15m width of seabed preparation) = 1,050,000m^2. • Anchoring during inter-array cable repairs/reburial (based on 6 anchors x 100m^2 x 35 anchoring events) = 21,000m^2. • Total disturbance in Array Area (sum of above) = 1,380,000m^2. **Offshore ECC (includes portion within Array Area):** • Export cable repairs - seabed disturbance over the Project's lifetime (35 visits over project lifetime (1 per year) x 1,000m (distance per year) 15m width of seabed preparation) = 525,000m^2. • Export cable reburial - seabed disturbance over the Project's lifetime (35 visits over project lifetime (1 per year) x 2,000m (distance per year) 15m width of seabed preparation) = 1,050,000m^2. • Anchoring during export cable repairs/reburial (based on 6 anchors x 100m^2 x 35 anchoring events) = 21,000m^2. • Total disturbance in offshore ECC (sum of above) = 1,596,000m^2. **Total disturbance footprint = 2,976,000m^2**.	Temporary habitat loss / physical disturbance relates to seabed maintenance activities. The persistent / permanent footprint of infrastructure is assessed in the habitat loss / alteration impact below.

Impact ID	Impact and Project Activity	Realistic Worst-Case Scenario	Rationale
BEN-O-02	Habitat loss / alteration	**Array Area:** • Total worst case turbine footprint with scour protection (14,314m^2 maximum scour protection area per foundation including structure footprint (135m diameter) x 113 WTGs) = 1,617,482m^2. • Total worst-case scour protection for two OPs with monopile foundations ((25,000m^2 per monopile foundation including scour protection) = 50,000m^2. • Inter-array cable rock / remedial protection (10m width of rock berm protection x 40km length of exposed inter-array cables requiring remedial protection) = 400,000m^2. • Total footprint inter-array cable crossing material (100m length of crossing x 10m width of for cable crossings x 5 cable crossings = 5,000m^2. • Total Array Area (sum of the above) = 2,072,482m^2. **Offshore ECC (includes portion within Array Area):** • Total export cable rock / remedial protection (10m width of rock berm protection x 160km length of cable requiring protection) = 1,600,000m^2. • Total footprint of pipeline / cable crossing material (100m length of crossing x 10m width of for cable crossings x 16 cable crossings and 300m length of crossing x 16m width of for pipeline crossings x 3 pipeline crossings) x 2 ECC = 60,800m^2. • Total habitat loss within the offshore ECC (sum of the above) = 1,660,800m^2. **Total disturbance footprint = 3,733,282m^2.**	Total scour protection per turbine includes structure footprint area for suction bucket jacket foundations for WTGs and caisson island foundation for OP(s). Inter-array cable protection assumes 10% of entire length requires protection. Cable protection assumes 20% of entire cable length requires protection. Predicted no. of crossings for Project: • 16 cable crossings per cable; and • 3 pipeline crossings per cable.
BEN-O-03 BEN-O-05	Increased suspended sediments and sediment re-deposition Remobilisation of contaminated sediments	• Inter-array cable repairs - seabed disturbance over the Project's lifetime (15 visits over project lifetime x 1km (distance per year failure expected) x 15m width of seabed preparation x 3.5m depth) = 787,500m^3. • Inter-array cable reburials - seabed disturbance over the Project's lifetime (35 visits over project lifetime (1 per year) x 2km (distance per year failure expected) x 15m width of seabed preparation x 3.5m depth) = 3,675,000m^3. • Export cable repairs - seabed disturbance over the Project's lifetime (35 visits over project lifetime (1 per year) x 1km (distance per year failure expected) x 15m width of seabed preparation x 3.5m depth) = 1,837,500m^3. • Export cable reburials - seabed disturbance over the Project's lifetime (35 visits over project lifetime (1 per year) x 2km (distance per year failure expected) x 15m width of seabed preparation x 3.5m depth) = 3,675,000m^3. • Anchoring during inter-array cable repairs/reburial (based on 6 anchors x 100m^2 x 50 anchoring events x 6.1m depth) = 183,000m^3. **Total increased SSCs (sum of above) = 10,158,000m^3.**	The volume of sediment that could be suspended has not been calculated but will be a much smaller proportion compared with the quantity generated by construction and decommissioning activities.
BEN-O-07	Disturbance from noise and vibration	**Operational turbine noise** Modelled operational turbine noise is based on Tougaard *et al.* (2020) equation, with a 6m/s wind speed, and 27MW turbine. Assumed that turbines are operational 24 hours a day. See **Section 4** in **Volume 2, Appendix 12.3 Underwater Noise Modelling Report** for further detail.	Presence of operational wind turbine gearbox and generator will generate noise when operational.
BEN-O-08	Interactions of EMF, including potential cumulative EMF effects	Minimum target burial depth – 0.2m. *Note* - In exceptional circumstances, there may be lengths of cable where it will not be possible to achieve the minimum target burial depth. In these circumstances it may be appropriate to use a form of external protection to ensure the cable is not exposed.	

Impact ID	Impact and Project Activity	Realistic Worst-Case Scenario	Rationale
BEN-O-11	Colonisation of introduced substrate	**Vessels:** • Maximum number of O&M vessels on site at any one time – 16. • (See habitat loss / alteration row for infrastructure that could be colonised).	The risk of introducing INNS during construction is primarily related to vessel activities should vessels come from other marine bioregions. Based on simultaneous presence of jack-up vessels, service operations vessels, accommodation vessels, small crew transfer vessels, lift vessels, cable maintenance vessels and auxiliary vessels.
	Landfall	All cables will be buried below landfall, assumed no maintenance activities required during the operational stage. As such no operational impacts predicted to occur at landfall.	
Decommissioning			
BEN-D-01 BEN-D-02 BEN-D-03 BEN-D-05 BEN-D-07 BEN-D-11	The final decommissioning strategy of the Project's offshore infrastructure has not yet been decided. For a description of potential offshore decommissioning works, refer to **Chapter 4 Project Description**. It is recognised that regulatory requirements and industry best practice change over time. Therefore, the details and scope of offshore decommissioning works will be determined by the relevant regulations and guidance at the time of decommissioning. Specific arrangements will be detailed in an Offshore Decommissioning Plan (see **Table 10-4**, Commitment ID CO21), which will be submitted and agreed with the relevant authorities prior to the commencement of offshore decommissioning works. For this assessment, it is assumed that decommissioning is likely to operate within the parameters identified for construction (i.e. any activities are likely to occur within the temporary construction working areas and require no greater amount or duration of activity than assessed for construction). The decommissioning sequence will generally be the reverse of the construction sequence. It is therefore assumed that decommissioning impacts would likely be of similar nature to, and no worse than, those identified during the construction phase.		

10.5 Assessment Methodology

10.5.1 Guidance Documents

37. The following guidance documents have been used to inform the baseline characterisation, assessment methodology and mitigation design for benthic and intertidal ecology:

- Parker *et al.,* (2022) Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications;
- Natural England and Joint Nature Conservation Committee (JNCC) (2019) Advice on key sensitivities of habitats and Marine Protected Areas in English Waters to offshore wind farm cabling within Proposed Round 4 leasing areas;
- CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine;
- JNCC (2018) Monitoring guidance for marine benthic habitats;
- The British Standards Institution (2015) Environmental impact assessment for offshore renewable energy projects – Guide. PD 6900:2015;
- Cefas (2012) Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects;
- Ware & Kenny (2011) Guidance for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites; and
- Wyn & Brazier (2001); JNCC Marine Monitoring Handbook.
- Natural England's advice on 'Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications' (Parker *et al*, 2022);
- MMO (2014b) Review of Post-Consent Offshore Wind Farm Monitoring Data Associated with Licence Conditions, with input from the BTO, NPL and the SMRU;
- Defra (2005) Nature Conservation Guidance on Offshore Windfarm Development. A guidance note on the implications of the EC Wild Birds and Habitats Directives for developers undertaking offshore wind farm developments. Version R1.9. 13; and
- Cefas (2004) Offshore Wind Farms: Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA requirements: Version 2.

10.5.2 Data and Information Sources

10.5.2.1 Desk Study

38. A desk study has been undertaken to compile baseline information in the previously defined study area(s) (see **Section 10.4.1**) using the sources of information set out in **Table 10-7**.

Table 10-7 Desk-Based Sources for Benthic and Intertidal Ecology Data

Data Source	Spatial Coverage	Year(s)	Summary of Data Contents
Dogger Bank South (DBS) ES Volume 7 Chapter 9 Benthic and Intertidal Ecology	DBS array areas and offshore ECCs	2024	Assessment of the impacts of DBS on benthic and intertidal ecology. Of relevance due to the close proximity between the offshore ECC of the Project and DBS.
Hornsea Project Four ES Volume A2 Chapter 2 Benthic and Intertidal Ecology	Hornsea Project Four array area and offshore ECC	2022	Assessment of the impacts of Hornsea Project Four on benthic and intertidal ecology. Of relevance due to the close proximity between the offshore ECC of the Project and Hornsea Project Four.
Dogger Bank SAC MMO Fisheries Assessment	Dogger Bank SAC	2021	Assessment detailing the impacts of fishing activities on the Dogger Bank SAC.
Dogger Bank Teesside A & B Environmental Statement Chapter 12 - Marine and Intertidal Ecology	Dogger Bank Teesside A & B array area	2014	Assessment of the impacts of the Dogger Bank Teesside A & B (now C and Sofia) offshore wind farms on benthic and intertidal ecology.
Dogger Bank Site of Community Importance (SCI) 2014 Monitoring R&D Survey Report	Dogger Bank SCI (now the Dogger Bank SAC)	2014	Report investigating monitoring options in relation to fisheries management measures within the Dogger Bank SCI (now SAC).
Dogger Bank Creyke Beck Environmental Statement Chapter 12 - Marine and Intertidal Ecology	Dogger Bank Creyke Beck array area	2013	Assessment of the impacts of the Dogger Bank Creyke Beck (now Dogger Bank A & B) offshore wind farms on benthic and intertidal ecology.
Dogger Bank SAC Selection Assessment Document	Dogger Bank SAC	2011	Assessment detailing information about the Dogger Bank candidate SAC and evaluates its interest features according to the Habitats Directive selection criteria and guiding principles.

Data Source	Spatial Coverage	Year(s)	Summary of Data Contents
JNCC Report No. 429 - Understanding the marine environment – seabed habitat investigations of the Dogger Bank offshore draft SAC	Boundary of the draft Dogger Bank SAC	2009	Report providing evidence on the distribution and extent of Annex I habitat (including variations of these features) on the Dogger Bank, prior to its designation as an SAC.
EMODnet broad-scale seabed habitat map for Europe (EUSeaMap)	Entire study area	2016	EUSeaMap 2016 is a predictive habitat map which covers the seabed of a large area of European waters including the North Sea. Habitats are described in the EUNIS and Marine Strategy Framework Directive predominant habitat classifications and predicted based on a number of physical parameters. Associated confidence maps are also available which give a breakdown of confidence in predicted habitats into high, medium, and low categories.
OneBenthic	Entire study area	2025	Database of benthic datasets (e.g. seabed macrofauna, sediment particle size).

10.5.2.2 Site-Specific Surveys

39. In addition to desk-based sources, site-specific surveys were undertaken to provide detailed baseline information on benthic and intertidal ecology. **Table 10-8** summarises surveys that have been completed or are planned to be undertaken to inform the ES which are relevant to the benthic and intertidal ecology baseline characterisation. The geophysical survey results for the offshore ECC will be available at the next stage of the EIA, to inform the ES. The array area for the original survey are shown in **Volume 2, Appendix 10.4 Array Area Habitat Mapping**.

Table 10-8 Site-Specific Survey Data for Benthic and Intertidal Ecology

Survey	Spatial Coverage	Year(s)	Summary of Survey Data	Informed the PEIR
Completed				
Marine geophysical survey	Array Area	2023	Bathymetry, seabed features and shallow geology.	Yes
Benthic survey	Array Area	2023	Grab sampling and particle size analysis at 47 sampling stations in the Array Area.	Yes.
Ongoing				
Marine geophysical survey	offshore ECC and Characterisation Area	2024 - 25	Bathymetry, seabed features and shallow geology.	No. This information will be available for the ES.
Planned geotechnical survey	Array Area and offshore ECC	2025	Campaigns are planned for Cone Penetration Tests (CPTs) and vibrocores.	No. This information will be available for the ES.
Numerical modelling	Array Area and offshore ECC	2024	Hydrodynamic, wave, and sediment dispersion modelling.	Yes

10.5.3 Impact Assessment Methodology

40. **Chapter 6 Environmental Impact Assessment Methodology** sets out the overarching approach to the impact assessment methodology. The topic-specific methodology for the benthic and intertidal ecology assessment is described further in this section.

41. A matrix approach has been used to assess impacts following best practice, EIA guidance and the approach outlined in **Chapter 6 Environmental Impact Assessment Methodology**. An explanation of how this is applied within the benthic and intertidal ecology assessment is set out below.

42. The data sources summarised in **Section 10.5** were used to characterise the baseline environment, the description of which is presented in **Section 10.6**. Each impact, which has been identified using expert judgement and agreed through the Scoping Process, is then assessed in terms of its significance using the methods described below.

10.5.3.1 Impact Assessment Criteria

43. For each potential impact, the assessment identifies receptors sensitive to that impact and implements a systematic approach to understanding the impact pathways and the level of impacts (i.e. magnitude) on given receptors. The definitions of sensitivity and magnitude for the purpose of the benthic and intertidal ecology assessment are provided below.

10.5.3.1.1 Receptor Sensitivity

44. The assessment identifies receptors for which there is a pathway for effect, and the sensitivity of those receptors to each effect. The definitions of sensitivity are based on The Marine Life Information Network's (MarLIN) Marine Evidence based Sensitivity Assessment (MarESA), (MarLIN, 2021) which determines sensitivity based on resistance (tolerance) and resilience (recoverability) which are defined as (**Table 10-9**):

- Resistance: the likelihood of damage (termed intolerance or resistance) due to a pressure; and
- Resilience: the rate of (or time taken for) recovery (termed recoverability, or resilience) once the pressure has abated or been removed.

Table 10-9 Tolerance and recoverability scale definitions

Level	Description
Tolerance (Resistance)	
None	Key functional, structural, characterising species severely decline and / or physicochemical parameters are also affected e.g. removal of habitats causing a change in habitats type. A severe decline/reduction relates to the loss of 75% of the extent, density or abundance of the selected species or habitat component e.g. loss of 75% substratum (where this can be sensibly applied).
Low	Significant mortality of key and characterising species with some effects on the physicochemical character of habitat. A significant decline / reduction relates to the loss of 25-75% of the extent, density, or abundance of the selected species or habitat component e.g. loss of 25-75% of the substratum.
Medium	Some mortality of species (can be significant where these are not keystone structural / functional and characterising species) without change to habitats relates to the loss <25% of the species or habitat component.
High	No significant effects on the physicochemical character of habitat and no effect on population viability of key / characterising species but may affect feeding, respiration and reproduction rates.
Recoverability (Resilience)	
Very Low	Negligible or prolonged recovery possible; at least 25 years to recover structure and function.
Low	Full recovery within 10-25 years.
Medium	Full recovery within 2-10 years.
High	Full recovery within 2 years.

45. The MarESA assessment of sensitivity is guided by the presence of key structural or functional species / assemblages and / or those that characterise the biotope groups. Physical and chemical characteristics are also considered where they structure the community. MarESA has been used in order to determine sensitivity of specific biotopes and dominant macrofauna recorded during the site-specific benthic characterisation surveys.

46. For the purpose of this assessment, 'tolerance' has been used in place of 'resistance' and 'recoverability' has been used in place of 'resilience'. This terminology is in line with the recent Natural England best practice advice for evidence and data standards, which utilises the definitions provided by MarESA (Natural England, 2022).

47. MarESA uses a matrix approach using both recovery and resilience to determine sensitivity. The sensitivity matrix used in this assessment, based on MarESA, is presented in **Table 10-10** (Natural England, 2022).

Table 10-10 Sensitivity matrix

Recoverability (Resilience)	Tolerance (Resistance)				
		None	Low	Medium	High
	Very Low	High	High	Medium	Low
	Low	High	High	Medium	Low
	Medium	Medium	Medium	Medium	Low
	High	Medium	Low	Low	Negligible

48. MarESA sensitivities are not available at the habitat level (European Nature Information System (EUNIS)[1] level 3). As such, in instances where biotope identification was not possible and where sensitivity at the habitat level is assessed, it is based on the worst-case sensitivity of biotopes identified within the relevant habitat.

49. It is important to note that where local evidence is available about habitat tolerance and recovery, sensitivities are modified accordingly.

10.5.3.1.2 Value

50. In addition, the 'value' of the receptor forms an important element within the assessment, for instance if the receptor is a protected species or habitat it is considered to be of higher value than a habitat or species that is not protected. It is important to understand that high value and high sensitivity are not necessarily linked within a particular effect.

51. A receptor could be of high value (e.g. Annex I habitat) but have a low or negligible physical / ecological sensitivity to an effect. Similarly, low value does not equate to low sensitivity and is judged on a receptor-by-receptor basis. The value will be considered, where relevant, as a modifier for the ecological sensitivity assigned to the receptor, based on expert judgement. **Table 10-11** states the definitions of value levels for benthic and intertidal ecology.

Table 10-11 Definition of value for benthic and intertidal ecology receptors

Value	Definition
High	Habitats (and species) protected under international law.
Medium	Habitats protected under national law. Species/habitat that may be rare or threatened in the UK.
Low	Habitats or species that provide prey items for other species of conservation value.
Negligible	Habitats and species which are not protected under conservation legislation and are not considered to be particularly important or rare.

[1] The European Nature Information System (EUNIS) habitat classification is a comprehensive pan-European system for habitat identification. More information is available at: https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification-1

10.5.3.1.3 Impact Magnitude

52. The definitions of magnitude of impact for the purpose of the benthic and intertidal ecology assessment are provided in **Table 10-12**.

Table 10-12 Definition of Magnitude of Impacts

Magnitude	Definition
High	Fundamental, permanent / irreversible changes, over the majority of the receptor, and / or considerable alteration to medium or high value receptors.
Medium	Considerable, long term (throughout the project duration) changes, over the majority of the receptor, and / or discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Low	Discernible, long term (throughout the project duration) change, over a minority of the receptor, and / or limited but discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Negligible	Discernible, temporary (for part of the project 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.

10.5.3.1.4 Effect Significance

53. The assessment of significance of an effect is informed by the sensitivity of the receptor and the magnitude of the impact. The determination of significance is guided by the use of an impact significance matrix presented in **Chapter 6 Environmental Impact Assessment Methodology** and **Section 10.5**. Definitions of each level of significance are provided in **Table 10-13**. For the purposes of this assessment, any effect that is of major or moderate significance is considered to be significant in EIA terms, whether this be adverse or beneficial. Any effect that has a significance of minor or negligible is not considered significant in EIA terms.

Table 10-13 Benthic and Intertidal Ecology Significance of Effect Matrix

		Adverse Effect				Beneficial Effect			
		Impact Magnitude							
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Receptor Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Negligible	Negligible	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Table 10-14 Definition of Effect Significance

Significance	Definition
Major	Very large or large change in receptor condition, which is likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which is likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No Change	No impact, therefore, no change in receptor condition.

10.5.4 Cumulative Effect Assessment Methodology

54. The cumulative effect assessment (CEA) considers other plans and projects that may act collectively with the Project to give rise to cumulative effects on benthic and intertidal ecology receptors. The general approach to the CEA for benthic and intertidal ecology involves screening for potential cumulative effects, identifying a short list of plans and projects for consideration and evaluating the significance of cumulative effects. **Chapter 6 Environmental Impact Assessment Methodology** provides further details on the general framework and approach to the CEA.

55. The final CEA will be undertaken during the later stages of the EIA, once further information is available on a number of projects. However, for the purposes of the PEIR, it is possible to identify a number of projects and plans which are likely to feature in that assessment and consider the extent to which cumulative effects might arise. **Section 10.8** presents the following preliminary information regarding cumulative effects:

- Screening for cumulative effects; and
- A preliminary short list of plans and projects considered for CEA, including a brief description as to how projects have been screened in and the initial tier level they have been assigned.

10.5.5 Transboundary Effect Assessment Methodology

56. The transboundary effect assessment considers the potential for effects to occur as a result of the Project on benthic and intertidal ecology receptors within the Exclusive Economic Zone of other European Economic Area (EEA) member states or other interests of EEA member states. **Chapter 6 Environmental Impact Assessment Methodology** provides further details on the general framework and approach to the transboundary effect assessment.

57. For benthic and intertidal ecology, the potential for transboundary effects will utilise the assessment conducted in **Chapter 8 Marine Physical Processes**. The effects assessed for the Dogger Bank SAC have also been identified in relation to all impacts for the Doggersbank SAC which is under the Netherlands jurisdiction due to the proximity of the Project to this area. The designation of this Doggersbank SAC is the habitat; ‘Sandbanks which are slightly covered by sea water all the time’. This is the same habitat as is presently protected under the Dogger Bank SAC. Due to this, all effects screened in for assessment of the Dogger Bank SAC will have the same assessment as that for the Doggersbank SAC, which is assessed further in the **RIAA** (document number 5.3).

10.5.6 Assumptions and Limitations

58. This chapter provides a preliminary assessment of the likely significant effects of the Project in relation to benthic and intertidal ecology using information available at the time of drafting as described in **Chapter 6 Environmental Impact Assessment Methodology**. This assessment will be refined where relevant and presented in the ES to be submitted with the DCO application.

59. Large datasets were collected during the 2023-2024 site-specific surveys with the Array Area habitat mapping data used to generate **Volume 2, Appendix 10.4 Array Area Habitat Mapping**, which has been used to inform this chapter. The survey data in **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report** has been utilised for the offshore ECC and Characterisation Area. However, habitat mapping which uses the benthic and geophysical data combined is only available for the Array Area and is currently not available for the offshore ECC and Characterisation Area and will be available at the ES stage of the EIA.

60. In addition information available from neighbouring wind farms in the wider Dogger Bank area, site designation data for the Dogger Bank SAC and data available on the Cefas OneBenthic data portal has been considered. Datasets for the neighbouring projects include those from the characterisation (EIA) stages of development (**Table 10-7**). As a result, the benthic ecology of the project areas has been thoroughly characterised and there is a high degree of confidence in the data for the purpose of informing the impact assessment.

61. During the analysis of benthic habitat maps, the EUNIS habitat classification (EEA, 2022) was used. Classifying benthic communities, biotopes or EUNIS levels may be subject to recorder bias due to the potential for confusion between biotopes which occupy similar habitats e.g. Infralittoral sands (MB523) mapped as Sublittoral sands (MB52) or where the characteristic species could allow classification of multiple biotopes. However, this is a known characteristic of the habitat mapping process and is not considered to materially affect the overall confidence in it for the purpose of informing the assessment.

62. The impact assessments in **Section 10.7** describe the level of confidence in each assessment. There is high confidence in the understanding of the magnitude of impact based on the worst-case scenarios provided in **Section 10.4.4** and therefore confidence in the conclusions of effect significance is primarily driven by the level of confidence in the sensitivity of receptors. MarLIN provides information on the confidence associate with sensitivity classifications based on the following definitions:

- High confidence - "based on peer reviewed papers (observational or experimental) or grey literature reports by established agencies on the feature, assessment based on the same pressures acting on the same type of feature in the UK, and studies agree on the direction and magnitude of impact or recovery".
- Medium confidence - "based on some peer reviewed papers but relies heavily on grey literature or expert judgement on feature or similar features, assessment based on similar pressures on the feature in other areas, and studies agree on the direction but not the magnitude of impact or recovery".
- Low confidence - "based on expert judgement, assessment based on proxies for pressures e.g. natural disturbance events, studies do not agree on concordance or magnitude of impact or recovery".

63. Information from MarLIN, and specifically the MarESA method, provides a solid resource for the fundamentals of the significance of effect assessment. As taken from their online database; "*MarLIN provides information to support marine conservation, management and planning. Our resources are based on available scientific evidence and designed for all stakeholders, from government agencies and industry to naturalists and the public. MarLIN hosts the largest review of the effects of human activities and natural events on marine species and habitats yet undertaken.*" It is supported by a number of organisations including Defra, JNCC, and Natural England.

10.6 Baseline Environment

10.6.1 Existing Baseline

64. The environmental baseline, including descriptions of sediment type, infauna and epifauna, is presented for the Array Area, the offshore ECC, and a third area which is the area that falls outside of the cable route and is considered as the Characterisation Area (see **Figure 10-1)**. The Characterisation Area falls to the northwest of the Dogger Bank SAC and is being surveyed to provide to enable routeing flexibility to account for current uncertainty on a potential future MPA extension (for further information see **RIAA** (document reference 5.3). A description of protected areas and important species in the vicinity of the project is also provided. It should be noted that **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report** is the collation of two separate survey campaign the Array Area (surveyed in 2023) and the offshore ECC (surveyed in 2024), as detailed in **Section 10.5.2.2**.

65. The following sections outline the offshore zone (**Section 10.6.1.1**) which is the marine area seaward of Mean Low Water Springs (MLWS). The Offshore Zone does not include the intertidal zone (**Section 10.6.1.2**) which is the area between MLWS and MHWS.

10.6.1.1 Offshore Zone

10.6.1.1.1 Sediment Classification

10.6.1.1.1.1. Seabed Composition

66. In the site-specific survey conducted between 31st July to 23rd August 2023, grab samples were successfully acquired at 48 sampling stations across the Array Area (for further information see **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**).

67. The site-specific survey conducted between 9th September to 26th September 2024 successfully acquired 104 sample stations and seven reserve sample stations. This included sample stations within the ECC and a number of stations within the Array Area that were resurveyed from the site-specific survey in 2023. Comparison between the 2023 and 2024 grab samples are provided within **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**.

68. Sediments were classified using the using The Folk (British Geological Survey (BGS) modified) classification (Long, 2006) and the Wentworth sediment classification (Wentworth, 1922). **Figure 4.33** and **Figure 4.34** in **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report** details the spatial variations of percentage of sand, gravel and fines found within the Array Area, with the offshore ECC having changed since this survey and not included for this assessment.

69. The seabed observed across the survey area primarily comprised of sandy sediment, the mean sand content being 83.40% and the median 94.53% with high variation of gravel, and the fines content was generally low. The gravel content was higher at stations along the offshore ECC than that of the stations in the Array Area, whereas the variation of fines content was higher at stations in the Array Area.

70. The coarseness of the sediment was assessed by means the Wentworth (1922) scale, through which seven sediment descriptions were identified. Of these, 'fine sand' described most stations in the Array Area, followed by 'medium sand', 'very coarse sand', 'coarse sand', and 'fine pebble'.

71. The sediment in the Array Area is typical of the Dogger Bank, which is reported to comprise fine sands with shell fragments in the shallow areas and muddy fine sands in the deeper parts (Eggleton *et al*., 2017; Krönche & Knust, 1995). In both site-specific surveys, shell fragments were recorded through in situ observation of the grab samples. This is of relevance, as the PSD analysis does not discern between shells and gravel and may result in slightly gravelly sand being identified in areas which may actually represent shelly sand and which is also reported to be typical of the Dogger Bank (Diesing *et al*., 2009).

72. Patches of gravelly sediment are reported to occur in topographic depressions in water depth of less than 40m (Diesing *et al*., 2009), whereas above the 30m depth contour the sand fraction is reported to be higher than 94% (Van Moorsel, 2011). In the site-specific surveys, the water depth in the array ranged from 17.9m to 32.3m below sea level, with 53 of the 62 stations sampled in the array, being in water depth <30.0m.

73. Gravelly sediments are reported as 'gravel', 'sandy gravel', 'gravelly sand', 'gravelly muddy sand', and 'muddy sandy gravel' based on the Folk (1954) classification (Diesing *et al*., 2009). In this study, gravelly sediment, classified as 'gravel', 'gravelly sand', 'sandy gravel', 'gravelly muddy sand' and 'muddy gravelly sand' (Folk, 1954) were recorded at 19 of the 62 stations in the array and most stations were classified as 'sand'. Gravelly sediment was also characterised in 26 of the 60 stations along the offshore ECC with most stations being classified as 'sand' again (see **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**).

74. Muddy sediments are reported to include only 'muddy sand', which occurs sporadically below the 50m contour (Diesing *et al*., 2009). In the 2023 site-specific survey, 33 of the 47 stations sampled in the array were devoid of mud and at the remaining stations, the mud content was <10%, except at stations ST133 and ST147, which had mud contents of 26.97% and 17.13%, respectively, resulting in these stations being classified as 'gravelly muddy sand' (Folk, 1954).

75. Most stations had unimodal distributions, peaking in the fine sand region. Bimodal and / or polymodal distributions were recorded at 12 stations in the array, and 21 stations along the offshore ECC, indicating different sediment sources (Hein, 2007). These are likely to be represented by physical disturbance associated with the tidal and storm-induced currents on the Dogger Bank, as well as fluvial sediment input.

76. Previous studies of the area (Forewind, 2014) identified five Folk (1954) sediment classes across the Tranche B, which encompasses DBD, including 'slightly gravelly sand', 'gravelly sand', 'sandy gravel', 'gravel' and 'muddy sandy gravel'.

77. The sand and fines content was broadly comparable between the 2023 and 2024 site-specific surveys. Gravel content decreased from the 2023 survey to the 2024 survey (further information in **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**).

10.6.1.1.1.2. Habitat Classification

78. **Table 10-15** presents the classification hierarchy for the biotopes observed within the survey area. It should be noted that a number of habitats identified could not be identified to the biotope level (such as Faunal communities in Atlantic offshore circalittoral sand).

79. Further information can be found in **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**). Owing to the presence of cobbles and sporadic boulders, 19 stations were assessed in relation to the presence of the Annex I habitat 'Reef', specifically, 'stony reef'. along a number of section of the transects at 10 stations, the cobble and boulder components were classified as 'low resemblance to a stony reef'. The epifaunal assemblage associated with the cobble and boulder component was generally comparable to that of the surrounding seafloor. Where the low-lying cobbles and boulders were classified within the elevation criteria of 64mm to 5m, the elevation was at the lower end of the range.

80. However, aggregation of cobbles and boulders were classified as 'medium resemblance to a stony reef' at five stations. Of these 19 stations, 16 of them are located within the offshore ECC, with the remaining three located in the Array Area. Of the Array Area stations, two were classified as 'medium resemblance to a stony reef'.

81. The actual extent of occurrences of stony reefs has not been ground truthed as the geophysical data for the offshore ECC is not currently available and considered within the PEIR. This dataset will be available and considered at ES stage.

82. **Figure 4.46** and **Table 4.21** in **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report** illustrates the spatial distribution of cobbles and boulders aggregations, with low and medium resemblance to a stony reef in the Array Area.

83. **Table 10-15** highlights the biotope classifications identified within the Offshore Development Area and which are discussed further in **Section 10.6.1.1.1** to **Section 10.6.1.3.7**. The biotopes designated for each station has been shown in relation to the particular area of the Offshore Development Area in the 4th column in **Table 10-15**. The Characterisation Area is located on the northwestern edge of the current Dogger Bank SACs boundary. Further information on the assessment of the Dogger Bank SAC can be found in the **RIAA** (document reference 5.3).

10.6.1.1.1.2.1. Sparse Fauna on Highly Mobile Atlantic Infralittoral Shingle (MB3231)

84. The biotope 'Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)' (MB3231) is described as unstable coarse sediment (e.g. pebbles lying on or embedded in other sediment) that are strongly affected by tidal steams and / or wave action that can support few animals and are consequently faunally impoverished. The species composition of this biotope may be highly variable seasonally and is likely to comprise low numbers of robust polychaetes or bivalves. In more settled periods there may be colonisation by anemones of hydroids and bryozoans (EEA, 2022). This biotope covers a depth range of 5m to 50m (JNCC, 2022a).

85. This biotope was assigned to station ST127, characterised by poorly and very poorly sorted sandy gravel (Folk, 1954), at a depth of 30m below sea level. The fauna at these stations comprised motile taxa such as *G. intermedia*, *Leptocheirus hirsutimanus* and *Pisidia longicornis*, along with amphipods such as *Ampelisca diadema* and species of *Monocorophium*, robust polychaetes such *P. kefersteini and P. inornate,* and bivalves such as *T. ovata*.

86. Colonial epifauna from the grab samples at these stations was well represented with 19 taxa present at station ST127, comprising of bryozoans, including *F. foliacea*, poriferan of the genus *Sycon*, and hydroids, including *Alcyonium digitatum*.

87. Results of the seafloor photographic analysis (see **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**) indicated a sediment featuring sandy gravel with pebbles and cobbles at station ST127. Epibiota comprised cnidarians of the genus *Urticina* including *U. felina*; encrusting and erect bryozoans, including *F. foliacea* and *A. diaphanum*; brown and red algae, including encrusting species of the family *Corallinaceae*, crustacean species of the genus *Munida*, echinoderms *A. rubens*, calcareous tube worms of the family *Serpulidae*, barnacles, and fish of the family *Ammodytidae*.

10.6.1.1.1.2.2. *Glycera lapidum* in Impoverished Atlantic Infralittoral Mobile Gravel and Sand (MB3235)

88. The biotope '*Glycera lapidum* in impoverished Atlantic infralittoral mobile gravel and sand' (MB3235) is described as slightly gravelly sand featuring impoverished communities characterised by the species complex *G. lapidum* (agg.).

89. This biotope was assigned to one station (ST137) characterised by poorly sorted gravelly sand (Folk, 1954) and featured polychaetes such as *G. lapidum*, *A. paucibranchiata* and species of *Notomastus*.

90. Results of the seafloor photographic analysis (see **Section 4.6.1.6** in **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**) indicated a sediment featuring gravelly sand or sandy gravel. Clay outcrops with piddock holes were also recorded at station ST137, which were assigned the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' (MC1251), detailed in **Section 10.6.1.1.1.2.4**.

91. Epibiota was generally sparse and comprised the echinoderms *A. rubens* and *A. irregularis*, crustaceans of the genus *Liocarcinus* and family *Paguridae*, polychaetes of the family *Serpulidae*, molluscs of the family *Pectinidae* and faunal turfs of hydrozoans and bryozoans. Fish included *P. platessa*, *Mullus surmuletus* and species of the families *Triglidae*, and *Ammodytidae*. Faunal burrows were also recorded at the station.

Table 10-15 Biotope Classifications

<table>
<tr><th colspan="2">EUNIS (EEA, 2022) Habitat Classification</th><th rowspan="2">Equivalent JNCC Classification (JNCC, 2023)</th><th rowspan="2">Station locations where Classifications located</th></tr>
<tr><th>Biotope Complex Level 4</th><th>Biotope Complex Level 5</th></tr>
<tr><td rowspan="3">MB323 – Atlantic infralittoral coarse sediment</td><td>-</td><td>SS.SCS.ICS - Infralittoral coarse sediment</td><td>Array Area = 1
Offshore ECC = 3</td></tr>
<tr><td>MB3231 – Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)</td><td>SS.SCS.ICS.SSh - Sparse fauna on highly mobile sublittoral shingle (cobbles and pebbles)</td><td>Array Area = 1
Offshore ECC = 2</td></tr>
<tr><td>MB3235 - Glycera lapidum in impoverished Atlantic infralittoral mobile gravel and sand</td><td>SS.SCS.ICS.Glap - Glycera lapidum in impoverished Atlantic infralittoral mobile gravel and sand</td><td>Array Area = 1</td></tr>
<tr><td>MB42 – Atlantic infralittoral mixed sediment</td><td>-</td><td>SS.SMx.IMx - Infralittoral mixed sediment</td><td>Offshore ECC = 5</td></tr>
<tr><td rowspan="2">MB523 - Faunal communities of full salinity Atlantic infralittoral sand</td><td>MB5233 - Nephtys cirrosa and Bathyporeia spp. in Atlantic infralittoral sand</td><td>SS.SSa.IFiSa.NcirBat - Nephtys cirrosa and Bathyporeia spp. in infralittoral sand</td><td>Array Area = 1
Offshore ECC = 2</td></tr>
<tr><td>MB5236 - Fabulina fabula and Magelona mirabilis with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand</td><td>SS.SSa.IMuSa.FfabMag - Fabulina fabula and Magelona mirabilis with venerid bivalves and amphipods in infralittoral compacted fine muddy sand</td><td>Array Area = 57
Offshore ECC = 11</td></tr>
<tr><td>MC125 - Communities on Atlantic circalittoral soft rock</td><td>MC1251 - Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay</td><td>CR.MCR.SfR.Pid - Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay</td><td>Array Area = 5</td></tr>
<tr><td rowspan="2">MC321 - Faunal communities of Atlantic circalittoral coarse sediment</td><td>MC3212 - Mediomastus fragilis, Lumbrineris spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel</td><td>SS.SCS.CCS.MedLumVen - Mediomastus fragilis, Lumbrineris spp. and venerid bivalves in circalittoral coarse sand or gravel</td><td>Array Area = 2
Offshore ECC = 13</td></tr>
<tr><td>MC3213 - Protodorvillea kefersteini and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand</td><td>SS.SCS.CCS.Pkef - Protodorvillea kefersteini and other polychaetes in impoverished circalittoral mixed gravelly sand</td><td>Offshore ECC = 1
Characterisation Area = 1</td></tr>
<tr><td>MC421 - Faunal communities of Atlantic circalittoral mixed sediment</td><td>-</td><td>SS.SMX.CMx - Circalittoral mixed sediment</td><td>Offshore ECC = 1</td></tr>
</table>

EUNIS (EEA, 2022) Habitat Classification		Equivalent JNCC Classification (JNCC, 2023)	Station locations where Classifications located
Biotope Complex Level 4	**Biotope Complex Level 5**		
MC521 - Faunal communities of Atlantic circalittoral sand	-	SS.SSa.CFiSa - Circalittoral fine sand	Offshore ECC = 9 Characterisation Area = 6
	MC5211 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	SS.SSa.CFiSa.EpusOborApri - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Offshore ECC = 9 Characterisation Area = 10
	MC5212 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	SS.SSa.CFiSa.ApriBatPo - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	Array Area = 1 Offshore ECC = 1 Characterisation Area = 1
	MC5214 - Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment	SS.SSa.CMuSa.AalbNuc - Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment	Offshore ECC = 4
	MC5215 - Amphiura brachiata* with Astropecten irregularis and other echinoderms in circalittoral muddy sand	SS.SSa.CMuSa.AbraAirr - Acrocnida brachiata with Astropecten irregularis and other echinoderms in circalittoral muddy sand	Array Area = 45 Offshore ECC = 7
MD521 - Faunal communities in Atlantic offshore circalittoral sand	-	SS.SSa.OSa - Offshore circalittoral sand	Offshore ECC = 7 Characterisation Area = 12
MC621 - Faunal communities of Atlantic circalittoral mud	MC6216 - Seapens and burrowing megafauna in Atlantic circalittoral fine mud	SS.SMu.CFiMu.SpnMeg - Sea pens and burrowing megafauna in circalittoral fine mud	Burrows: • Array Area = 3 • Offshore ECC = 23 • Characterisation Area = 26 Individuals: • Characterisation Area = 7
Notes: *Amphiura brachiata* is currently *Acrocnida brachiata*, but the EUNIS biotope name has retained the species' former name			

10.6.1.1.1.2.3. *Fabulina fabula* and *Magelona mirabilis* with Venerid Bivalves and Amphipods in Atlantic Infralittoral Compacted Fine Muddy Sand (MB5236)

92. The biotope '*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand' (MB5236) is described as compacted sands and slightly muddy sands in the infralittoral and littoral fringe characterised by the bivalve F. fabula and polychaetes of the genus *Magelona*. Other taxa include mobile amphipods and robust polychaetes (EEA, 2022).

93. This biotope was characterised by poorly sorted gravelly sand (Folk, 1954). Characterising taxa comprised polychaetes such as *S. bombyx*, and species of *Owenia* and *Magelona*, bivalves such as *F. fabula*, *K. bidentata* and species of *Abra*, and amphipods of the genus *Bathyporeia*. At most stations, this biotope occurred in combination with '*Amphiura brachiata* with *Astropecten irregularis* and other echinoderms in circalittoral muddy sand' (MC5215), detailed in **Section 4.6.1.1** of **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**.

94. Colonial epifauna from the grab samples comprised 18 taxa of which the hydroids *L. clausa*, *C. hemisphaerica*, and species of the families *Tubulariidae* and *Campanulariidae* were the most frequently occurring, along with ciliates of the family *Folliculinidae*.

95. Results of the seafloor photographic analysis indicated a sediment featuring small-scale rippled sand with a varying proportion of shell fragments and gravel. Pebbles were recorded at station ST113; pebbles and cobbles at stations ST139 and ST147, the latter also featuring boulders. Clay with piddock holes covered in a veneer of sediment were also observed on stations ST139, ST142, ST145, and ST147, which were assigned the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' (MC1251), detailed in **Section 10.6.1.1.1.2.4**.

96. Epibiota was generally sparse and comprised the echinoderms Astropecten irregularis, Asterias rubens, Luidia sarsii, Luidia ciliaris, Psammechinus miliaris and species of the family Ophiuroidea, the crustaceans Corystes cassivelaunus, Pagurus bernhardus, species of Liocarcinus and faunal turfs of hydrozoans and bryozoans. Fish included Pleuronectes platessa, Microchirus variegatus, Buglossidium luteum, Eutrigla gurnardus, species of the family Triglidae and species of the genus Callionymus. Faunal burrows were recorded at most stations.

10.6.1.1.1.2.4. Piddocks With a Sparse Associated Fauna in Atlantic Circalittoral Very Soft Chalk or Clay (MC1251)

97. 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' (MC1251) occurs on circalittoral soft rock, which is sufficiently soft to be bored by bivalves, with the piddock *Pholas dactylus* the most widespread borer recorded. While it is typically too soft for rich epifaunal communities to establish, sessile fauna may include sponges and mobile fauna often includes crabs (*Necora puber* and *Cancer pagurus*; EEA, 2022). This habitat has most frequently been reported from tide-swept areas off the south-east of England (Tillin and Hill, 2016).

98. This biotope was assigned to areas of firm clay, with burrows of piddocks (Imparidentia), recorded through the photographic data at station ST137, where it occurred as a mosaic with other habitat types. Clay with piddock holes covered in a veneer of sediment were also observed from an additional four stations (stations ST139, ST142, ST145 and ST147) and these stations have also been assigned a biotope mosaic (further detail in **Section 4.1.6.1.5** in **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**).

99. As is typical of this biotope, the clay seabed itself had little or no attached epifauna with piddock burrows (*Imparidentia*) evident and abundances ranging from 'Frequent' to 'Abundant'. The most commonly occurring mobile epifauna recorded in this biotope were starfish (*A. rubens* and *A. irregularis*) and crabs (*Brachyura*, including *Necora pub*er). In areas of coarser sediment, faunal turf (Hydrozoa / Bryozoa, including *Halecium* sp., *Alcyonidium dia*phanum, *F. foliacea*, and *Nemertesia* sp.) and additional crustaceans, including lobster *Homarus gammarus* and shrimp (*Caridea*), were also observed. This biotope complex occurred in patches within mixed sediment areas classified as 'Faunal communities of Atlantic circalittoral mixed sediment' (MC421) and in areas classified as 'Faunal communities of Atlantic circalittoral sand' (MC521) at two stations.

10.6.1.1.1.2.5. *Amphiura brachiata* with *Astropecten irregularis* and Other Echinoderms in Circalittoral Muddy Sand (MC5215)

100. The biotope '*Amphiura brachiata* with *Astropecten irregularis* and other echinoderms in circalittoral muddy sand' (MC5215) is described as circalittoral non-cohesive muddy sand characterised by the echinoderms *Acrocnida* (formerly *Amphiura*) *brachiata*, *Astropecten irregularis*, *Asterias rubens*, *Echinocardium cordatum* and species of *Ophiura* (EEA, 2022).

101. This biotope was assigned to 34 stations as an epibiotic biotope overlaying the biotope '*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand' (MB5236). Typical taxa comprised *A. brachiata*, *E. cordatum*, and *O. albida* recorded in the grab samples and through the photographic data analysis, and *A. irregularis*, *A. rubens*, and species of *Ophiura* recorded through the photographic data analysis, along with *Alcyonium digitatum* and species of the genera *Pagurus* and *Liocarcinus* which are amongst the charactering taxa of this biotope.

10.6.1.1.1.2.6. *Abra prismatica*, *Bathyporeia elegans* and Polychaetes in Circalittoral Fine Sand (MC5212)

102. The biotope '*Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand' (MC5212) is described as circalittoral and offshore medium to fine sands communities characterised by the bivalve *A. prismatica*, the amphipod *B. elegans*, polychaetes and echinoderms (EEA, 2022).

103. This biotope was assigned to three stations, which were characterised by moderately sorted 'sand' (Folk, 1954). Characterising taxa included *A. prismatica*, *B. elegans* and polychaetes such as *N. cirrosa* and *S. bombyx* in addition to E. pusillus and species of Phoronis.

104. Colonial epifauna from the grab samples comprised six taxa of which the hydroid *L. clausa*, *C. hemisphaerica* and species of the families Tubulariidae, and Folliculinidae were the most frequently occurring.

105. Results of the seafloor photographic analysis indicated a sediment featuring small-scale rippled sand and gravelly sand with shell fragments. Epibiota was generally sparse and comprised the echinoderms *A. rubens*, *A. irregularis*, *L. sarsii*, crustaceans of the superfamily Paguroidea and the genus Polybius, the bryozoan *A. diaphanum* and faunal turfs of hydrozoans and bryozoans. Fish included species of the families Ammodytidae and Triglidae and the order Pleuronectiformes.

10.6.1.1.1.2.7. Echinocyamus pusillus, Ophelia borealis and Abra prismatica in circalittoral fine sand (MC5211)

106. The biotope '*Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand' (MC5211) is described as circalittoral and offshore medium to fine sand characterised by the urchin *E. pusillus*, the polychaete *O. borealis* and the bivalve *A. prismatica* (EEA, 2022).

107. This biotope was assigned to 20 stations, which were characterised by poorly sorted gravelly sand (Folk, 1954). Charactering taxa comprised E. pusillus, O. borealis and *A. prismatica*, as well as polychaetes including *S. bombyx*, *M. filiformis* and the genus Owenia.

108. Colonial epifauna from the grab samples comprised 16 taxa of which the bryozoan of the order Ctenostomatida, hydroids *L. clausa*, *C. hemisphaerica* and species of the families Tubulariidae were the most frequently occurring, along with ciliates of the family Folliculinidae.

109. Results of the seafloor photographic analysis indicated a sediment featuring small-scale rippled sand with shell fragments. Epifauna comprised the echinoderms *A. irregularis, A. rubens* and *L. ciliaris*, cnidarians *A. digitatum* and species of the genus Urticina, crustaceans *C. pagurus*, the family Paguroidea, species of Ebalia and species of the genus Polybius, the bryozoan A. diaphanum and faunal turfs of hydrozoans and bryozoans. Fish of the families Gadidae, Triglidae and Soleidae, in addition to species of the genus Callionymus. The order Pleuronectiformes including the species Buglossidium luteum were also observed. Faunal burrows were recorded at most stations.

10.6.1.1.1.2.8. *Mediomastus fragilis*, *Lumbrineris spp*. and Venerid Bivalves in Atlantic Circalittoral Coarse Sand or Gravel (MC3212)

110. The biotope '*Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in Atlantic circalittoral coarse sand or gravel' (MC3212) is described as gravels, coarse to medium sands, and shell gravels with small percentage of silt in the circalittoral zones. Faunal communities are characterised by polychaetes such as *M. fragilis* and species of Lumbrineris, along with Nemertea, amphipod crustaceans, and venerid bivalves, although the latter are often under-sampled in benthic grab surveys (EEA, 2022).

111. This biotope was assigned to stations ST091 and ST099, which were characterised by poorly and very poorly sorted gravelly sand and sandy gravel (Folk, 1954) featuring polychaetes such as the species *L. conchilega*, *P. baltica*, *E. longa* and the genus Notomastus, which were amongst the characterising taxa. The polychaetes *M. fragilis* and *S. bombyx* and the species of Nemertea were also recorded.

112. Colonial epifauna from the grab samples that was assigned this biotope comprised 55 taxa of which the hydroids *L. clausa*, *C. hemisphaerica*, the bryozoans *E. immersa*, *B. ciliata* and species of the genus Schizomavella and the order Ctenostomatida were the most frequently occurring, along with ciliates of the family Folliculinidae.

113. Results of the seafloor photographic analysis indicated a sediment featuring muddy gravelly sand with shell fragments and varying number of pebbles, cobbles and infrequent boulders. Epibiota was generally more diverse and abundant than the sand dominated sediments. Epibiota comprised the bryozoans *F. foliacea*, *A. diaphanum* and *S. securifrons*, the echinoderms *E. esculentus*, *A. rubens* and species of the genus Henricia, the family Ophiuridae, the crustaceans *N. puber*, and species of the genera Munida and Polybius, the cnidarian *A. digitatum* and species of the genus Nemertesia, anemones of the genus Urticina, encrusting polychaetes of the family Serpulidae, the bivalve *P. maximus*, and fish of the order Pleuronectiformes. Faunal turfs of hydrozoans and bryozoans were also recorded.

10.6.1.1.1.2.9. *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)

114. The biotope '*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment' (MC5214) is described as muddy sands or gravelly muddy sand sediments. Faunal communities are typified by population of *A. alba* and *Nucula nitidosa*. Other conspicuous infauna may include *Nephtys sp*., *S. bombyx*, *Chaetozone setosa*. Epifauna can include *Ophiura albida* and *Asterias rubens* (EEA, 2022).

115. This biotope was characterised by moderately well sorted slightly gravelly sand (Folk, 1954) and featured *N. nitidosa*, *A. alba* and *B. tenuipes* amongst the characterising taxa.

116. Results of the seafloor photographic analysis indicated a sediment featuring small scaled rippled sand with shell fragments alongside gravelly sand with pebbles, cobbles and boulders recorded at station ST002. Epibiota was generally sparse and comprised crustaceans of the genus Polybius, the bryozoans *F. foliacea* and *A. diaphanum*, faunal turfs of hydrozoans and bryozoans, cnidarians of the genus Urticina, the polychaete *L. conchilega* and fish of the family Triglidae, the order Pleuronectiformes and the genus Callionymus. Red algae in the phylum of Rhodophyta were also recorded.

10.6.1.1.1.2.10. *Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic Infralittoral Sand (MB5233)

117. The biotope '*Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic infralittoral sand' (MB5233) is described as well-sorted medium and fine sand sediments in shallow, high energy environments. Faunal communities are characterised by population of *Nephtys cirrosa* and *Bathyporeia sp*. Other infauna may include *Magelona mirabilis* and *Chaetozone setosa* (EEA, 2022).

118. This biotope was assigned to stations ST007, ST060 and ST100, which were characterised by moderately well sorted slightly gravelly sand (Folk, 1954). Infauna featured an abundance of the polychaetes *N. cirrosa*, *S. bombyx* and *E. longa* along with the amphipod *Bathyporeia guilliamsoniana*.

119. Colonial epifauna from all the grab samples in this biotope comprised 9 taxa of which hydroids *L. clausa*, *C. hemisphaerica* and the genus Sertularella, the bryozoan *E. immersa*, *B. ciliata*, porifera of the genus Cliona were the most frequently occurring, along with ciliates of the family Folliculinidae.

120. Results of the seafloor photographic analysis indicated a sediment featuring small scale rippled muddy sand with shell fragments and a small area with sparse cobbles. Epibiota was generally sparse and comprised echinoderms which included A. irregularis, A. rubens, crustaceans of the genus Polybius and the family Paguroidea, the bryozoan *Bugulina flabellata*, faunal turfs of hydrozoans and bryozoans, the polychaete *L. conchilega* and fish of the families Gadidae and Soleidae, and the order Pleuronectiformes including *P. platessa*. Faunal burrows were recorded at most stations.

10.6.1.1.1.2.11. *Protodorvillea kefersteini* and Other Polychaetes in Impoverished Atlantic Circalittoral Mixed Gravelly Sand (MC3213)

121. The biotope '*Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand' (MB5233) is described as coarse gravelly / shelly sand sediments in depths of 10 m to 30 m. Faunal communities are characterised by population of *Protodorvillea kefersteini*. Other associated infauna may include species of Nemertea, G. lapidum and range of other polychaetes including *Sabellaria spinulosa* which occur at low abundances (EEA, 2022).

122. This biotope was characterised by poorly sorted sandy gravel (Folk, 1954) and featured the polychaetes *P. kefersteini*, *G. lapidum*, *Pisione remota* and species of Nemertea. Colonial epifauna from the stations to which this biotope was assigned, comprised 19 taxa of which hydroids of the families Campanulariidae and Tubuliporidae, bryozoans of the family Cribrilinidae were the most frequently occurring, along with ciliates of the family Folliculinidae.

123. Results of the seafloor photographic analysis indicated a sediment featuring small-scale rippled sand with shell fragments alongside gravelly sand with pebbles, cobbles and shell fragments recorded at station ST047. Epibiota was generally sparse and comprised echinoderms including *A. rubens*, the crustacean *C. pagurus*, the bryozoan *A. diaphanum*, faunal turfs of hydrozoans and bryozoans, fish of the family Triglidae and the genus of Callionymus. Faunal burrows were recorded at most stations.

10.6.1.1.1.2.12. Faunal Communities in Atlantic Offshore Circalittoral Sand (MD521)

124. The biotope complex 'Faunal communities in Atlantic offshore circalittoral sand (MD521) is described as a stable habitat with fine/muddy sands. The fauna is represented by a diverse range of polychaetes, bivalves, echinoderms and amphipods (EEA, 2022).

125. This biotope complex was assigned to the stations characterised by moderately sorted sand (Folk, 1954) in water depth greater than 50m. Infauna featured polychaetes such as *Sthenelais limicola*, *Galathowenia ocu*lata, *Scoloplos armiger* and the echinoderm *Amphiura filiformis*.

126. Colonial epifauna from the grab samples comprised 12 taxa of which the hydroids L. clausa, and species of the order Anthoathecata and the family Tubulariidae and cnidarians of the order Leptothecata were the most frequently occurring, along with ciliates of the family Folliculinidae.

127. Results of the seafloor photographic analysis (Appendix C.3) indicated a sediment featuring small scale rippled muddy sand with shell fragments. Epibiota comprised echinoderms such as *A. irregularis*, *A. rubens*, *L. sarsii* alongside crustaceans including species of the superfamily Paguroidea and the genus Ebalia, Cnidaria including *A. digitatum*, *Pennatula phosphorea*, species of the genus Epizoanthus, the polycheate *Oxydromus flexuosus* and faunal turfs of hydrozoans and bryozoans. Fish of the family Gadidae including Melanogrammus aeglefinus and species of the family Triglidae, the order Pleuronectiformes including the family Soleidae and *M. kitt* were also recorded.

10.6.1.1.1.2.13. Faunal Communities of Atlantic Circalittoral Sand (MC521)

128. The biotope complex 'Faunal communities of Atlantic circalittoral sand' (MC521) is described as non-cohesive muddy sands with a silt content of 5 % to 20 % supporting communities characterised by polychaetes, bivalves and echinoderms. These circalittoral habitats tend to be more stable than their infralittoral counterparts and as such support a richer infaunal community (EEA, 2022).

129. This biotope complex was assigned to stations ST038, ST073, ST078 and ST088 and characterised by moderately well sorted slightly gravelly sand (Folk, 1954). Infaunal taxa featured the echinoderm E. pusillus, the polychaetes *N. cirrosa, Chaetozone christiei, S. limicola, Eudorellopsis deformis,* and the bivalves *Cochlodesma praetenue, A. prismatica* and *Phaxas pellucidus* which were amongst the top ten most abundant taxa.

130. This biotope complex was also assigned to the ungrouped station ST039, characterised by moderately well sorted slightly gravelly sand (Folk, 1954). Infauna was represented by the following Arthropoda, *Ampelisca brevicornis*, *Perioculodes longimanus*, Urothoe poseidonis and species of Mollusca included Phaxas pellucidus, Cha*melea striatula* and *Thracia phaseolina*, each comprising one individual.

131. Colonial epifauna from stations ST038, ST073, ST078 and ST088 comprised 8 taxa and the ungrouped station ST039 comprised 4. Taxa included hydroids *L. clausa*, the order Anthoathecata, the cnidarian *Epizoanthus papillosus* and species of the order Leptothecata and Porifera of the genus Cliona were the most frequently occurring, along with ciliates of the family Folliculinidae.

132. Results of the seafloor photographic analysis indicated a sediment featuring small scale rippled sand with shell fragments. Epibiota was generally sparse and included the crustaceans Paguroidea, the echinoderms A. *rubens*, A. *irregularis* and species of the order Spatangoida, cnidarians of the genus Epizoanthus and faunal turfs of hydrozoans and bryozoans. Fish included species of the order Pleuronectiformes, including the species of the family Soleidae and *P. platessa*. Faunal burrows were recorded at most stations.

10.6.1.1.1.2.14. Sparse Fauna on Highly Mobile Atlantic Infralittoral Shingle (Cobbles and Pebbles) (MB3231)

133. The biotope 'Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)' (MB3231) is described as unstable coarse sediment (e.g. pebbles lying on or embedded in other sediment) that are strongly affected by tidal steams and/or wave action which can support few animals and are consequently faunally impoverished. The species composition of this biotope may be highly variable seasonally and is likely to comprise low numbers of robust polychaetes or bivalves. In more settled periods there may be colonisation by anemones of hydroids and bryozoans (EEA, 2022). This biotope covers a depth range of 5m to 50m (JNCC, 2022).

134. This biotope was assigned to the ungrouped station ST009 characterised by very poorly sorted sandy gravel (Folk, 1954), in a water depth of 17.9m BSL. Infauna at station ST009 comprised the Anthropoda *Diastylis bradyi* and A. *echinata*, the polycheates *Malmgrenia darbouxi*, C. zetlandica and Eumida bahusiensis with a single Bivalvia species of *Mactra stultorum*.

135. Colonial epifauna was absent from the grab sample at stations ST009. This biotope was also assigned to the ungrouped station ST010 characterised by very poorly sorted sandy gravel (Folk, 1954), in a water depth of 17m below sea level. Station ST010 was more diverse than station ST009 and comprised of the species of Arthropodas such as *Balanus crenatus*, *A. echinata*, species of the family Aoridae and *Synchelidium maculatum*. The species of polychaete, *Euclymene oerstedii*, *S. spinulosa*, *C. zetlandica*, *L. conchilega* and the genus Polygordius were also present. Species of Mollusca such as *Kurtiella bidentata* and *A. alba* were also recorded but in low abundances.

136. Colonial epifauna from the grab samples at station ST010 comprised 31 taxa, including Porifera of the order Leucosolenida, cnidarians such as *C. syringa*, and species of the family Haleciidae and the genus Sertularia, and Bryozoa including species of Crisia, Amathia, Celleporella and Bugulina.

137. Results of the seafloor photographic analysis at station ST009 indicated a sediment featuring small-scale rippled sand with pebbles, cobbles and shell fragments. Epibiota comprised erect bryozoans, including *F. foliacea*, *S. securifrons* and *A. diaphanum*; red algae, crustacean species of the genus Polybius and the superfamily Paguroidea, calcareous tube worms of the family Serpulidae and faunal turfs of hydrozoans and bryozoan.

138. Results of the seafloor photographic analysis at station ST010 indicated a sediment featuring sandy gravel with pebbles, cobbles and boulders. Epibiota comprised cnidarians of the genus Urticina including *U. felina*; erect bryozoans, including *F. foliacea*, and *A. diaphanum*; red algae, crustacean of the species *N. puber*, echinoderms of the genus Henricia, calcareous tube worms of the family Serpulidae, hydrozoan including the species *Tubularia indivisa* and faunal turfs of hydrozoans and bryozoan. Fish of the genus Callionymus were also observed.

10.6.1.1.1.2.15. Seapens and burrowing megafauna in Atlantic circalittoral fine mud (MC6216)

139. The biotope of seapens and burrowing megafauna in Atlantic circalittoral fine mud has little structural complexity above the sediment surface. Burrows and mounds of burrowing megafauna may form a prominent feature of the sediment surface with conspicuous populations of sea pens, typically *Virgularia mirabilis* and *Pennatula phosphorea*. However, apart from a couple of species of nudibranch the seapens do not provide significant habitat for other fauna. Where present, the tube of the rare sea anemone *Pachycerianthus multiplicatus*, creates a habitat for attached species.

140. However, dense populations of burrowers create considerable structural complexity, below the surface, relative to sediments lacking these animals. For example, *Callianassa subterranea* creates complex burrow systems in sandy mud sediments. The burrows consist of a multi-branched network of tunnels connected to several inhalent shafts, each terminating in a funnel- shaped opening to the surface. Burrows also create habitats for other animals such as clams and polychaetes. The sediment expelled by *Callianassa subterranea* forms unconsolidated volcano-like mounds, which significantly modify seabed surface topography (Rowden *et al.*, 1998).

141. The bioturbatory activities of callianassids such as *Callianassa subterranea* have important consequences for the structural characteristics of the sediment. Many infauna are limited to the upper oxygenated layer, however, others penetrate deeper in irrigated burrows or possess long siphons capable of transporting oxygenated water into the sediment, which may result in an oxygenated layer around their burrows.

10.6.1.1.1.3. Contaminants

142. Sediment samples were analysed for total hydrocarbon content (THC), polycyclic aromatic hydrocarbons (PAH), metal content, polychlorinated biphenyls (PCB), and organotins. Results were compared against marine sediment quality guidelines (SQG) namely the OSPAR effects range low, the National Oceanic and Atmospheric Administration (NOAA) effects range median (EFM), the Centre for Environment, Fisheries and Aquaculture Science (Cefas) Guideline ALs, and the Canadian threshold effect level (TEL) and probable effect level (PEL).

143. The THC content at all stations in the Array Area were below the limit of detection (LOD). Concentrations of individual PAHs were below their respective marine SQGs at all stations. In general, PAH concentrations were higher along the nearshore section of the offshore ECC than further offshore and in the Array Area (where all station were below the LOD) due to runoff and discharges in the nearshore, alongside a higher nearshore drift current.

144. Arsenic concentrations at the Array Area stations were all below the Cefas AL1 and Canadian TEL. All metals concentrations were below their respective marine SQGs. The concentrations of most individual PCB congeners analysed were below the LOD. Values above the LOD were reported for most congeners at stations ST136 in the array. However, the sum of the 25 congeners was below the Cefas ALs at all stations. The organotins analysed were dibutyltin and tributyltin (TBT), the concentrations of which were below their respective LODs and below the Cefas ALs at all stations in the Array Area (which includes the additional samples in the 2024 benthic survey, see **Section 10.5.2.2**).

145. Further analysis on sediment chemistry within the Offshore Development Area is detailed in **Section 5.2** of **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report** and **Chapter 9 Marine Water and Sediment Quality**.

10.6.1.2 Intertidal Zone

146. A Phase I qualitative intertidal ecology survey was undertaken on the 23rd of July 2024 at the landfall location for the Project.

147. Four transects across the landfall were surveyed to determine the habitat present and the presence / absence of any fauna. Three distinct habitats were identified within the Landfall where the beach predominantly comprised sand and shingle habitat interspersed with occasional hard anthropogenic structures. Instances of *Arenicola marina* worm casts and *Lanice conchilega* tubes were found along the lower shore. While distinct differences in habitat and species composition were identified across the tidal range, such differences were not significant enough to constitute a change in biotope present. As such, the entirety of the survey area has been classified as the biotope barren littoral coarse sand (EUNIS biotope MA5231) and no protected habitats of species were observed.

148. See **Volume 2, Appendix 10.2 Intertidal Ecology Survey Report** for further details on the methodology and results of this survey.

10.6.1.3 Potential Sensitive Habitats and Species

10.6.1.3.1 *Sabellaria spinulosa* reefs

149. High densities of *Sabellaria spinulosa* have been found to occur in the UK in the vicinity of the Wash and along the South Coast of the UK (Hendrick, 2007; Hendrick *et al*., 2011). Occurrences of *S. spinulosa* were observed along the transect at station ST024. However, the maximum reef morphology assessed was ‘not a reef’. No other occurrences were present in the photographic data. There were no occurrences of *S.spinulosa* within the Array Area, from both benthic surveys conducted. The actual extent of occurrences of *S. spinulosa* could not be determined within the offshore ECC and Characterisation Area as geophysical data were not available to inform PEIR, however data will be available for the ECC and Characterisation Area to inform the ES.

150. Temporal changes of *S. spinulosa* reef habitat are likely due to the ephemeral nature of *S. spinulosa*, which can be influenced by numerous environmental factors such as wave height, storm events, sand movements and recruitment success (OSPAR, 2008).

10.6.1.3.2 Peat and Clay Exposures with Piddocks

151. The biotope ‘Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay’ (MC1251) is part of the UK Biodiversity Action Plan (BAP) priority habitat ‘Peat and Clay Exposures with Piddocks’, and a FOCI in MCZ (JNCC, 2016). Piddocks are elongated burrowing bivalves and include *P. dactylus*, *Barnea candida* and *Barnea parva*. These are capable of boring into the soft peat and clay, creating a unique and fragile habitat (BRIG, 2011). Peat and clay exposures with either existing or historical evidence of piddock activity are unusual communities of limited extent. This habitat has been reported intertidally, from the north-west coast to the south and east coasts of England. Although the distribution of the subtidal element of this habitat is relatively unknown, they are likely to be found in areas where it occurs intertidally (BRIG, 2011).

10.6.1.3.3 Stony Reef

152. As noted in **Section 10.6.1.1**, at 19 stations there was an aggregation of cobbles and boulders which were assessed for the potential to constitute Annex I habitat ‘Reef, specifically ‘stony reef‘, in line with the criteria detailed in Irving (2009) and Golding *et al* (2020) for geogenic reefs (detailed in **Section 4.2.6.2**). Along sections of transects at 10 stations, the cobble and boulder component was classified as ‘low resemblance to a stony reef’. These areas are a component part of the mixed sediment seafloor type that characterises this region of the North Sea and are unlikely to be considered to represent Annex I habitats. Irving (2009) guidelines state that if a ‘low’ is scored in composition, elevation, extent, or biota, then a strong justification would be required for this area to qualify as Annex I habitat ‘Reefs’ under the current marine nature conservation legislation.

153. Aggregations of cobbles and boulders were classified as ‘medium resemblance to a stony reef’ at stations within the offshore ECC, ST004A, ST011, ST012, ST013 and ST014 exceeding 25m^2. However, the actual extent of occurrences of stony reefs could not be determined as the geophysical data for the offshore ECC has not been analysed in time for PEIR. This will be revisited and checked with habitat mapping that includes both the geophysical and benthic data at the ES stage.

10.6.1.3.4 Sandbanks

154. Sandbanks which are slightly covered by sea water all the time consist of sandy sediments that are permanently covered by shallow sea water, typically at depths of less than 20m below chart datum (but sometimes including channels or other areas greater than 20m deep). However, the sides of these sandbanks, can extend into deeper water up to 60m whilst still being considered the feature (JNCC, 2025).

155. Most of the habitat types recorded across the Array Area are part of the BSH ‘Subtidal sands and gravel’, which is a UK BAP priority habitat (BRIG, 2011) and a habitat of conservation importance in MCZs (JNCC, 2016). Subtidal sands and gravel sediments are the most common habitats found below the level of the lowest low tide around the UK coast. The sands and gravels from the North Sea are largely formed from rock material (BRIG, 2011).

156. Several of the habitats and associated fauna recorded through the grab sampling and / or the seafloor photography, are considered characteristic of the Annex I habitat ‘Sandbanks which are slightly covered by sea water all the time’ for which the Dogger Bank SAC is designated (JNCC, 2023). Typical taxa include polychaete worms, crustaceans, anthozoans, burrowing bivalves, and echinoderms, as well as fish, notably, species of the genus *Callionymus* and *Ammodytes* (European Commission, 2013).

157. Many of the fish and benthic species observed on the sandbanks are widely distributed in other sandy habitats on the continental shelf. Therefore, the fauna of sandbank communities may simply be based on a specialised niche of the sand-associated fauna of the region, rather than being obligate sandbank species, and, as such, occur on other sandy habitats in other regions. It is the local abundance of selected species, such as *Echiichthys vipera*, which are potentially indicative of such habitats (Ellis *et al*., 2011).

158. In this study, one individual of *Callionymus* was recorded through the photographic analysis at nine stations, namely ST118, ST003, ST005, ST006, ST010, ST022, ST024, ST026 and ST048. Fish of the order Pleuronectiformes, which include *Solea solea*, and of the family Ammodytidae, which includes *Ammodytes marinus*, were recorded through the photographic data at station ST075. Fish of the family Gadidae, which include *Gadus morhua* were recorded through the photographic data at 14 stations. Five Ammodytes marinus were also recorded in the grab samples at stations ST037, ST044, ST060 and ST072 for a total of five individuals; a single individual of *Callionymus reticulatus* was recorded in the grab sample at station ST091.

159. Other species reported as indicators of sandbanks are *Philocheras trispinosus* and *Pagurus bernhardus* (Kaiser *et al*., 2004). In this study *P. trispinosus* was not recorded, however, *P. bernhardus* was recorded through the photographic data at the stations where the biotope '*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand' was noted, which was a total of 34 stations throughout the offshore ECC and Array Area.

10.6.1.3.5 Seapens and Burrowing Megafauna

160. Due to observations in both the offshore ECC and Array Area of the sea pen *Pennatula phosphorea* plus mounds and burrows, the presence of the OSPAR listed threatened and/or declining habitat 'sea pens and burrowing megafauna communities' is considered. The potential presence of the Oslo and Paris Commission (OSPAR, 2008) habitat 'Sea pens and burrowing megafauna' was further shown in **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**.

161. To assess the abundance and density of sea pens and burrowing megafauna, the seafloor video was reviewed at half speed to real-time, with visible sea pen taxa, burrows and mounds enumerated. Counts were then converted to the superabundant, abundant, common, frequent, occasional, rare (SACFOR) abundance scale used by the Marine Nature Conservation Review and JNCC to semi-quantitatively record the abundance and density of marine benthic flora and fauna (JNCC, 2015). When assessing density, the SACFOR scale converts 'numbers per m^2' to an abundance category with consideration of the size class of the species (further information of this assessment is found in **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**).

162. Faunal burrows were present along 53 stations in the Offshore Development Area, ranging from 'rare' to 'common'. However, at station ST099 (in the Array Area) faunal burrows were recorded as 'superabundant' and the sediment type was classified as muddy sandy gravel, with cobbles also identified from the photographic data. The biotope assigned to this station was '*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel' (MC3212). Due to the biological community present and the presence of gravel and cobbles, this station was not considered representative of the habitat 'Sea pen and burrowing megafauna communities.

163. At the remaining stations where burrows were present as 'frequent' or 'common', the sediment were classified as sand or small scaled rippled sand from the photographic data. Due to the mobility of the sediments and the biological assemblage present, most of these stations were not considered representative of the habitat 'Sea pen and burrowing megafauna communities'. At four of these stations (ST063, ST066, ST089 and ST121), the sea pen *Pennatula phosphorea* was observed in combination with burrows, and therefore the habitat 'Sea pen and burrowing megafauna communities' may be present. However, these stations were characterised by sand and were all within the multivariate group B which was assigned the biotope complex 'Faunal communities in Atlantic offshore circalittoral sand' (MD521). All four of these stations were located within the Characterisation Area, outside of the primary offshore ECC.

164. See **Section 10.7** for an assessment of impacts on this habitat as a worst-case scenario.

10.6.1.3.6 Ocean Quahog (Artica islandica)

165. Ocean quahogs (*Artica islandica*), which are included in the OSPAR list of threatened and / or declining species and habitats (OSPAR, 2008), were identified at stations ST021 and ST022 and as juveniles in samples from stations ST036; ST047, ST052, ST054 and ST100 of the 2024 benthic survey. Stations ST021 and ST022 are located just outside of the Holderness Offshore MCZ by approximately 6.1km and 8.4km, stations ST036 and ST047 are located just north of the Dogger Bank SAC and ST052, ST054 and ST100 are located within the Dogger Bank SAC, with ST100 being located within the Array Area.

166. *Arctica islandica* is found at extreme low water level but predominately on sublittoral firm sediments including level offshore areas, buried (or part buried) in sand and muddy sand that ranges from fine to coarse grains. See **Section 10.7** for an assessment of impacts on this habitat as a worst-case.

10.6.1.3.7 Other Potentially Sensitive Habitats and Species

167. Anemones of the family Edwardsiidae were recorded from the grab samples at 26 stations, with the highest abundance of 6 individuals at station ST090 . This is of relevance in relation to the UK BAP species Edwardsia timida (JNCC, 2007), which is part of the family Edwardsiidae, and as such may occur within the DBD survey area.

168. Although not discussed further in this chapter, several potentially sensitive fish are found in the Offshore Development Area and assessed further in **Chapter 11 Fish and Shellfish Ecology**.

169. Of the *Ammodytidae*, *Ammodytes marinus* is a UK BAP priority species, as is *Solea solea* (JNCC, 2019), which is part of the *Pleuronectiformes* and as such may occur in the Offshore Development Area. Of the *Gadidae*, *Gadus morhua* is a UK BAP priority species (JNCC, 2019). In addition, *G. morhua* is also on the OSPAR list of threatened and / or declining habitats and species for regions II and III (OSPAR, 2024), the Offshore Development Area being part of OSPAR region II. This species is also on the international union for conservation of nature (IUCN) red list of threatened species as 'vulnerable' (IUCN, 2024). *Gadus morhua* was also recorded through the eDNA analysis of water samples, along with *Melanogrammus aeglefinus* and *Trachurus trachurus*, both of which are listed as 'vulnerable' on the IUCN red list of threatened species (IUCN, 2024).

170. The potentially sensitive fish species of haddock *Melanogrammus aeglefinus*, whiting *Merlangius merlangus*, hake *Merluccius merluccius*, European plaice *Pleuronectes platessa*, Atlantic salmon *Salmo salar*, Atlantic mackerel *Scomber scrombrus*, and Atlantic horse mackerel *Trachurus trachurus* will be assessed further in **Chapter 11 Fish and Shellfish Ecology**.

10.6.1.4 Designated Sites

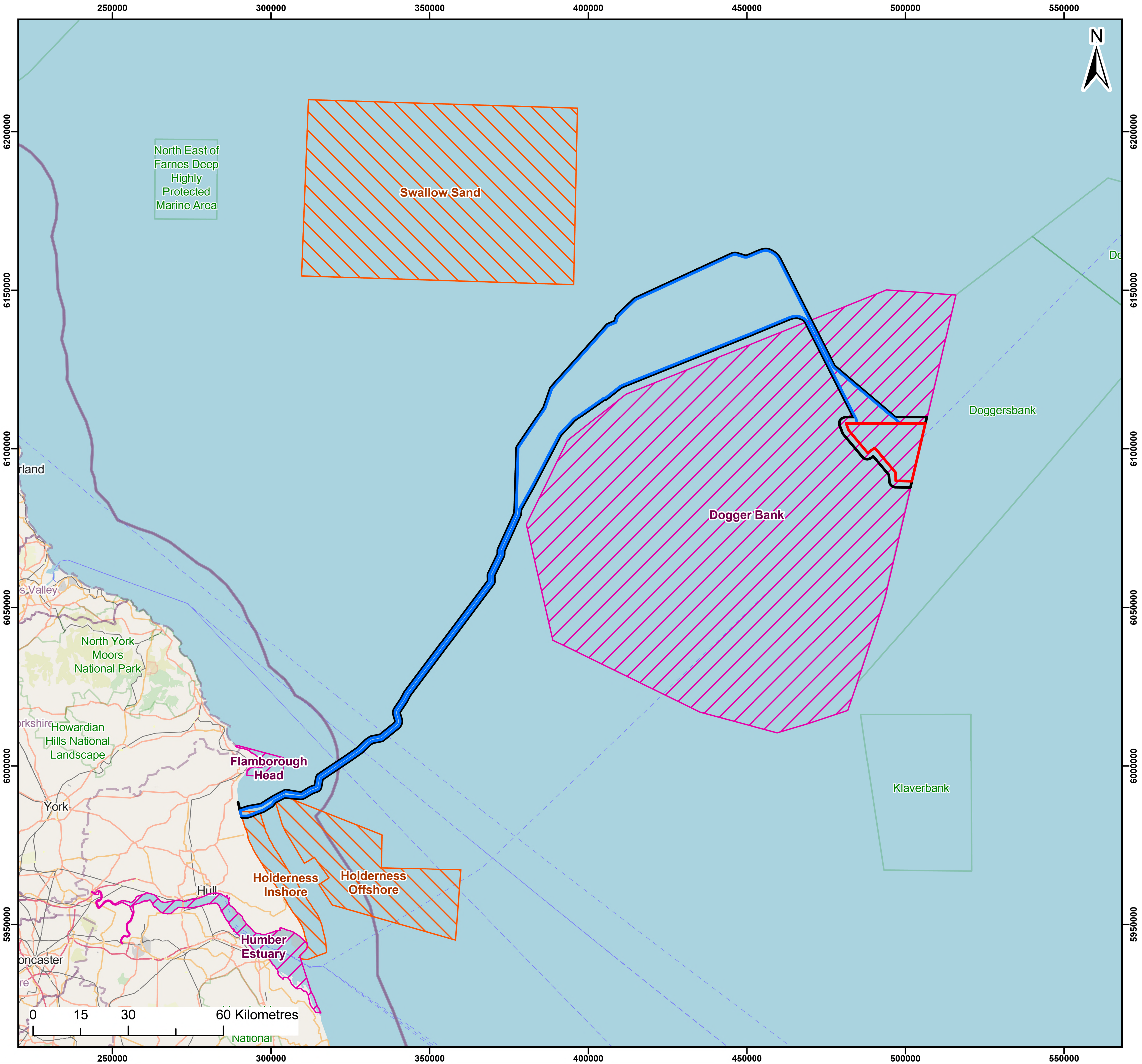
171. The Offshore Development Area lies within / in the vicinity of sites designated for the protection of benthic habitats and species. These sites are detailed in the following section and summarised in **Table 10-16**, which includes their distance from the Project, see **Figure 10-2**. All designated sites are assessed further in the **Marine Conservation Zone Assessment (MCZA)** (document reference 7.11) and the **RIAA** (document reference 5.3).

Table 10-16 Designated Sites for Benthic Features Within / In the Vicinity of the Project

Site	Distance from Project	Designated Features
Dogger Bank SAC	0km (Array Area and part of offshore ECC within SAC)	Annex I Sandbanks which are slightly covered by sea water all the time.
Holderness Inshore MCZ	0km (offshore ECC overlaps MCZ near the landfall area)	EUNIS Habitat Features: • Intertidal sand and muddy sand (A2.2); • High energy circalittoral rock (A4.1); • Moderate energy circalittoral rock (A4.2); • Subtidal coarse sediment (A5.1); • Subtidal sand (A5.2); • Subtidal mud (A5.3); • Subtidal mixed sediments (A5.4); and • Spurn head (subtidal) **Geological feature*.
Holderness Offshore MCZ	0km (offshore ECC overlaps MCZ near the landfall area)	Broad scale habitat: • Subtidal coarse sediment; • Subtidal sand; • Subtidal mixed sediments; • Species feature of conservation importance; and • Ocean quahog (*Arctica islandica*).
Swallow Sands MCZ	Approximately 17km north of the offshore ECC	Broad scale habitat: • Subtidal coarse sediment; • Subtidal sand; and • Geological / Geomorphological feature • North Sea glacial tunnel valley (Swallow Hole)
Flamborough Head SAC	Approximately 4.15km north of the offshore ECC	• Annex I Reefs • Vegetated sea cliffs of the Atlantic and Baltic Coasts • Submerged or partially submerged sea caves
Humber Estuary SAC	40km south of the proposed landfall location	• Estuaries • Mudflats and sandflats not covered by seawater at low tide • Sandbanks which are slightly covered by seawater all the time • Coastal lagoons Salicornia and other annuals colonising mud and sand Atlantic salt meadows (*Glauco Puccinellietalia maritima*).

10.6.1.4.1 Dogger Bank SAC

172. The Dogger Bank SAC is designated for the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time'. The Dogger Bank is an extensive sublittoral sandbank in the southern North Sea formed by glacial processes and submergence through sea-level rise. A large part of the southern area of the bank is covered by water typically no deeper than 20m below chart datum. The bank is non-vegetated and comprises moderately mobile, clean sandy sediments (JNCC, 2019).



Legend:

- Dogger Bank D Array Area
- Offshore Development Area
- Offshore Export Cable Corridor
- Special Area of Conservation
- Marine Conservation Zone

Source: © Haskoning DHV UK Ltd, 2025 © Natural England, 2025; © OpenStreetMap (and) contributors, CC-BY-SA

Project:	
Dogger Bank D Offshore Wind Farm	DOGGER BANK WIND FARM

Title:

Benthic and Intertidal Ecology Designated Sites

Figure:	10-2	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0576		
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	11/04/2025	JH	AB	A3	1:1,200,000

Co-ordinate system: WGS 1984 UTM Zone 31N

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10.6.1.4.2 Holderness Inshore MCZ

173. The Holderness Inshore MCZ is located north of the Humber estuary mouth (DEFRA, 2016). The seabed in this site is made up of rock, sand, mud and sediment. The mosaic of habitats within the site supports a diverse range of organisms including red algae, sponges and other encrusting fauna. The site also supports fish species such as European eel, dab and wrasse, as well as commercially significant crustaceans such as edible and velvet swimming crabs and lobster.

174. Partly above the water, the sandy beaches of intertidal sand and muddy sand are uncovered at low tide. These beaches are home to many species, buried in the damp sand (see **Volume 2, Appendix 10.2 Intertidal Ecology Survey Report**).

10.6.1.4.3 Holderness Offshore MCZ

175. The Holderness Offshore MCZ is located approximately 11km offshore from the Holderness coast (JNCC, 2021). The seabed is dominated by subtidal coarse sediment and hosts subtidal sand, subtidal mixed sediments and part of a glacial tunnel valley. The diverse seabed allows for a wide variety of species which live both in and on the sediment such as, crustaceans (crabs and shrimp), starfish and sponges. This site is also a spawning and nursing ground for a range of fish species for example lemon sole *Microstomus kitt*, plaice *Pleuronectes platessa* and European sprat *Sprattus*. Therefore, the species living both in and on the sediment may benefit from the protection afforded to the habitat features within this site.

176. The slow-growing (but widely occurring) bivalve, Ocean quahog *Arctica islandica* has been found in the site, with one adult specimen of the species being identified during the post-survey site report (Defra, 2017). Ocean quahog is a threatened / declining species of bivalve mollusc that can take up to six years to reach maturity and can live for over 500 years.

10.6.1.4.4 Flamborough Head SAC

177. The Flamborough Head SAC is designated for the Annex I habitats ‘Reefs’, ‘Vegetated sea cliffs of the Atlantic and Baltic Coasts, and ‘Submerged or partially submerged sea caves’. Of the designated habitats for the site, those of interest in relation to potential indirect effects from the Project activities are the areas of reef within the site. The clarity of the relatively unpolluted sea water and the hard nature of the extensive sublittoral chalk habitat have enabled kelp, *Laminaria hyperborea,* forests to become established in the shallow sublittoral zone. The reefs to the north of the site support a different range of species from those on the slightly softer and more sheltered south side of the headland. The site supports an unusual range of marine species and includes rich animal communities and some species that are at the southern limit of their North Sea distribution, e.g. the northern alga *Ptilota plumosa* (JNCC, 2022b).

10.6.1.4.5 Humber Estuary SAC

178. The Humber is the second-largest coastal plain estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. At the time of writing, cable protection will potentially be installed in the nearshore zone which could potentially cause changes to nearshore sediment transport processes and result in impacts to the Humber Estuary SAC (further information within the **RIAA** (document number 5.3)), designated for the following Annex I habitats:

- Estuaries;
- Mudflats and sandflats not covered by seawater at low tide;
- Sandbanks which are slightly covered by seawater all the time;
- Coastal lagoons; and
- Salicornia and other annuals colonising mud and sand Atlantic salt meadows (*Glauco Puccinellietalia maritima*).

10.6.1.5 Other Important Sites

10.6.1.5.1 Smithic Bank

179. The offshore ECC is located to the south of Smithic Bank, a north-east to south-west aligned offshore sand bank. Although Smithic Bank is not a designated site, it is an area of importance for the local environment and therefore the habitats present will be assessed within this chapter, drawing on the conclusions from **Chapter 8 Marine Physical Processes**. Smithic Bank rises to a minimum depth of about 6m below Ordnance Datum (OD). The western inshore flank of the bank is about 5km offshore from Bridlington before the bathymetry deepens down its eastern flank to its edge around 18m below OD. The inshore flank of the bank has a much steeper slope than that of the seaward flank.

180. The extent of Smithic Bank has been delimited by JNCC, as outlined in **Figure 8-18** in **Chapter 8 Marine Physical Processes**. The offshore ECC avoids this area and is located directly to the south. The British Geological Survey’s fine-scale maps of seabed geomorphology Offshore Yorkshire (BGS, 2002) have defined Smithic Bank as a morphological feature and shows it is more limited in extent then that defined by JNCC, located approximately 4km north of the offshore ECC. Surrounding Smithic Bank the seabed is covered by a sheet of sand (BGS Offshore Geoindex, 2024) that partially extends into the offshore ECC. Detailed seabed habitat mapping has shown the seabed in between The offshore ECC and Smithic Bank is characterised by Sublittoral Mud (EUNIS 2012 Code A5.3) (presented on **Figure 8-19** in **Chapter 8 Marine Physical Processes**) which would suggest Smithic Bank as a sedimentary system is disconnected to the patches of sandy sediment within the offshore ECC as mapped by BGS.

10.6.1.6 Invasive / Non-Native Species

181. Invasive non-native species (INNS) are those that have reached the UK by accidental human transport, deliberate human introduction, or which have arrived by natural dispersion from a non-native population in Europe (Government Digital Service [GDS], 2021). Once introduced, some INNS can become established and their subsequent dispersal from the point of introduction can result in environmental and economic impact (Cottier-Cook *et al.*, 2017). The INNS that have a negative impact on biodiversity, through the spread of disease, competition for resources, or by direct consumption, parasitism, or hybridisation, are termed 'invasive' (GDS, 2021).

182. The INNS recorded in the grab samples included the polychaete *Goniadella gracilis*. This species was first recorded in 1970 in Liverpool Bay and had been previously reported in South Africa and North America, from where it was originally described. Although the method of introductions is unknown, this species is likely to have been introduced from the United States east coast through trans-Atlantic shipping. In the British Isles, this species is common in Liverpool Bay in sandy gravel at depths greater than 15m and widespread in the southern Irish Sea (Eno *et al.*, 1997) and in Europe it has been recorded in Bay of Douarnenez in France (Ifremer, 2004). In the site-specific survey, two individuals of *G. gracilis* were recorded at station ST137 (within the Array Area), this species has also been noted in the benthic surveys conducted for Dogger Bank South in recent years.

183. The INNS recorded are not included in the invasive species England Biodiversity Indicator for 2021 (Harrower *et al.*, 2021).

10.6.2 Predicted Future Baseline

184. The baseline environment within the Dogger Bank is influenced by the physical processes which exist within the southern North Sea, including waves and tidal currents driving changes in sediment transport and then seabed morphology (see **Section 8.7** in **Chapter 8 Marine Physical Processes**).

185. The current baseline conditions for benthic ecology are currently considered to be relatively stable across Dogger Bank. Datasets from the last three decades in the area, including surveys for the Dogger Bank A, B, C (which directly overlap with DBD Array Area), Sofia (Forewind, 2014), andDogger Bank South (RWE, 2024) offshore wind farms, the original Dogger Bank SAC selection assessment (JNCC, 2011), and a 1995 review of the Dogger Bank by Kröncke & Knust (1995), detail a similar habitat and species composition to that identified by the site-specific surveys for the Project.

186. As a result of The Dogger Bank SAC (Specified Area) Bottom Towed Fishing Gear Byelaw 2022, enacted to protect the entirety of the Dogger Bank SAC from the impacts of bottom-towed fishing gear (MMO, 2022), impacts from such fishing will prevented as long as the byelaw remains in place. It is expected that the prohibition of fishing with bottom-towed gear will result in changes to the benthic and fish communities within the SAC through their recovery from repeated historic disturbance events. This is likely to allow long-lived, slow growing species to recover in the absence of this pressure.

187. Long term established patterns may be affected by climate change driven sea-level rise. Warming sea temperatures and ocean acidification are leading to changes in the composition and geographical distribution of benthic communities, with a general north westerly shift (Hiddink *et al.*, 2015) in the latitudinal ranges of many species.

188. Despite the currently stable baseline, long term analyses of the current communities of North Sea benthos have led to the conclusion that they are under severe threat from climate change. Sea bottom temperature has increased by 1.6°C between 1980 and 2004 (Dulvy *et al.*, 2008) and sea surface temperature (SST) has increased by ~0.06°C yr^1 when the average global SST rise is 0.017±0.005 (Good *et al.*, 2007). Using predictions for increasing ocean temperature, the populations of key benthic species are likely to change over time, with key indicator species such as *A. filiformis* potentially being replaced by species more suited to the warming of bottom water temperature predicted to occur (Weinert *et al.*, 2021).

189. Given the uncertainties in the effects of the removal of historic pressure on the benthos, it is unclear how the benthos will change and how rapidly this will happen.

10.7 Assessment of Effects

190. The likely significant effects to benthic and intertidal ecology receptors that may occur during construction, O&M, and decommissioning of the Project are assessed in the following sections. The assessment follows the methodology set out in **Section 10.5.3** and is based on the realistic worst-case scenarios defined in **Section 10.4.4**, with consideration of embedded mitigation measures identified in **Section 10.4.3**.

191. As described in **Section 10.5.3**, the sensitivities of benthic receptors have been assessed using the MarESA method. The MarESA method assesses sensitivity of biotopes identified in the survey area. Where habitats or biotope complexes have been identified at high-level EUNIS classifications based on physical parameters only, biotopes commonly found within these habitats have been used to assess the sensitivities as a proxy.

10.7.1 Potential Effects during Construction

10.7.1.1 Temporary Habitat Loss / Physical Disturbance (BEN-C-01)

10.7.1.1.1 Offshore Zone

192. During construction there will be disturbance within the Offshore Zone due to cable laying operations, jack-up operations, construction works for foundations and UXO clearance. This will cause temporary habitat loss and physical disturbance to the seabed.

193. Where disturbed sediments (e.g. preparation areas for foundations) are subsequently covered with infrastructure, habitat loss will be for the 35-year duration of the Project. As such, habitat loss / alteration has been assessed as an operational impact in **Section 10.7.2.2**, and is not considered further here.

10.7.1.1.1.1. Receptor Sensitivity

194. The sensitivity of the biotopes identified within the Offshore Zonehave been assessed in relation to MarESA pressures relevant to the construction phase and temporary habitat loss / physical disturbance:

- Habitat structure changes – removal of substratum (extraction);
- Abrasion / disturbance of the surface of the substratum or seabed; and
- Penetration or disturbance of the substratum subsurface.

195. The sensitivity of identified habitats and biotopes to temporary physical disturbance (including sediment deposition and smothering) pressures are summarised in **Table 10-17**. Note that the sensitivity definitions presented in **Table 10-17** (and following tables referring to the sensitivity of biotopes to potential impacts) have been taken directly from the assessments presented on the MarLIN website. It should also be noted that MarESA sensitivity information was not available for the habitat ‘circalittoral coarse sediment’ due to its high-level classification. As such, the nearest available proxy biotope, ‘*Pomatoceros triqueter* with barnacles and bryozoan crusts on Atlantic circalittoral unstable cobbles and pebbles’, was selected by expert judgement (detailed in **Table 10-17** to represent the sensitivity of this habitat.

196. **Section 10.5.3.1** highlights that sensitivity is primarily based upon the ecological sensitivity of the receptor to an effect, and this is based on the MarESA biotope sensitivities. Although there are some stations where burrows were present within the Dogger Bank SAC, these locations were not representative of the habitat ‘seapen and burrowing megafauna’. Whilst the value of being part of the designated feature can be used as a modifier to increase sensitivity, this is not automatically done and is subject to expert judgement. Given the ubiquity of the biotopes within the Dogger Bank SAC across the Southern North Sea, it was not considered that the value element was required to modify the sensitivity. Whether these biotopes are within or outwith a designated site is not relevant in this case.

197. The most prevalent biotopes within the OffshoreZone are characteristic of highly disturbed environments, and typically have medium to high recoverability and will therefore recover rapidly from disturbance as a result of construction impacts. However, the biotope ‘Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay’ is more sensitive to physical disturbance, being classed as highly sensitive to removal of substratum and penetration or disturbance of the substratum subsurface. As such, this biotope has the potential to be impacted in the long-term by construction activities. This biotope can be considered as being of medium value given its association with the UK BAP Priority Habitat ‘Peat and clay exposures with piddocks’.

198. ‘Ocean quahog (*Artica islandica*)’ and ‘seapens and burrowing megafauna in Atlantic circalittoral fine mud’ also have a high sensitivity to physical disturbance. Both being highly sensitive to removal of substratum and penetration or disturbance of the substratum subsurface and ocean quahog also being highly sensitive to abrasion / disturbance of the surface of the substratum or seabed. Ocean quahog is a protected feature within the Holderness Offshore MCZ, and therefore is assessed further within the **Marine Conservation Zone Assessment** (document reference 7.11).

199. The remaining identified biotopes (as shown in **Table 10-17**) are considered as being of low value as they are not specifically designated as requiring protection under national or international law. It should be noted that the determination of value for these biotopes remains the same for the entirety of this assessment.

Table 10-17 The Sensitivity of Biotopes to Temporary Physical Disturbance

Receptor	Tolerance	Recoverability	Sensitivity	Confidence Assessment
Impact pressure pathway: Habitat structure changes – removal of substratum (extraction)				
MB3231 – Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)	None	High	**Medium**	Low
MB3235 - *Glycera lapidum* in impoverished Atlantic infralittoral mobile gravel and sand	None	Medium	**Medium**	Medium
MB5233 - *Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic infralittoral sand	None	High	**Medium**	High
MB5236 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand	None	Medium	**Medium**	High
MC1251 - Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay	None	Very Low	**High**	High
MC3212 - *Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in Atlantic circalittoral coarse sand or gravel	None	Medium	**Medium**	Medium
MC3213 - *Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand	None	Medium	**Medium**	Medium
MC5211 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	None	Medium	**Medium**	High
MC5212 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	None	Medium	**Medium**	High
MC5214 - Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment	None	Medium	**Medium**	High
MC5215 - Amphiura brachiata* with Astropecten irregularis and other echinoderms in circalittoral muddy sand	None	Medium	**Medium**	Medium
MC6216 - Seapens and burrowing megafauna in Atlantic circalittoral fine mud	None	Low	**High**	Medium
Ocean quahog (*Artica islandica*)	None	Very Low	**High**	High
Impact pressure pathway: Abrasion / disturbance of the surface of the substratum or seabed				
MB3231 – Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)	High	High	**Not sensitive**	Low
MB3235 - *Glycera lapidum* in impoverished Atlantic infralittoral mobile gravel and sand	Medium	High	**Low**	Low
MB5233 - *Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic infralittoral sand	Low	High	**Low**	High
MB5236 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand	Medium	High	**Low**	Low
MC1251 - Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay	Medium	Very Low	**Medium**	Low
MC3212 - *Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in Atlantic circalittoral coarse sand or gravel	Medium	High	**Low**	Low
MC3213 - *Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand	Medium	High	**Low**	Low

Receptor	Tolerance	Recoverability	Sensitivity	Confidence Assessment
MC5211 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Medium	High	**Low**	Low
MC5212 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	Medium	High	**Low**	Low
MC5214 - Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment	Medium	High	**Low**	Low
MC5215 - Amphiura brachiata* with Astropecten irregularis and other echinoderms in circalittoral muddy sand	Low	Medium	**Medium**	Medium
MC6216 - Seapens and burrowing megafauna in Atlantic circalittoral fine mud	Medium	Low	**Medium**	Low
Ocean quahog (*Artica islandica*)	Low	Very Low	**High**	Medium
Impact pressure pathway: Penetration or disturbance of the substratum subsurface				
MB3231 – Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)	High	High	**Not sensitive**	Low
MB3235 - *Glycera lapidum* in impoverished Atlantic infralittoral mobile gravel and sand	Medium	High	**Low**	Low
MB5233 - *Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic infralittoral sand	Medium	High	**Low**	High
MB5236 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand	Medium	High	**Low**	Medium
MC1251 - Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay	Low	Very Low	**High**	Low
MC3212 - *Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in Atlantic circalittoral coarse sand or gravel	Medium	High	**Low**	Medium
MC3213 - *Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand	Medium	High	**Low**	High
MC5211 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Medium	High	**Low**	Medium
MC5212 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	Medium	High	**Low**	Medium
MC5214 - Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment	Medium	High	**Low**	Medium
MC5215 - Amphiura brachiata* with Astropecten irregularis and other echinoderms in circalittoral muddy sand	Low	Medium	**Medium**	Medium
MC6216 - Seapens and burrowing megafauna in Atlantic circalittoral fine mud	Low	Low	**High**	Low
Ocean quahog (*Artica islandica*)	Low	Very Low	**High**	Medium
**Amphiura brachiata* is currently *Acrocnida brachiata*, but the EUNIS biotope name has retained the species' former name				

10.7.1.1.1.2. Impact Magnitude

200. Together, installation of the inter-array cabling, turbine and OP foundations, and vessel jack-up and anchoring will result in a worst-case temporary disturbance across an area totalling 33,885,742m^2 within the Project (**Table 10-6**). It is worth noting that this disturbance would be episodic, associated with particular locations across the Array Area at any one time and occur over the five-year duration of construction, not as a single event.

201. As detailed previously in **Section 10.6.1**, the biotopes present within the Array Area are typical to those found within the wider Dogger Bank and wider North Sea. Given the Dogger Bank SAC itself measures 12,331km^2 in extent and does not cover the entirety of the Dogger Bank itself, the extent of disturbance within the Array Area is negligible in the context of the wider available habitat (designated and undesignated), representing only 0.002% of the area of the Dogger Bank SAC.

202. Installation of the offshore ECC will result in a worst-case temporary disturbance of 16,637,100m^2 which will occur as a single continuous installation event. The worst-case scenario for temporary disturbance in the array area is 17,248,642m^2. Disturbance in the Array Area would be localised, episodic and occur over the five-year duration of construction, not as a single event.

203. Dredged material from sandwave levelling during the construction phase will be disposed of adjacent to the area where the works are being undertaken to keep the sediment within a similar area and habitat type, meaning the Offshore Development Area will be considered the disposal site. This will be equivalent to a worst-case of 88,256,000m^3 from across the Offshore Development Area; 32,256,000m^3 within the Offshore ECC and 56,000,000m^3 within the Array Area (**Table 10-6**). Such redeposition of dredged material will occur over the course of the entire offshore construction period (between 2029 - 2034 years).

204. Previous studies conducted for the Norfolk Boreas and Vanguard projects on the size of craters left behind after UXO clearance found thatdetonation of a German LMB (GC) Ground Mine (Hexanite) would lead to a crater 21.1m in diameter and 3.3m deep (Ordtek, 2018). Note this study took place in an area with similar conditions to that of Dogger Bank (sandy substrate and similar water depths). This is considered the worst-case scenario in terms of maximum potential crater size.

205. Studies completed for DBA and DBB have demonstrated through recent surveys of UXO removal that crater size reduces rapidly post UXO removal as a result of infilling (Dogger Bank B, 2023). On DBB specifically, a UXO removal campaign was completed in March 2023. Surveys of the craters completed in June 2023 showed that in all cases, the craters had infilled rapidly, and in some cases infilled completely. The slowest infilling crater had infilled halfway, from the original 0.8m crater depth to 0.4m.

206. Using the data from Dogger Bank B (2023), it is shown that the maximum crater diameter was around 5m (approximately 20m^2). Therefore, 100 such clearances would likely equate to a maximum of 2,000m^2, which equates to approximately 0.007% of disturbance from the DBB project within the Dogger Bank SAC. It is not expected this many clearances to occur for the Project during the construction phase across the entirety of the Offshore Development Area. As such, the potential area of UXO clearances within the Dogger Bank SAC is likely to be even lower than that as estimated above. It is not considered that this represents a material consideration for the assessment.

207. While such a detonation would lead to a temporary loss of habitat, due to the dynamic nature of the underlying sediment and strong tidal currents within the Offshore Development Area, craters would be expected to re-fill with sediment over the course of weeks (see Dogger Bank B, (2023) and **Section 8.7** in **Chapter 8 Marine Physical Processes** for further information on seabed recoverability regarding indentations). In addition, the overall spatial extent of any craters resulting from UXO clearance will be negligible in the context of the habitat present in the Dogger Bank and wider North Sea.

208. Due to the temporary, episodic and relatively localised nature of the impact, recoverability of the receptors and extent of the receptors across the wider region, temporary physical disturbance is considered to be of **negligible** magnitude.

10.7.1.1.1.3. Effect Significance

209. Due to the **negligible** magnitude and **low** to **medium** sensitivity for the widespread biotopes to each impact pathway for physical disturbance, the effect is considered to be of **negligible** to **minor adverse** significance for the majority of biotopes from temporary physical disturbance, which is **not significant** in EIA terms.

210. However, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' was identified at five stations within the Array Area. This is a biotope with **high** sensitivity to temporary physical disturbance. While this biotope was rarely encountered within the survey, there still exists the potential for temporary physical disturbance to this biotope.

211. This is the same for ocean quahog and 'seapens and burrowing megafauna' (**Section**), which both have a **high** sensitivity to temporary physical disturbance. It should be noted that the ocean quahog was recorded from visual observations from grab samples at two stations in the offshore ECC and as juveniles in samples from a further three stations in the offshore ECC and one more location as juveniles in the Array Area.

212. 'Seapens and burrowing megafauna', although recorded in more stations, the presence of seapens was only noted within the Characterisation Area, with all the other locations just noting burrows, with the one superabundant area not being considered representative of the habitat 'seapen and burrowing megafauna' (further information in **Section 4.2.6.4** of **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**).

213. However, using the worst-case, due to the **high** sensitivity of 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', 'ocean quahog (*Artica islandica*)' and 'seapens and burrowing megafauna communities' and **negligible** magnitude of the impact, the overall significance of effect is assessed to be **minor adverse,** which is **not significant** in EIA terms.

214. No additional mitigation is proposed due to the negligible to minor adverse significance of effect and given the small areas where the highly sensitive biotopes are located. The overall confidence in this assessment is medium (as per MarESA), based on a balance of confidence levels provided by MarESA (see **Table 10-17**).

10.7.1.1.2 Intertidal Zone

215. Trenchless techniques will be used at the landfall so potential impacts upon the intertidal zone will be avoided. As such, there is no potential for temporary physical disturbance to occur in the intertidal zone as there will be no change and therefore no assessment required.

10.7.1.2 Increased Suspended Sediments and Sediment Re-Deposition (BEN-C-03)

216. Increases in suspended sediment concentrations (SSC) and sediment re-deposition may occur as a result of seabed preparation for the installation of infrastructure in the Array Area and offshore ECC. Activities such as seabed disturbances from jack-up vessels and placement of cable protection are not expected to increase SSC to the extent where there could potentially be a significant effect to benthic ecology receptors. **Chapter 9 Marine Water and Sediment Quality** provides details of changes to SSC and subsequent sediment deposition.

217. Increased SSC loads have the potential to affect benthic ecology receptors by causing physical damage or injury, blocking feeding apparatus and by smothering sessile species upon redeposition.

10.7.1.2.1 Receptor Sensitivity

218. The sensitivity of the biotopes identified in the Offshore Development Area have been assessed in relation to MarESA pressures relevant to construction phase increased SSC and deposition. The relevant pressures are:

- Changes in suspended solids (water clarity); and
- Smothering and siltation rate changes (light).

219. The pressure 'smothering and siltation rate changes (light)' has been used to assess the significance of effect as the MarESA justification for light smothering and siltation is 'up to 5cm'. The sensitivity of identified biotopes to increased suspended sediment pressures are summarised in **Table 10-17**.

220. As shown in **Table 10-18**, all of the identified biotopes are classified as 'low' sensitivity or 'not sensitive' to changes in suspended sediments (water clarity) and smother and siltation rate changes (light) pressure described. Therefore, these biotopes will either not be affected by or will recover rapidly from an increase in SSC and subsequent deposition in relation to water clarity.

Table 10-18 The sensitivity of biotopes to increased SSC

Receptor	Tolerance	Recoverability	Sensitivity	Confidence Assessment
Impact pressure pathway: Changes in suspended solids (water clarity)				
MB3231 – Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)	High	High	**Not sensitive**	Low
MB3235 - *Glycera lapidum* in impoverished Atlantic infralittoral mobile gravel and sand	High	High	**Not sensitive**	Low
MB5233 - *Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic infralittoral sand	Medium	High	**Low**	Low
MB5236 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand	Medium	High	**Low**	Low
MC1251 - Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay	High	High	**Not sensitive**	Low
MC3212 - *Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in Atlantic circalittoral coarse sand or gravel	Medium	High	**Low**	Low
MC3213 - *Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand	High	High	**Not sensitive**	Low

Receptor	Tolerance	Recoverability	Sensitivity	Confidence Assessment
MC5211 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Medium	High	**Low**	Medium
MC5212 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	Medium	High	**Low**	Medium
MC5214 - Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment	Medium	High	**Low**	Low
MC5215 - Amphiura brachiata* with Astropecten irregularis and other echinoderms in circalittoral muddy sand	High	High	**Not sensitive**	Low
MC6216 - Seapens and burrowing megafauna in Atlantic circalittoral fine mud	High	High	**Not sensitive**	Medium
Ocean quahog (*Artica islandica*)	High	High	**Not sensitive**	Medium
Impact pressure pathway: Smothering and siltation rate changes (light)				
MB3231 – Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)	High	High	**Not sensitive**	Low
MB3235 - *Glycera lapidum* in impoverished Atlantic infralittoral mobile gravel and sand	Medium	High	**Low**	Medium
MB5233 - *Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic infralittoral sand	High	High	**Not sensitive**	High
MB5236 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand	Medium	High	**Low**	Medium
MC1251 - Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay	Medium	Medium	**Medium**	Low
MC3212 - *Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in Atlantic circalittoral coarse sand or gravel	Medium	High	**Low**	Low
MC3213 - *Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand	No evidence	No evidence	**No evidence**	Not relevant
MC5211 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	Medium	High	**Low**	Medium
MC5212 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	Medium	High	**Low**	Medium
MC5214 - Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment	Medium	High	**Low**	Medium
MC5215 - Amphiura brachiata* with Astropecten irregularis and other echinoderms in circalittoral muddy sand	Medium	High	**Low**	Medium
MC6216 - Seapens and burrowing megafauna in Atlantic circalittoral fine mud	High	High	**Not sensitive**	Low
Ocean quahog (*Artica islandica*)	High	High	**Not sensitive**	Medium

**Amphiura brachiata* is currently *Acrocnida brachiata*, but the EUNIS biotope name has retained the species' former name

221. The only biotope not to have a low to none sensitivity for smother and siltation rate changes (light) is 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', which has a medium sensitivity to light smothering and siltation rate changes (light). This is due to the short length of the siphons (utilised by the characteristic piddock species to maintain contact with the surface of the seabed) being susceptible to smothering (Tillin and Hill, 2016). The piddock species *Pholas dactylus* has been found to be tolerant of deposition depths of 1cm to 5cm (Knight, 1984).

222. As detailed in **Section 10.6.1**, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' is considered to be of medium value, while the remaining biotopes (outside of ocean quahog and seapens and burrowing megafauna) are considered to be of none-to-low value.

10.7.1.2.2 Impact Magnitude

223. Regional mapping of seabed sediments indicates the array area is dominated by sandy sediments and mixed sediment (see **Section 8.6** in **Chapter 8 Marine Physical Processes**). The seabed sediments of the offshore ECC transition from coarser mixed sediments (sandy gravel and gravelly sand) in the nearshore area to sand-dominated sediments as the offshore ECC approaches the Array Area.

224. It is expected that the coarser sediment found along the offshore ECC will settle rapidly to the seabed following disturbance, in close proximity of the disturbance event. The finer sand that comprises the majority of the array area and easterly extremes of the offshore ECC may stay in suspension within the water column for a longer period of time (see **Figure 8-114** to **Figure 8-116** in **Volume 2, Appendix 8.3 Marine Physical Processes Modelling Report**).

225. Any released fine material will form a plume which would become affected by tidal currents. It is expected that the maximum predicted deposition resulting from a sediment plume will be 10mm to 50mm in localised areas immediately adjacent to the foundation installation area. Outside the area of installation within the Array Area or the offshore ECC, deposition reduces to an average of 1mm to 5mm within 10km of the disturbance and is less than 0.5mm within 35km (see **Figure 8.4** in **Volume 1, Chapter 8 Marine Physical Processes**). Over an installation period of 30 days, changes in seabed level induced by deposition of suspended sediment are persistent for a maximum period of seven days within the foundation installation area and reduce within hours to days with distance from the location of disturbance. This conceptual evidence-based assessment is supported by the findings of a review of the evidence base into the physical impacts of marine aggregate dredging on sediment plumes and seabed deposits (Whiteside *et al*. 1995; John *et al*. 2000; Hiscock and Bell, 2004; Newell *et al*., 2004; Tillin *et al*., 2011; Cooper and Brew, 2013).

226. Overall, increases in SSC are expected to be localised and short-term. Fine suspended sediment may be transported a further distance than coarse sediments, however this is likely to be widely and rapidly dispersed and within the range of natural variability within the region.

227. Given the localised and short-term increases in SSC around the point of discharge, and negligible changes in seabed level expected due to deposition, the magnitude of effect is considered to be **negligible**.

10.7.1.2.3 Effect Significance

228. Due to the **negligible** magnitude and **not sensitive** to **low** sensitivity assessed for these biotopes, the significance of effect for the majority of biotopes is assessed as **negligible adverse**, which is **not significant** in EIA terms.

229. The worst-case effect for the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' is considered to be of **minor adverse** significance from increased SSC, should there be sediment deposition of >50mm (which could only occur in locations immediately adjacent to foundation installation), which is **not significant** in EIA terms.

230. No additional mitigation is proposed due to the negligible significance of effect. The overall confidence in this assessment is medium (as per MarESA), due to the mix of high, medium and low confidence in assessments for the described biotopes.

10.7.1.3 Remobilisation of Contaminated Sediments (Offshore ECC) (BEN-C-05)

231. Sediment disturbance during construction (e.g. through drilling for foundation installation) could lead to the mobilisation of contaminants within sediment which could be harmful to the benthos. This impact was originally scoped out based on site specific survey data showing no exceedances for any contaminants across the old offshore ECC route. However, due to the project changing the offshore ECC route, this impact was scoped back in pending the results of updated site specific surveys (for further information see **DBD Scoping Report** (DBD, 2024)). Information has now been received for the updated 2024 site specific survey (**Volume 2, Appendix 10.3 Benthic Characterisation Survey 2024**), which shows no exceedances for any contaminants in the Project's offshore ECC (see **Volume 2, Appendix 9.2 Marine Sediment Quality Results**). As a worst-case, this is still assessed and discussed in the following sections.

10.7.1.3.1 Receptor Sensitivity

232. The sensitivity of the identified biotopes within the Offshore Development Area to chemical pressures have not been assessed by MarESA.

233. The survey results generally indicate low concentrations of contaminants within the DBD Array Area and offshore ECC (for further information see **Volume 2, Appendix 9.2 Marine Sediment Quality Results**). Although none have been recorded above the regulated amount assessed, contaminant levels would be expected to be higher close to shore, due to the presence of shore-based chemical inputs and the presence of industry and ports and as such this is expected to be similar at the landfall.

234. The results indicate it is unlikely that Environmental Quality Standards for contaminants within the water column would be exceeded. Furthermore, the predominantly sandy coarse nature of the seabed sediments within the Array Area and at locations between the Array Area and landfall significantly reduces the risk of resuspension into the water column and subsequent transportation over long distances.

235. However, the assessments made in **Chapter 9 Marine Water and Sediment Quality** concluded that the magnitude of impact is **absent** and therefore of **no** significance. This is due to the impacts of water quality which, as it is not in a confined area, has a low vulnerability. Due to the size of the water body and its ability to flush and dilute, this receptor has a high capacity to adapt, a high tolerance to change and can recover from changes to water quality parameters.

10.7.1.3.2 Impact Magnitude

236. As detailed in **Chapter 9 Marine Water and Sediment Quality**, overall levels of contaminants were very low across the majority of the Offshore Development Area. This is likely due to the fact that sediment contaminants are typically associated with mud and silt particles, which have limited distribution within the Offshore Development Area. As they are associated with mud and silt particles, any contaminants will not remain in the water column for a significant length of time, and will not travel a great distance from their point of origin. Any contaminant dispersal will occur at very low levels, given the minimal contaminants identified across the Offshore Development Area, with any dispersal remaining under the significant contaminant level thresholds. Therefore, the magnitude of effect is considered to be **negligible**.

10.7.1.3.3 Effect Significance

237. Due to the **negligible** magnitude and **low** sensitivity to the presence of existing contamination, the overall worst-case effect is considered to be of **negligible** significance from the remobilisation and redeposition of contaminated sediments, which is **not significant** in EIA terms. No additional mitigation is proposed due to the negligible significance of effect.

10.7.1.4 Disturbance from Noise and Vibration (BEN-C-07)

238. Underwater noise and vibration from pile driving for the installation of some foundation types, cable installation, UXO clearance, and other construction activities including seabed preparation, rock placement and vessel activity (as described in **Chapter 4 Project Description**) have the potential to impact on benthic ecology receptors.

10.7.1.4.1 Receptor Sensitivity

239. The sensitivity of benthic species to noise and vibration is poorly understood and the MarESA pressures assess the sensitivity of underwater noise changes as Not Relevant for all biotopes noted in **Section 10.6.1**. Studies have tended to focus on crustaceans. Studies have shown that some species, such as the common lobster *Homarus gammarus*, are able to detect sound by utilising their hair-fan organ to act as an underwater vibration receptor (Horridge, 1966). Lovell *et al* (2005) showed that the common prawn *Palaemon serratus* is capable of hearing sounds within a range of 100Hz to 3,000Hz, and the brown shrimp *Crangon crangon*, has shown behavioural changes at frequencies around 170Hz (Heinisch and Wiese, 1987).

240. Further research into the effects of vibration on common benthic species, such as common hermit crab *Pagurus bernhardus*, found that they exhibited behaviours associated with shell rapping (when a hermit crab rapidly and repeatedly makes contact with the shell of another individual in a series of bouts (Briffa and Elwood, 2000)) as a consequence of vibrations within the sediment (Roberts *et al*., 2016). At high amplitudes, individuals lifted their shells, and some left their shell completely. High amplitudes in the study matched levels within those produced by construction works such as pile-driving, therefore further understanding of the effects of vibration is needed.

241. Dannheim *et al.,* (2020) acknowledge that even though there is evidence to suggest a change in behaviour for some benthic species, the effects of noise and vibration is a priority area for future research as we do not know if changes to population structure and distribution may be affected long term.

242. The sensitivity of biotopes identified in the Offshore Development Area have been assessed in relation to the following MarESA pressure relevant to underwater noise and vibration as a result of construction activities:

- Underwater noise changes.

243. There is evidence to suggest that some benthic species perceive and react to noise, however the MarESA sensitivity assessment for all of the biotopes recorded in the Offshore Development Area is that noise impacts are ‘Not Relevant’. ‘Not Relevant’ is recorded where the evidence suggests that there is no direct interaction between the pressure and biotope or characteristic species within. Therefore, the sensitivity of biotopes and species to underwater noise and vibration is considered to be **negligible**.

10.7.1.4.2 Impact Magnitude

244. The spatial extent of disturbance from noise and vibration on benthic receptors is unknown. However, it is likely to be localised to areas in the immediate vicinity of monopile or jacket foundation installation. These installation activities would be intermittent, short term and temporary. Therefore, the magnitude of effect from noise and vibration is considered to be **low**.

10.7.1.4.3 Effect Significance

245. Based on the worst-case **negligible** sensitivity of biotopes and the **low** magnitude of effects of disturbance from noise and vibration on benthic ecology receptors during the construction phase, the significance of effect is assessed as **negligible**, which is **not significant** in EIA terms.

246. No additional mitigation is proposed due to the negligible significance of effect. The overall confidence in this assessment is low, due to the lack of information available on this effect in regard to the species present within the Offshore Development Area.

10.7.2 Potential Effects during Operation

247. Impacts on the intertidal zone have been scoped out of further assessment in regard to the O&M phase of the Project. This is because trenchless techniques will be used to install the cable, ensuring that the cable is buried to a sufficient depth and will not lead to any O&M phase impacts. Therefore there is no potential for exit pit to be located within the intertidal zone, and therefore no cable trenching will be required in the lower intertidal zone. As such no impacts on the intertidal zone will occur.

248. In addition, as impacts from underwater noise during the O&M phase of the Project will be of a lesser magnitude than that during the construction phase due to the lack of noisy activities like pile-driving, UXO detonation and a reduction in vessel traffic (see **Section 10.7.1.4**), the significance of effect for underwater noise and vibration during the construction phase will remain **negligible**.

10.7.2.1 Temporary Habitat Loss / Physical Disturbance (BEN-O-01)

249. Temporary physical disturbance will occur during the O&M phase of the Project through activities such as cable repairs and reburial, foundation repairs, and potentially the deployment of jack up vessels or vessel anchors. The areas disturbed would be extremely small in comparison to during construction. For this impact, it is considered that there is no difference in the worst-case scenario (**Table 10-6**). As such a single assessment is provided that applies to the entire Offshore Development Area.

10.7.2.1.1 Receptor Sensitivity

250. The sensitivity of the biotopes identified in the Offshore Development Area have been assessed in relation to MarESA pressures relevant to construction phase temporary habitat loss / physical disturbance, set out in **Table 10-17**.

251. Whilst there is potential for recurring disturbance during maintenance, these impacts would be at discrete locations and times, and it is highly unlikely that the same stretch of cable or turbine would repeatedly fail. Therefore, recurring disturbance in the same location is considered highly unlikely. The worst-case would be temporary disturbance to the biotopes ‘Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay’, which as detailed previously is highly sensitive to penetration or disturbance of the substratum subsurface.

10.7.2.1.2 Impact Magnitude

252. The impacts from planned maintenance and changes in physical processes would be temporary, localised and small scale and, overall, there would be less impact than during construction.

253. The area of disturbance will be even smaller than that already detailed in **Section 10.6.1**. The temporary habitat loss / physical disturbance is assessed as being 2,976,000m^2 (see **Table 10-6**), which is smaller than that as shown for the construction phase. An indiscernible, temporary change, over a small area of the receptors is anticipated and therefore the magnitude of this effect is considered to be **negligible**.

10.7.2.1.3 Effect Significance

254. Based on the worst-case **medium** sensitivity of biotopes and the negligible magnitude of temporary physical disturbance during the O&M phase, the effect is assessed as **minor adverse** for the Offshore Development Area, which is **not significant** in EIA terms. This has been reached on the basis that each disturbance activity would occur relatively infrequently, would be localised and temporary and that benthic ecology receptors would recover rapidly.

255. No additional mitigation is proposed due to the minor adverse significance of effect. The overall confidence in this assessment is medium based on a balance of confidence provided by MarESA.

10.7.2.2 Habitat Loss / Alteration (BEN-O-02)

256. Habitat loss / alteration will occur during the lifetime of the Project as a result of the presence of foundations, scour and scour protection, and external cable protection installed on the seabed.

10.7.2.2.1 Receptor Sensitivity

257. The sensitivity of biotopes identified in the Offshore Development Area have been assessed in relation to the following MarESA pressure relevant to habitat loss:

- Physical change to another seabed type.

258. Installed infrastructure / protection added will be colonised by species of the existing epibenthic community (such as more mobile species, hydroids and bryozoans). Though the new hard substrate will differ in character from the existing hard substrate of shell fragments, pebbles and occasional cobbles / boulders, so that replacement of natural surfaces with artificial hard substratum may lead to changes in the biotope through changes in species composition, richness and diversity.

259. The sensitivity of the identified biotopes to the impact habitat loss / alteration (BEN-O-02) is summarised in **Table 10-19.**

Table 10-19 The Sensitivity of Biotopes to Physical Change to Another Seabed

Receptor	Tolerance	Recoverability	Sensitivity	Confidence Assessment
Impact pressure pathway: Physical change (to another seabed type)				
MB3231 – Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)	None	Very low	**High**	High
MB3235 - *Glycera lapidum* in impoverished Atlantic infralittoral mobile gravel and sand	None	Very low	**High**	High
MB5233 - *Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic infralittoral sand	None	Very low	**High**	High
MB5236 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand	None	Very low	**High**	High
MC1251 - Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay	None	Very low	**High**	High
MC3212 - *Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in Atlantic circalittoral coarse sand or gravel	None	Very low	**High**	High
MC3213 - *Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand	None	Very low	**High**	High
MC5211 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	None	Very low	**High**	High
MC5212 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	None	Very low	**High**	High
MC5214 - Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment	None	Very low	**High**	High
MC5215 - Amphiura brachiata* with Astropecten irregularis and other echinoderms in circalittoral muddy sand	None	Very low	**High**	High
MC6216 - Seapens and burrowing megafauna in Atlantic circalittoral fine mud	None	Very low	**High**	High
Ocean quahog (*Artica islandica*)	None	Very low	**High**	High
**Amphiura brachiata* is currently *Acrocnida brachiata*, but the EUNIS biotope name has retained the species' former name				

260. **Table 10-19**, the sensitivity of all benthic ecology biotopes identified within the Array Area and offshore ECC to habitat loss / alteration is **high**.

10.7.2.2.2 Impact Magnitude

261. The estimated area of worst-case habitat loss within the Array Area is 2,227,482m^2, representing <0.01% of the Array Area and <0.01% of the area of the Dogger Bank SAC. With the precautionary assumption that up to 20% of the offshore Export Cable may require cable protection, the estimated loss of habitat within the offshore ECC is 1,660,800m^2, representing <0.01% of the offshore ECC. However, as this is a precautionary assumption, and burial is the preferred technique of cable protection this is likely to be lower in reality (see CO24 in **Table 10-4**).

262. Although the effect is long term (up to 35 years), as shown above this represents a discernible portion of the Dogger Bank and wider North Sea with these biotopes being commonly encountered, with the exception of 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', 'ocean quahog' and 'seapens and burrowing megafauna in Atlantic circalittoral fine mud'. Therefore, due to the 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, loss of habitat is considered to be of **negligible** magnitude in relation to the site and the wider region.

10.7.2.2.3 Effect Significance

263. While the biotopes identified within the Array Area and offshore ECC are considered to have a **high** sensitivity to the MarESA pressure 'physical change to another seabed type', the **negligible** magnitude of the impact of habitat loss makes the significance of effect assessed as **minor adverse**, which is **not significant** in EIA terms.

264. No additional mitigation is proposed due to the negligible significance of effect. The confidence in this assessment is high, in line with MarESA.

10.7.2.3 Increased Suspended Sediments and Sediment Re-Deposition (BEN-O-03)

265. Increases in SSC within the water column and subsequent deposition onto the seabed may occur as a result of operation activities. This includes the need for jack-up vessels, cable repair, and replacement and reburial activities.

266. Changes in coastal processes in the area caused by the deployment of wind farm infrastructure may also lead to increased sediment deposition on the seabed. However, it is not expected that there would be significant smothering effects during operation.

267. Significant effects of increased suspended sediment concentrations have been assessed in **Chapter 8 Marine Physical Processes**. The assessment found that the worst-case volumes of sediment released following operation activities are considerably less than in the construction phase.

10.7.2.3.1 Receptor Sensitivity

268. The sensitivity of biotopes has been assessed in relation to MarESA pressures relevant to O&M phase increases in SSC, as set out in **Table 10-17**.

269. Biotopes within the Offshore Development Area were determined to have none-to-low sensitivity, with the only exception being 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay'. This biotope has a **medium** sensitivity to light smothering and siltation rate changes (light). As operation activities are temporary, localised and small scale the same sensitivities that were concluded for the construction phase (**Section 10.7.1.2**) have been applied here.

10.7.2.3.2 Impact Magnitude

270. As described in **Section 10.7.1.2**, increased SSC and subsequent deposition is likely to occur when any form of maintenance is carried out. These are expected to be small in magnitude relative to construction activities, given maintenance activities involve less piling and dredging. Increases in SSC and deposition as a result of O&M phase activities are expected to cause localised and short-term increases in SSC at the point of discharge. However, negligible changes to seabed level due to deposition are expected to be intermittent and temporary in nature throughout the lifetime of the project, and therefore the magnitude of impact is considered to be **negligible**.

10.7.2.3.3 Effect Significance

271. The worst-case sensitivity assessment for the Offshore Development Area is **medium** and the magnitude of impact is **negligible**. Therefore, the significance of effect from increased suspended sediments and subsequent deposition is assessed as **minor adverse**, which is **not significant** in EIA terms.

272. No additional mitigation is proposed due to the negligible significance of effect. The overall confidence in this assessment is medium (as per MarESA), due to the mix of high, medium and low confidence in assessments for the described biotopes.

10.7.2.4 Remobilisation of Contaminated Sediments – Offshore ECC (BEN-O-05)

273. During operational activities, there is a risk of disturbing contaminated sediment and remobilising it back into the water column. However, **Chapter 9 Marine Water and Sediment Quality** assessed the impact in more detail and concluded that there are no elevated levels of contaminants within the sediments and they align with typical levels for the region. Therefore, contaminants do not pose a high risk.

10.7.2.4.1 Receptor Sensitivity

274. The MarESA pressure benchmark for 'Pollution and other chemical changes' is named as 'Exposure of marine species or habitat to one or more relevant contaminants via uncontrolled releases or incidental spills' (Tyler-Walters *et al.*, 2022). Given contaminant levels are within environmental protection standards, marine species and habitats have **negligible** sensitivity to changes that remain within these standards.

10.7.2.4.2 Impact Magnitude

275. As described in **Chapter 9 Marine Water and Sediment Quality**, sediment analysis has been conducted and sediment contamination levels are not to be of significant concern and are low risk in terms of potential impacts on the marine environment.

276. Therefore, there is **negligible** magnitude of impact to benthic ecology receptors from remobilisation of contaminated sediments during operational activities.

10.7.2.4.3 Effect Significance

277. With the biotopes holding **no** sensitivity to contaminated sediment and **negligible** magnitude of impact, a **negligible** effect is determined, which is **not significant** in EIA terms.

278. No additional mitigation is proposed due to the negligible significance of effect. The overall confidence in this assessment is high, due to the surveys undertaken for the Offshore Development Area (see **Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**).

10.7.2.5 Disturbance from Noise and Vibration (BEN-O-07)

279. During O&M works, the majority of disturbance from noise and vibration will occur as a result of vessel activity. There is, however, the possibility that noise produced by operational wind turbines could have an effect on benthic species.

10.7.2.5.1 Receptor Sensitivity

280. As described in **Section 10.7.1.4**, the biotopes identified over the entire offshore development area have MarESA sensitivity of 'Not Relevant' to the impact of underwater noise and vibration. 'Not Relevant' is recorded where the evidence suggests that there is no direct interaction between the pressure and biotope or characteristic species within. Therefore, the sensitivity of biotopes and species to underwater noise and vibration is considered to be **negligible** for all O&M activities.

281. Equally, it is likely that the benthic species in the southern North Sea are habituated to noise created by existing shipping occurring in the area therefore limiting sensitivity to maintenance vessel activities within the Offshore Development Area.

10.7.2.5.2 Impact Magnitude

282. Noise associated with the O&M phase is primarily related to vessel movements on site. The impact of vessel noise on benthic species will be very localised and of a small-scale nature.

283. However, noise produced from the operation of wind turbines has also been considered. Norro *et al* (2011) found that steel pile wind turbines produce a sound pressure level increase of 20dB re 1μ Pa to 25dB re 1μ Pa for a wind farm with 3MW turbines. Measurement data from operational offshore wind farms in the UK, collated in MMO (2014), indicated low noise levels which were broadly comparable to ambient noise at ranges of only a few hundred metres.

284. It is noted that these measurements were taken from smaller wind turbines than those that will be installed for the Project. However, it is considered that, while the distances over which noise would propagate from the wind turbines would likely increase with size, they would still be expected to reach ambient levels within a few hundred metres. **Volume 2, Appendix 12.3 Underwater Noise Modelling Report** provides underwater noise modelling for the Project and shows the effects of operational noise from wind turbines would be within 100m for noise sensitive marine mammal species and therefore the impact ranges for benthic receptors would be significantly less. Therefore, any impact magnitude on benthic receptors would be **low**.

10.7.2.5.3 Effect Significance

285. As the biotopes, and subsequent benthic species within, have **negligible** sensitivity to disturbance from noise and vibration, and the magnitude is concluded **low**, the significance of effect from underwater noise and vibration is assessed as a **negligible** effect which is **not significant** in EIA terms.

10.7.2.6 Interactions of Electromagnetic Fields (BEN-O-08)

286. There is potential for inter-array cables and offshore export cables to produce EMF that interfere with the behaviour of benthic species.

287. The effect of EMFs on benthic species has received increasing interest through a variety of studies conducted both in the field and under controlled environments. Boles and Lohmann (2003) found the Spiny lobster *Panulirus argus* use geomagnetic fields to return to known locations after displacement. Similar responses have been found in subsequent studies. Hutchison, Secor and Gill (2020) found the American lobster *Homarus americanus* showed an increase in exploratory response when exposed to EMF from a High Voltage Direction Current (HVDC) cable compared to their natural geomagnetic response. Similarly, Scott, Harsanyi and Lyndon (2018) found *Cancer pagarus* individuals to have an attraction to EMF sources.

288. In contrast, Love *et al* (2015) found that yellow rock crabs *Metacarcinus anthonyu* and red rock crabs *Cancer productus* have shown no preferences for EMF sources. Further support for the findings from Love *et al* (2017) found no significant differences among fish and invertebrate communities between energised cables, pipe and natural habitat.

10.7.2.6.1 Receptor Sensitivity

289. The sensitivity of biotopes identified in the offshore ECC and the Array Area have been assessed in relation to the MarESA pressure relevant to the impact of EMF:

- Electromagnetic changes.

290. There is a lack of evidence as to the impacts of EMF on benthic species. There is a need for further research so understanding can be complete for how EMF impacts the behavioural, physiological and biological aspects of the benthos.

291. The biotopes identified over the entire Offshore Development Area have a MarESA sensitivity of ‘Not Relevant’ in relation to the impact of EMF. ‘Not Relevant’ is recorded where the evidence suggests that there is no direct interaction between the pressure and biotope or characteristic species within. Therefore, the sensitivity of biotopes and species to EMF is considered to be **negligible**.

10.7.2.6.2 Impact Magnitude

292. The presence of increased EMF will last over the entirety of the O&M phase for the Project, however, indiscernible alteration to baseline EMF levels is predicted. This is due to the cables are planned to be buried in the seabed (where conditions allow) to a target depth of 3.5m (see CO24 in **Table 10-4**). Greater than 0.5m is the depth at which Love *et al* (2017) found that EMF levels for submarine power cables declined to background levels. However, the minimum depth that may be achievable is 0.2m, although this is considered to be in a rare few spots where sediment conditions do not allow for deeper burial. Therefore, the magnitude of the interactions of EMF is considered **low**.

10.7.2.6.3 Effect Significance

293. Due to the **negligible** (not relevant) sensitivity of biotopes present in the offshore ECC and array area, and the **low** magnitude of effect, the overall significance of effect from interactions of EMF is **minor adverse**, which is **not significant** in EIA terms.

294. No additional mitigation is proposed due to the negligible significance of effect. The overall confidence in this assessment is low (as per MarESA), due to the lack of information available on the effects of EMF upon the species present within the Offshore Development Area.

10.7.2.7 Colonisation of Introduced Substrate (BEN-O-11)

295. Artificial hard substrates introduced via infrastructure such as foundations, scour and cable protection could act as potential ‘stepping stones’ or vectors for INNS whereby these species colonise the introduced substrate. This colonisation of marine fauna on introduced hard substrate has been widely recognised across the southern North Sea. Schrieken *et al*. (2013), found that new species were colonising wrecks around the Dogger Bank and Cleaver Bank regions. There were 29 species identified on the wrecks that had not been previously known to reside in the entire Dogger Bank area.

296. Alongside the above, the introduction of hard substrate into an open, sandy marine environment such as that of the southern North Sea, could provide a potentially detrimental transition for benthic communities of hard-bottom or intertidal communities, which is a change from the current communities (Kerckhof *et al*., 2011).

297. Due to a natural lack of hard substrate in the southern North Sea, many species found in such habitats do not naturally occur across the study area (Cameron and Askew, 2011). However, increasing numbers of wrecks, oil and gas rigs, and now offshore wind turbines, may make it possible for more species to successfully colonise and establish communities in sheltered, productive zones.

298. The primary pathway for the potential introduction of INNS is from the use of vessels and infrastructure that has originated from an ecologically different location than the southern North Sea.

299. It should be noted that in line with the embedded mitigation measures outlined in **Section 6.3** of the **Outline PEMP** (document reference 8.6), the risk of spreading INNS during the O&M phase will be reduced by employing a range of industry standard biosecurity measures. As such, the risk of introduction of INNS from operational activities for the Project is limited, with any potential spread of INNS arising from existing species within the Dogger Bank and wider North Sea, such as those found in the site-specific surveys for the Project (see **Section 10.5.2.2**).

300. Though introduction of INNS could occur during construction as infrastructure is installed, it has been assessed in the O&M phase as all the hard substrate would be present and therefore, the significance of effect would be greater in this phase (for further information see **DBD Scoping Report** (DBD, 2024) and **Volume 2, Appendix 10.1 Consultation Reponses for Benthic and Intertidal Ecology**).

10.7.2.7.1 Receptor Sensitivity

301. The sensitivity of biotopes identified in the offshore ECC and the Array Area have been assessed in relation to the MarESA pressure:

- Introduction or spread of invasive non-indigenous species.

302. The sensitivity of identified biotopes to introduction or spread of invasive non-indigenous species pressures are summarised in **Table 10-20**.

Table 10-20 The Sensitivity of Biotopes to Introduction or Spread of INNS

Receptor	Tolerance	Recoverability	Sensitivity	Confidence Assessment
Impact pressure pathway: Introduction or spread of INNS				
MB3231 – Sparse fauna on highly mobile Atlantic infralittoral shingle (cobbles and pebbles)	High	High	**Not sensitive**	Not relevant
MB3235 - *Glycera lapidum* in impoverished Atlantic infralittoral mobile gravel and sand	Medium	Very low	**Medium**	Not relevant
MB5233 - *Nephtys cirrosa* and *Bathyporeia spp*. in Atlantic infralittoral sand	High	High	**Not sensitive**	Not relevant
MB5236 - *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand	High	High	**Not sensitive**	Not relevant
MC1251 - Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay	High	High	**Not sensitive**	Low
MC3212 - *Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in Atlantic circalittoral coarse sand or gravel	Low	Very Low	**High**	Not relevant
MC3213 - *Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand	Low	Very Low	**High**	Not relevant
MC5211 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand	None	Very Low	**High**	Low
MC5212 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand	None	Very Low	**High**	Low
MC5214 - *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment	Medium	Very low	**Medium**	Not relevant
MC5215 - *Amphiura brachiata** with Astropecten irregularis and other echinoderms in circalittoral muddy sand	High	High	**Not sensitive**	Not relevant
MC6216 - Seapens and burrowing megafauna in Atlantic circalittoral fine mud	No evidence	Not relevant	**No evidence**	Not relevant
Ocean quahog (*Artica islandica*)	No evidence	Not relevant	**No evidence**	Not relevant

**Amphiura brachiata* is currently *Acrocnida brachiata*, but the EUNIS biotope name has retained the species' former name

303. Of the identified biotopes, seven are considered **not sensitive** to the introduction of INNS, primarily due to the mobile nature of the sediments upon which the biotopes are based preventing INNS from establishing themselves. The sediments characterising the seven biotopes are likely to be too mobile or otherwise unsuitable for most of the invasive non-indigenous species currently recorded in the UK.

304. Of the remaining habitats, two are of **medium sensitivity**, four of **high sensitivity** and two with no evidence (**Table 10-20**). The species of particular concern in the North Sea for impacting the four biotopes with high sensitivity include the American slipper limpet *Crepidula fornicate,* colonial ascidian *Didemnum vexilluim* and the whelk *Rapana venose*, whereby all species which may be able to establish themselves and lead to a reduction in the characteristic bivalve populations. Or, in the case of *D.vesillum*, smother the existing habitat (Tillin, 2022a, Tilling, 2022b).

305. *C. fornicata* was introduced to the UK and Europe in the 1870s from the Atlantic coasts of North America with imports of the eastern oyster *Crassostrea virginica*. It was recorded in Liverpool in 1870 and the Essex coast in 1887-1890. It has spread through expansion and introductions along the full extent of the English Channel and into the European mainland (Blanchard, 1997, 2009; Bohn *et al*., 2012, 2013a, 2013b, 2015; De Montaudouin *et al*., 2018; Helmer *et al*., 2019; Hinz *et al*., 2011; McNeill *et al*., 2010; Powell-Jennings & Calloway, 2018; Preston *et al*., 2020; Stiger-Pouvreau & Thouzeau, 2015).

306. Bohn *et al.* (2015) demonstrated that *C. fornicate* preferred gravelly habitats, while De Montaudouin & Sauriau (1999) and Bohn *et al.* (2015) noted that *C. fornicate* densities were low in intertidal coarse sediments. Therefore, *C. fornicate* has the potential to colonise, and modify the habitat and its associated community due to the introduction of *C. fornicate* shell biomass, silt, pseudofaeces and faeces (Blanchard, 2009; Tillin *et al.,* 2020), as occurs in maerl gravels (Grall & Hall-Spencer, 2003) resulting in the loss of the biotope.

307. The coarse sediment habitat that *C. fornicate* could colonise in the Offshore Development Area is very wave exposed to moderately exposed, in which wave action and storms may mobilise the sediment (JNCC, 2022a), which may mitigate or prevent colonisation by *C. fornicate* at high densities, although *C. fornicate* has been recorded from areas of strong tidal streams (Hinz *et al*., 2011). Therefore, the habitat may be more suitable for *C. fornicate* where water movement is meditated by tidal flow rather than wave action, e.g. the deeper examples of the biotope, but *C. fornicate* might not reach high densities. However, *C. fornicate* reduced the density of suspension feeders and mobile Crustacea in coarse sediment even at low densities (De Montaudouin & Sauriau, 1999).

308. It should be noted that there is no existing evidence for the spread of these species being facilitated by offshore wind developments, with D. vexillum, for example, typically being spread via shipping and aquaculture activities (Marine Scotland, 2021).

309. The biotopes below have a high sensitivity to INNS (**Table 10-20**), therefore, as a worst-case the sensitivity for this impact is assessed as **high**:

- MC3212 - *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel;
- MC3213 - *Protodorvillea kefersteini* and other polychaetes in impoverished Atlantic circalittoral mixed gravelly sand;
- MC5211 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand; and
- MC5212 - *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand.

10.7.2.7.2 Impact Magnitude

310. The risk of spreading INNS will be reduced by employing biosecurity measures in accordance with the regulations detailed in **Table 10-1**. As noted in habitat loss / alteration (**Section 10.7.2.2**), although the effect is long term, it is over a small proportion of the total benthic ecology resource due to the presence of comparable biotopes within the wider Southern North Sea. Therefore, the magnitude of effect is **negligible**.

10.7.2.7.3 Effect Significance

311. As the sensitivity of present biotopes across the Offshore Development Area is **high** and the magnitude of effect is **negligible** (apart from biotope MB3235), the overall significance of effect from the colonisation and introduction of INNS is **minor adverse**, which is **not significant** in EIA terms. Therefore no additional mitigation is proposed. The confidence in this assessment is high (as per MarESA).

10.7.3 Potential Effects during Decommissioning

312. No decision has been made regarding the final decommissioning strategy for the offshore infrastructure, as it is recognised that regulatory requirements and industry best practice change over time.

313. Commitment ID CO21 in **Volume 2, Appendix 6.3 Commitments Register**, requires an Offshore Decommissioning Plan to be prepared and agreed with the relevant authorities prior to the commencement of offshore decommissioning works. This will ensure that decommissioning benthic and intertidal ecology impacts will be assessed in accordance with the applicable regulations and guidance at that time of decommissioning where relevant, with appropriate mitigation implemented as necessary to avoid significant effects.

314. The detailed activities and methodology for decommissioning will be determined later within the Project's lifetime, but would be expected to include:

- Removal of all the wind turbine components and part of the foundations (those above seabed level);
- Removal of some or all of the array and export cables; and
- The Inter-Array and Offshore Export Cables will likely be cut at the cable ends and left in-situ below the seabed, and scour and cable protection would likely be left in-situ other than where there is a specific condition for its removal.

315. Whilst a detailed assessment of decommissioning impacts cannot be undertaken at this stage, for this assessment, it is assumed that decommissioning is likely to operate within the parameters identified for construction (i.e. any activities are likely to occur within the temporary construction working areas and require no greater amount or duration of activity than assessed for construction). The decommissioning sequence will generally be the reverse of the construction sequence. It is therefore assumed that decommissioning impacts would likely be of similar nature to, and no worse than, those identified during the construction phase.

316. The magnitude of decommissioning effects will be comparable to, or less than, those as assessed during the construction phase. Accordingly, given that all effects were assessed to be **minor adverse** significance, or less, for the identified receptors during the construction phase, it is anticipated that the same would be valid for the decommissioning phase regardless of the final decommissioning methodologies. Therefore, all would be considered as **not significant** in EIA terms.

10.8 Cumulative Effects

317. The cumulative effects assessment (CEA) considers other plans and projects that may act collectively with the Project to give rise to cumulative effects on commercial fisheries receptors. The general approach to the CEA for commercial fisheries involves screening for potential cumulative effects, identifying a short list of plans and projects for consideration and evaluating the significance of cumulative effects. **Chapter 6 Environmental Impact Assessment Methodology** and **Volume 2, Appendix 6.4 Cumulative Effects Screening Report - Offshore** provides further details on the general framework and approach to the CEA.

10.8.1 Screening for Potential Cumulative Effects

318. The first step of the CEA identifies which impacts associated with the Project alone, as assessed under **Section 10.7**, have the potential to interact with other plans and projects to give rise to cumulative effects. All potential cumulative effects to be taken forward in the CEA are detailed in **Table 10-21** with a rationale for screening in or out. Only impacts determined to have a residual effect of negligible or greater are included in the CEA. Those assessed as 'no impact' are excluded, as there is no potential for them to contribute to a cumulative effect.

10.8.2 Screening for Other Plans / Projects

319. The second step of the CEA identifies a short-list of other plans and projects that have the potential to interact with the Project to give rise to significant cumulative effects during the construction and O&M phases. The short-list provided in **Table 10-22** has been produced specifically to assess cumulative effects on benthic and intertidal ecology receptors. The exhaustive list of all offshore plans and projects considered in the development of the Project's CEA framework is provided in **Volume 2, Appendix 6.4 Cumulative Effects Screening Report - Offshore**.

320. Developments that were fully operational during baseline characterisation, including at the time of site-specific surveys, are considered as part of baseline conditions for the surrounding environment. It is assumed that any residual effects associated with these developments are captured within the baseline information. As such, these developments are not subject to further assessment within the CEA and excluded from the screening exercise presented in **Table 10-22**.

321. For developments that were not fully operational, including those in planning / pre-construction stages or under construction, during baseline characterisation and operational developments with potential for ongoing impacts, these are included in the screening exercise presented in **Table 10-22**. The screening exercise has been undertaken based on available information on each plan or project as of 9th December 2024 and will be reviewed and updated for the ES. Information has been obtained from:

- MMO Public Register (Marine case management system - Public register - MCMS);
- MD-LOT Marine Licence Applications Portal (All applications | marine.gov.scot);
- Planning Inspectorate, National Infrastructure Planning Portal (National Infrastructure Planning);
- East Riding of Yorkshire Council planning website (Planning permission and building control);
- Hull City Council planning website (www.hull.gov.uk/planning-applications/planning);
- 4C Offshore website (Global Offshore Renewables Map | 4C Offshore);
- UK Offshore Wind Report 2023 (UK Offshore Wind Report 2023);
- Offshore wind farm specific websites;
- The Crown Estate Aggregates Portal (Aggregates Site Agreements (England, Wales & NI), The Crown Estate | The Crown Estate Open Data Portal);
- North Sea Transition Authority UKCS Lease Agreements (UKCS Lease Agreements);
- Cefas UK Disposal Sites (Cefas Data Portal - View);
- KIS-ORCA Infrastructure Map (Map | KIS-ORCA);
- North Sea Transition Authority Offshore Activity Map (Offshore Activity);
- UK Government EIA Submissions and Decisions (EIA Submissions and Decisions - Search - GOV.UK);
- UKHO Military Practice Areas (Additional Military Layers | ADMIRALTY); and
- SCCS Global CCS Map (Global CCS Map | SCCS Corporate).

322. The ZOI used to identify relevant plans and projects for the benthic and intertidal ecology CEA is 28km from the Offshore Development Area. This distance has been used as it encompasses two tidal ellipses (14km at their maximum in the Offshore Development Area). Two tidal ellipses are used as it relates to one maximum tidal excursion ellipse that is then doubled to consider effects from the Project and the other projects as described in **Section 10.4.1**.

Table 10-21 Benthic and Intertidal Ecology – Potential Cumulative Effects

Impact ID	Impact and Project Activity	Potential for Cumulative Effects	Rationale
Construction			
BEN-C-01	Temporary habitat loss / physical disturbance from installation of foundations, cables, seabed preparation, sandwave levelling and indentations on the seabed from jack-up vessels.	Yes	Temporary physical disturbance from construction activities for nearby projects could result in a cumulative effect on benthic receptors.
BEN-C-03	Increased SSC and sediment re-deposition from installation of foundations, cables and any erosion or other protection.	Yes	Increased SSC from nearby projects could result in a cumulative effect on benthic receptors.
BEN-C-05	Remobilisation of contaminated sediments from installation of export cables into the seabed.	No	Due to no contaminants identified during surveys for the Project, no cumulative effects are predicted for the remobilisation of contaminated sediments.
BEN-C-07	Disturbance from noise and vibration from pile driving during construction activities, UXO clearance.	Yes	Disturbance from noise and vibration generated construction activities for nearby projects could result in a cumulative effect on benthic receptors.
Operation and Maintenance			
BEN-O-01	Temporary habitat loss / physical disturbance from maintenance activities, cable repairs and reburial.	Yes	Temporary habitat loss / physical disturbance from construction activities for nearby projects could result in a cumulative effect on benthic receptors.
BEN-O-02	Habitat loss / alteration from presence of foundations, cable / scour protection, any erosion or other protection.	Yes	Habitat loss / alteration in the Dogger Bank SAC and wider area from nearby plans/projects may result in a cumulative effect on benthic receptors.
BEN-O-03	Increased SSC and sediment re-deposition from operation and maintenance activities.	Yes	Increased SSC from nearby projects could result in a cumulative effect on benthic receptors.
BEN-O-05	Remobilisation of contaminated sediments - offshore ECC during operation and maintenance activities.	No	As the impact from remobilisation is negligible for the Project, there will be no cumulative effect.
BEN-O-07	Disturbance from noise and vibration from vessel activity and presence of operational wind turbines.	No	As the impact from noise is negligible for the Project, there will be no cumulative effect.
BEN-O-08	Interactions of EMFs from presence of operational cables.	No	As the impact from EMF is negligible for the Project, there will be no cumulative effect.
BEN-O-11	Colonisation of introduced substrate from presence of sub-sea structures, including foundation structures.	Yes	Presence of hard substrate from nearby projects could provide a surface for INNS to colonise, resulting in a cumulative effect on benthic receptors.
Decommissioning			
There is insufficient information available on other plans and projects which could have a spatial and temporal overlap with the Project's offshore decommissioning works. The details and scope of offshore decommissioning works will be determined by the relevant regulations and guidance at the time of decommissioning and provided in the Offshore Decommissioning Plan (see Commitment ID CO21 in **Volume 2, Appendix 6.3 Commitments Register**). This will include a detailed assessment of decommissioning impacts and appropriate mitigation measures to avoid significant effects, including cumulative effects. For this assessment, it is assumed that cumulative decommissioning effects would be of similar nature to, and no worse than, those identified during the construction phase.			

Table 10-22 Short List of Plans / Projects for the Benthic and Intertidal Ecology Cumulative Effect Assessment

Project / Plan	Development Type	Status	Tier	Construction / Operation Period	Closest Distance to Array Area (km)	Closest Distance to Offshore ECC (km)	Potential for Significant Cumulative Effects	Rationale
East Inshore, North-east Inshore, East Offshore and North-east Offshore Marine Plans	Strategic Plans	Plan	7	-	Overlaps	Overlaps	No	Although there is an overlap spatially, this is a plan for how the sea is used and the individual activities covered by the plan will be assessed where relevant.
Dogger Bank A (EN010021)	Offshore Wind Farm	Under construction	2	2024 - 2025	42.85	Overlap	Yes	There is a spatial but no temporal overlap with the offshore ECC.
Dogger Bank B (EN010021)			2	2024 - 2025	Over 50	Overlap		
Sofia (EN010051)			2	2024 – 2026	17.75	Overlap		
Dogger Bank C (EN100051)			2	2024 - 2026	Adjacent	Overlap		
Hornsea Project Four (EN010098)		Consented	3	2025 - 2029	Over 50	Overlap		There is a spatial and temporal overlap with the offshore ECC.
Ossian (EN0210006)		Pre-planning	6	2026 - 2030	Over 50	Overlap		
Dogger Bank South (EN010125)		Pre-planning	6	2026 - 2032	Over 50	Overlap		
Breagh Platform to shore	Oil and Gas pipeline	Active	1	-	Over 50	24.08	No	Although there is a spatial overlap for some of these projects, the pipelines are already active and therefore part of the baseline. The crossings are already accounted for in the worst-case disturbance as shown in **Table 10-6**.
Shearwater to Bacton Seal pipeline		Active	1	-	Over 50	Overlap		
Apollo to Minerva		Active	1	-	Over 50	27.10		
Eris to Mercury		Active	1	-	Over 50	35.98		
Esmond to Bacton		Active	1	-	Over 50	28.93		
Kilmar routes		Active	1	-	Over 50	24.46		
Johnston routes		Active	1	-	Over 50	41.21		
Johnston Field Extension		Active	1	-	Over 50	47.45		
Langeled to Easington		Active	1	-	Over 50	Overlap		
Mercury to Neptune		Active	1	-	Over 50	31.11		
Easington to Tolmount		Active	1	-	Over 50	13.06		
Cleeton routes		Active	1	-	Over 50	10.30		
Ravenspurn routes		Active	1	-	Over 50	24.35		

Project / Plan	Development Type	Status	Tier	Construction / Operation Period	Closest Distance to Array Area (km)	Closest Distance to Offshore ECC (km)	Potential for Significant Cumulative Effects	Rationale
Rough routes		Active	1	-	Over 50	29.22		
West Sole to Easington		Active	1	-	Over 50	38.62		
Wollaston to Whittle		Active	1	-	Over 50	7.34		
York to Easington		Active	1	-	Over 50	24.48		
Northern Endurance CCS (D/4271/2021)	CCS	In planning	4	2026 – 2029	Over 50	Overlap	Yes	There is a spatial and temporal overlap with the offshore ECC.
Eastern Green Link (EGL 2)	Subsea cables	Under construction	2	2023 - 2028	Over 50	3.85	No	Although there is a spatial overlap, there is no temporal overlap.
Eastern Green Link (EGL 3) (EN0210003)		In planning	6	2028 - 2031	Over 50	Overlap	Yes	There is a spatial and temporal overlap with the offshore ECC.
Eastern Green Link (EGL 4) (EN0210003)		In planning	6	2027 - 2031	Over 50	Overlap		
Tata North Europe		Active	1	-	Over 50	Overlap	No	Although there is a spatial overlap, the cable is already active and therefore part of the baseline. The crossings are already accounted for in the worst-case disturbance as shown in **Table 10-6**.
Pangea North		Active	1	-	Over 50	Overlap	No	
Havhingsten Seg 2.1		Active	1	-	Over 50	Overlap	No	
VSNL Northern Europe (TGN North Europe)		Active	1	-	Over 50	Overlap	No	
UK – Denmark 4		Disused / Removed	1	-	Over 50	Overlap	No	Although there is a spatial overlap, the cable is disused / removed and therefore part of the baseline.
UK – Denmark 6			1	-	Over 50	Overlap	No	

323. It is noted that further information regarding the identified plans and projects may become available between PEIR publication and DCO application submission or may not be available in detail prior to construction. The assessment presented here is therefore considered to be conservative at the time of PEIR. The list of plans and projects will be updated at ES stage to incorporate more recent information at the time of writing.

324. Plans and projects identified in **Table 10-22** have been assigned a tier based on their development status, the level of information available to inform the CEA and the degree of confidence. A seven-tier system based on the guidance issued by Natural England and the Department of Environmental, Food and Rural Affairs (Defra) has been adopted (Parker *et al*., 2022).

325. Each plan or project in **Table 10-22** has been considered on a case-by-case basis. Only plans and projects with potential for significant cumulative effects with the Project are taken forward to a detailed assessment, which are screened based on the following criteria:

- There is potential that a pathway exists whereby an impact could have a cumulative effect on a receptor;
- The impact on a receptor from the Project and the plan or project in consideration has a spatial overlap (i.e. occurring over the same area);
- The impact on a receptor from the Project and the plan or project in consideration has a temporal overlap (e.g. occurring at the same time);
- There is sufficient information available on the plan or project in consideration and moderate to high data confidence to undertake a meaningful assessment; and
- There is some likelihood that the residual effect (i.e. after accounting for mitigation measures) of the Project could result in significant cumulative effects with the plan or project in consideration.

10.8.3 Assessment of Cumulative Effects

326. The CEA assumes the worse-case scenario for benthic and intertidal ecology (**Table 10-6**). Therefore, the construction, operation and decommissioning of the Project is assessed within the CEA.

10.8.3.1 Cumulative Impact 1: Temporary Habitat Loss / Physical Disturbance (BEN-C-01, BEN-O-01, BEN-D-01)

327. There is the potential for cumulative temporary habitat loss / physical disturbance as a result of construction, O&M, and decommissioning activities associated with the Project and other developments. For the purposes of this assessment, this cumulative impact has been assessed within the benthic and intertidal ecology ZOI, which extends 28km around the Offshore Development Area (see **Section 10.4.1**), and represents the furthest distance sediments can travel.

328. As discussed in **Section 10.7.1.1**, the sensitivity of prevalent biotopes within the Offshore Development Area to temporary physical disturbance is considered to be low due to their high recoverability. However, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay' and Ocean quahog (*Artica islandica*), which is present at some stations within the Offshore Development Area have higher sensitivities (medium and high) to temporary physical disturbance. Therefore, these more sensitive biotopes may be impacted by cumulative construction activities. Given that the areas of overlap with other developments screened into the CEA do not overlap with the stations where this biotope was recorded, it is unlikely that a cumulative effect could occur.

329. The Sofia array area is located 17.75km from the Offshore Development Area. Offshore construction of this project has begun, with first power expected by 2026. Therefore, there is no potential for construction overlap with the Project and no pathway for cumulative temporary physical disturbance impacts. This is also the case for Dogger Bank C which is adjacent to the Array Area and currently under construction and is expected to be complete in 2026 (see **Table 10-22**).

330. Hornsea Project Four export cables are proposed to cross the offshore ECC in the nearshore area, approximately 13km from landfall. Offshore construction of Hornsea Project Four is expected to commence in 2026 at the earliest and offshore export cable installation activities will take place between 2027 and 2029 (Ørsted, 2022). The construction of Hornsea Project Four export cables will result in a maximum design scenario temporary habitat disturbance of 36.05km^2 (Ørsted, 2022). However, 35.53% of the Hornsea Project Four ECC falls within the Project's ZOI. It can therefore be assumed that worse case 12.81km^2 temporary habitat disturbance from Hornsea Project Four export cables fall within the Project's ZOI. Even with the spatial overlap, it is unlikely that a temporal overlap in export cable construction activities would occur in the same location at the same time, there are not predicted to be any significant cumulative effects from the construction of Hornsea Four export cables.

331. The ECC of Dogger Bank South overlaps the Project's ZOI running adjacent to the offshore ECC in the nearshore section and crossing with the Dogger Bank South cable approximately 58km offshore. Construction is expected to begin in 2026 through to 2032. There is potential for spatial overlap of the cable corridors, and therefore a pathway for cumulative temporary disturbance effects. The construction of the Dogger Bank South export cables will result in a maximum design scenario temporary habitat disturbance of 36.86km^2 (RWE, 2024). However, 62.15% of the Dogger Bank South ECC falls within the Project's ZOI. It can therefore be assumed that worse case 22.91km^2 temporary habitat disturbance from Dogger Bank South's export cables fall within the Project's ZOI. Even with the spatial overlap, it is unlikely that a temporal overlap in export cable construction activities would occur in the same location at the same time, as a result there are not predicted to be any significant cumulative effects from the construction of Dogger Bank South export cables.

332. The ECC of the Ossian OWF overlaps the Project's ZOI at one point where the corridors cross, approximately 50km offshore. The Ossian OWF has a potential capacity of 3.6GW and is a floating OWF that is located approximately 84km off the east coast of Scotland. Its offshore ECC runs from the Array Area down and connects to England via a grid connection in Lincolnshire. The application for the transmission assets has not yet been submitted and therefore the full information of the projects temporary habitat loss / physical disturbance in relation to the ECC is currently not available. Even with the spatial and potential temporal overlap, it is unlikely that a temporal overlap in export cable construction activities would occur in the same location at the same time, there are not predicted to be any significant cumulative effects from the construction of Ossian export cables.

333. The Northern Endurance CCS scheme's Teeside corridor is proposed to cross the offshore ECC approximately 64km from landfall. The storage area is located approximately 14.5km from the Offshore Development Area. Installation of the pipelines and seabed infrastructure for the CCS project is scheduled to commence in 2026, with the first CO_2 injection anticipated to take place in 2026-2029 (Xodus, 2021). Therefore, there is potential for construction overlap between the Project and a pathway for cumulative temporary disturbance effects. However, construction of the area within 28km of the offshore ECC can be mitigated through coordination with the Northern Endurance CCS developers.

334. EGL3 and EGL4 currently cross the offshore ECC at one point for each project, approximately 39km and 41km offshore, respectively. These projects are currently only at the scoping stage, therefore information on the temporary habitat disturbance is not currently available. However, even with the spatial overlap, it is unlikely that a temporal overlap in export cable construction activities would occur in the same location at the same time, there are not predicted to be any significant cumulative effects from the construction of Hornsea Four export cables.

335. However, given the effects are likely to be intermittent, temporary and short-term, the overlap will lead to minor impacts. As assessed in **Section 10.7.1.1**, the magnitude would not be much greater and therefore the significance of effect is still assessed as **minor adverse**, which is **not significant** in EIA terms.

10.8.3.2 Cumulative Impact 2: Habitat Loss / Alteration (BEN-O-02, BEN-D-02)

336. Cumulative habitat loss / alteration is predicted to occur as a result of the Project's infrastructure and other projects within the Dogger Bank (using the Dogger Bank SAC boundary as a reference). Habitat loss / alteration may result from the physical presence of foundations, scour protection and cable / pipeline protection, which are assumed to be in place for the lifetime of the relevant projects and potentially beyond. Note that the Dogger Bank SAC is used here simply as a discrete geographic unit for this assessment. The assessment of habitat loss / alteration in relation to the Conservation Objectives of the SAC is presented in **RIAA** (document number 5.3).

337. The CEA is based on information that is available at the time and it must be noted that project parameters quoted in respective ESs are often refined during the determination period of the application or post consent during detailed design. Therefore, the assessment presented is considered to be precautionary, with the magnitude of impact on benthic and intertidal ecology expected to be less than that presented here once projects are actually constructed.

338. As presented in **Table 10-23**, the predicted cumulative permanent habitat loss from all schemes is estimated to be 0.16% of the Dogger Bank or 19.83km^2 (using the Dogger Bank SAC boundary as a reference). While the cumulative impact from habitat loss / alteration will be locally significant and comprise a long-term or permanent change in seabed habitat within the footprint of the structures, the footprint of the area affected is highly localised.

339. In addition, Department for Business, Energy & Industrial Strategy (BEIS (2019)) estimated that other infrastructure (cables, and oil and gas infrastructure) accounted for approximately 1.7km^2 of habitat loss / alteration within the Dogger Bank SAC. In total, the habitat loss based on the BEIS estimates and the Applicant's own calculations (**Table 10-23**), equates to 0.17% of the area.

340. Given that the habitats and characterising biotopes observed within the Offshore Development Area are common and widespread throughout the Dogger Bank, and that the percentage area of the Dogger Bank SAC affected by habitat loss is small, the magnitude of impact is assessed as **negligible**.

Table 10-23 Predicted and as Built Habitat Loss / Alteration for Screened in Operational Schemes within the Dogger Bank (using the Dogger Bank SAC area of 12,331km² as a reference)

Scheme	Total predicted or as built habitat loss (km²)	Percentage of habitat loss (%)	Cumulative percentage of habitat loss
DBD*	2.25	0.020	0.13% (or 15.79km²)
DBS East	1.02	0.008	
DBS West	0.97	0.008	
DBA	3.36	0.027	
DBB	3.16	0.026	
DBC	2.77	0.022	
Sofia	2.41	0.020	

**Total predicted habitat loss includes that predicted for the Array Area, inter-array cables, and 10.98% of the offshore ECC which falls within the boundary of the Dogger Bank SAC used as a reference.*

341. As the maximum sensitivity of biotopes in the Offshore Development Area was assessed as **high** (**Section 10.7.2.2**), the same can be assumed for other biotopes within the Dogger Bank, and the magnitude of impact is **negligible**. It is therefore concluded that the significance of effect from cumulative permanent habitat loss with the Dogger Bank is **minor adverse**, which is **not significant** in EIA terms.

342. It should be noted that in the decommissioning phase, the number of infrastructure pieces and the area this takes up would be much less than that of the operational area due to no items being added and the potential for infrastructure to be removed. As a worst-case, the significance of effect is also assessed as **minor adverse** for the decommissioning phase, which is **not significant** in EIA terms.

10.8.3.3 Cumulative Impact 3: Increased Suspended Sediment Concentrations and Sediment Re-Deposition (BEN-C-03, BEN-O-03, BEN-D-03)

343. There is the potential for cumulative increases in SSC and associated deposition as a result of construction, operation and decommissioning activities associated with the Project and other developments. Where sediment plumes interact, there is likely to be a corresponding increase in SSC at that location over and above what would be expected should the developments be undertaken in isolation. For the purposes of this assessment, this cumulative effect has been assessed within the benthic and intertidal ecology ZOI, which extends 28km around the Offshore Development Area, and represents a precautionary distance that sediments can travel.

344. As discussed in **Section 10.7.1.2**, the sensitivity of prevalent benthic habitats and biotopes to increased SSC is considered to be low due to their high recoverability. However, the biotope 'Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay', is present at some stations within the Offshore Development Area having a higher sensitivity (medium) to increased SSC than others present and thus may be impacted by cumulative construction activities.

345. As with Cumulative Impact 1 (**Section 10.8.3.1**), there is no potential for temporal construction overlaps between the Project and Dogger Bank B, Dogger Bank C, Sofia, or the Northern Endurance project.

346. Hornsea Project Four export cables are proposed to cross the offshore ECC in the nearshore area. Construction of Hornsea Project Four is expected to commence in 2025, whereas the Project could start in 2029. Therefore, there is potential of the construction stages to overlap, although it is highly unlikely for the temporal overlap to occur given the length of the offshore ECC and potential to be constructing in another location than the overlapped location. Cable trenching and sandwave clearance within the Hornsea Project Four's ECC will result the cumulative suspension of up to 10,181,000m³ of sediment (Ørsted, 2022). However, only 35.53% of the Hornsea Project Four ECC falls within the Project's ZOI, therefore the maximum amount of sediment released cumulatively will be considerably less. It can be assumed that worse case 3,617,309m³ of sediment will be suspended from Hornsea Project Four export cables within the Project's ZOI.

347. As discussed in Cumulative Impact 1 (**Section 10.8.3.1**), The Offshore ECC of Dogger Bank South overlaps the Project's ZOI running adjacent to the offshore ECC in the nearshore section and crossing with the Dogger Bank South cable approximately 58km offshore. Construction is expected to begin in 2026 through to 2032. There is potential for spatial overlap of the cable corridors, and therefore a pathway for cumulative temporary disturbance effects. However, only 62.15% of the Dogger Bank South ECC falls within the Project's ZOI. It can therefore be assumed that worse case 22.91km² temporary habitat disturbance from Dogger Bank South's export cables fall within the Project's ZOI. From around 60km offshore, the extent of the sediment plume due to the Project's cable installation reduces from 17.6km to around 9.1km within the Array Area (see **Table 8.3-19** and **Table 8.3-20** in **Volume 2, Appendix 8.3 Marine Physical Processes Modelling Report**). As such there is unlikely to be a spatial overlap of both projects' sediment plumes and therefore no pathway for cumulative impact.

348. Ossian, EGL3 and EGL4, as discussed in Cumulative Impact 1 (**Section 10.8.3.1**), also overlap the Project's ZOI at one crossing for each project. However, the transmission assets EIA for Ossian and the assessments for EGL3 and EGL4 are currently not available. Therefore, it is currently not known of the extent in which these projects may impact SSC and sediment re-deposition. However, there is unlikely to be a spatial overlap of these projects' sediment plumes as the Project will work to ensure there is no temporal overlap, although there is no information known to date and this will be reassessed at ES to determine viability of no temporary overlap. Therefore, no pathway for cumulative impact is expected.

349. Based on **Section 8.6.1.12** in **Chapter 8 Marine Physical Processes** and the modelling used in that chapter, the sediment plume from in the nearshore part of the cable corridor is much more limited in extent and restricted to within a short distance of the cable corridor. The small potential overlap of sediment plumes and it being highly unlikely cable installation activities would occur within the same location and at the same time. Therefore, there are not predicted to be any significant cumulative impacts by increased SSC from the construction of Hornsea Project Four export cables.

350. There is, however, potential for cumulative changes in deposition of SSC due to cable installation where the two ECCs overlap. The maximum predicted deposition at the cable crossing location is up to 3cm due to cable installation activities for the Project, with changes of a similar order of magnitude expected for the Hornsea Project Four, although not reported in the Hornsea Project Four ES. This could result in a cumulative change of <10cm (see **Figure 8-4** in **Chapter 8 Marine Physical Processes**).

351. The habitats within this area have a not sensitive to medium sensitivity to smothering and siltation rate changes (heavy), but it is likely any sediment deposited during cable installation will be transported as bedload and incorporated into the baseline sediment transport regime. Therefore, no significant cumulative impacts by increased SSC (including deposition) from the construction of Hornsea Project Four export cables are predicted.

352. As with Cumulative Impact 1, there are a number of schemes listed in **Table 10-22** which cross the Project's Offshore Development Area. There is the potential exists for some of the respective plumes to interact if construction stages overlap. The cumulative impacts associated with increased SSC from the construction of cables / pipelines are predicted to be temporary and localised (i.e. of small spatial extent) within the site. Therefore, it is anticipated that any effects, once qualified, would result in no significant effect.

353. The cumulative impacts of increased SSC (and deposition), as detailed in the Project's assessment (**Section 10.7.1.2**, **Section 10.7.2.3**, and **Section 10.7.2.4**) are expected to be of local spatial extent, temporary duration, intermittent, and reversible. Fine suspended sediment may be transported a further distance than coarse sediments. However, this is likely to be widely and rapidly dispersed and within the range of natural variability within the region. The magnitude of impacts is therefore considered to be **low**.

354. Based on a **medium** sensitivity and **low** magnitude of impact, cumulatively increased SSC and subsequent deposition would have a **minor adverse** effect on the biotopes and habitats that are present within the ZOI of the Project, which is **not significant** in EIA terms.

10.8.3.4 Cumulative Impact 7: Disturbance from Underwater Noise and Vibration (BEN-C-07, BEN-O-07, BEN-D-07)

355. There is the potential for cumulative disturbance from underwater noise and vibration as a result of construction, operation and decommissioning activities associated with the Project and other developments. For the purposes of this assessment, this cumulative impact has been assessed within the benthic and intertidal ecology ZOI, which extends 28km around the Offshore Development Area, which is considered a precautionary approach with the effects expected to be more localised (see **Section 10.7.1.4**).

356. As discussed in **Section 10.7.1.4** and **Section 10.7.2.5**, the sensitivity and magnitude of prevalent benthic habitats and biotopes to disturbance from underwater noise and vibration is considered to be negligible.

357. As with Cumulative Impact 1 (**Section 10.8.3.1**), there is no potential for temporal construction overlaps between the Project and Dogger Bank B, Dogger Bank C, Sofia, or the Northern Endurance project.

358. Hornsea Project Four does have a temporal overlap but the Array Area is sufficient distanced away to not cause a spatial overlap with disturbance from noise and vibration given the localised effect. However, the vessel activity during cable laying could have a spatial and temporal effect. As discussed above in **Section 10.8.3.3**, no significant cumulative impacts are expected.

359. Dogger Bank South cable installation has the same effect as that discussed for Hornsea Project Four and is also expected to not have a significant cumulative impact. This is expected for EGL 2 too considering vessel activities will have minimal effects of disturbance from noise and vibration as discussed in **Sections 10.7.1.4** and **Section 10.7.2.5**.

360. Based on a **negligible** sensitivity and **negligible** magnitude of impact, cumulatively disturbance from noise and vibration would have a **negligible** effect on the biotopes and habitats that are present within the ZOI of the Project, which is **not significant** in EIA terms.

10.8.3.5 Cumulative Impact 11: Colonisation of Introduced Substrate (BEN-O-11, BEN-D-11)

361. Colonisation of introduced hard substrates in the form of foundations and scour / cable protection by marine flora and fauna will occur on all projects within the Dogger Bank and wider area. This is of particular note in sedimentary environments like Dogger Bank where availability of suitable substrates for colonisation are very limited.

362. Noting the presence of epifaunal species and colonising fauna found within the Offshore Development Area during the site-specific surveys (**Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report**), it is likely that these fairly common species will also colonise any introduced substrate. However, it is difficult to determine if such a change represents a beneficial or adverse impact. The introduced substrate has the potential to create a 'reef effect', which may be beneficial to certain fish and shellfish species but also may provide potential corridors for the spread of invasive species.

363. The amount of hard substrate introduced to the wider region via these developments will be broadly similar to the habitat loss / alteration areas calculated in **Table 10-23**. Due to this very small area, it is unlikely that a 'reef effect' will occur in the Dogger Bank SAC due to introduced substrate, and therefore the magnitude of impact is negligible.

364. As the sensitivity of the biotopes present within the Offshore Development Area is **high** but the magnitude of impact is **negligible**, the overall significance of cumulative effect from the colonisation of introduced substrate, including non-native species is **minor adverse** which is **not significant** in EIA terms.

10.9 Transboundary Effects

365. As discussed in **Section 10.5.5**, the potential for transboundary effects has been identified in relation to all impacts due to the proximity of the Doggersbank SAC which is under the Netherlands jurisdiction. The designation of this area is the habitat; 'Sandbanks which are slightly covered by sea water all the time'. This is the same habitat as is presently protected under the Dogger Bank SAC. Due to this, all effects screened in for assessment of the Dogger Bank SAC will have the same assessment as that for the Doggersbank SAC, which will be assessed further in the **RIAA** (document number 5.3).

366. In relation to the habitats present adjacent to the Array Area within the Netherlands jurisdiction, it is considered to be a similar habitat as to that assessed for the Array Area. Therefore, all of the assessment of effects results detailed in **Section 10.7** and summarised in **Table 10-27** will be the same for transboundary biotopes. The impacts on these biotopes will be indirect in nature, with no habitat loss associated with physical removal happening outside of British waters. This has also been shown to be the case for the marine physical processes assessment, as shown in **Section 8.9** of **Chapter 8 Marine Physical Processes**.

367. Therefore, it is proposed that no further assessment is required in terms of transboundary effects as the effect significance will be **minor adverse** for all impacts in relation to construction, O&M, and decommissioning of the Project, which is **not significant** in EIA terms.

10.10 Inter-Relationships and Effect Interactions

10.10.1 Inter-Relationships

368. Inter-relationships are defined as effects arising from residual effects associated with different environmental topics acting together upon a single receptor or receptor group. Potential inter-relationships between benthic and intertidal ecology and other environmental topics have been considered, where relevant, within the PEIR. **Table 10-24** provides a summary of key inter-relationships and signposts to where they have been addressed in the relevant chapters. Inter-relationships for impacts during the decommissioning phase will be the same as those outlined above for the construction phase.

Table 10-24 Benthic and Intertidal Ecology – Inter-Relationships with Other Topics

Impact ID	Impact and Project Activity	Related EIA Topic	Where Assessed in the PEIR Chapter	Rationale
Construction				
BEN-C-01 BEN-C-03 BEN-C-05 BEN-C-07	All impacts in relation to all construction activities	**Chapter 11 Fish and Shellfish Ecology**	**Section 10.7.1**.	The benthic environment represents a habitat for many fish and shellfish species. Additionally, a number of benthic species are prey for fish and shellfish. Therefore, impacts on benthic ecology can lead to indirect impacts on fish and shellfish, which are assessed further in **Chapter 11 Fish and Shellfish Ecology**.
BEN-C-03	SSC and deposition in relation to all construction activities	**Chapter 9 Marine Water and Sediment Quality**	Impacts as a result of SSC and deposition are assessed in **Section 10.7.1.2**.	Changes in SSC are assessed in **Section 9.7** of **Chapter 9 Marine Water and Sediment Quality**. Changes in SSC and associated sediment deposition could have potential impacts on benthic habitats and species.

Impact ID	Impact and Project Activity	Related EIA Topic	Where Assessed in the PEIR Chapter	Rationale
BEN-C-05	Remobilisation of contaminated sediments in relation to all construction activities	**Chapter 9 Marine Water and Sediment Quality**	Remobilisation of contaminated sediments during construction is assessed in **Section 10.7.1.3**.	**Section 9.7** of **Chapter 9 Marine Water and Sediment Quality** provides an assessment of the potential for contaminants to be present in the study area. Remobilisation of contaminated sediments and associated deposition could have potential impacts on benthic habitats and species.
Operation and Maintenance				
BEN-O-01 BEN-O-02 BEN-O-03 BEN-O-05 BEN-O-07 BEN-O-08 BEN-O-11	All impacts in relation to all operational activities	**Chapter 11 Fish and Shellfish Ecology**	**Section 10.7.2**.	The benthic environment represents a habitat for many fish and shellfish species. Additionally, a number of benthic species are prey for fish and shellfish. Therefore, impacts on benthic ecology can lead to indirect impacts on fish and shellfish, which are assessed further in **Chapter 11 Fish and Shellfish Ecology**.
BEN-O-03	SSC and deposition in relation to all operational activities	**Chapter 9 Marine Water and Sediment Quality**	Impacts as a result of SSC and deposition are assessed in **Section 10.7.2.3**.	Changes in SSC are assessed in **Section 9.7** of **Chapter 9 Marine Water and Sediment Quality**. Changes in SSC and associated sediment deposition could have potential impacts on benthic habitats and species.
Decommissioning				
BEN-D-01 BEN-D-02 BEN-D-03 BEN-D-05 BEN-D-07 BEN-D-11	All impacts in relation to decommissioning activities	**Chapter 11 Fish and Shellfish Ecology**	**Section 10.7.1**.	The benthic environment represents a habitat for many fish and shellfish species. Additionally, a number of benthic species are prey for fish and shellfish. Therefore, impacts on benthic ecology can lead to indirect impacts on fish and shellfish, which are assessed further in **Chapter 11 Fish and Shellfish Ecology**.
BEN-D-03	SSC and deposition in relation to decommissioning activities	**Chapter 9 Marine Water and Sediment Quality**	Impacts as a result of SSC and deposition are assessed in **Section 10.7.2**.	Changes in SSC are assessed in **Section 9.7** of **Chapter 9 Marine Water and Sediment Quality**. Changes in SSC and associated sediment deposition could have potential impacts on benthic habitats and species.
BEN-D-05	Remobilisation of contaminated sediments in relation to decommissioning activities	**Chapter 9 Marine Water and Sediment Quality**	Remobilisation of contaminated sediments during decommissioning is assessed in **Section 10.7.2**.	**Section 9.7** of **Chapter 9 Marine Water and Sediment Quality** provides an assessment of the potential for contaminants to be present in the study area. Remobilisation of contaminated sediments and associated deposition could have potential impacts on benthic habitats and species.

10.10.2 Interactions

369. The impacts identified and assessed in this chapter have the potential to interact with each other. Potential interactions between impacts are identified in **Table 10-25**. Where there is potential for interaction between impacts, these are assessed in **Table 10-26** for each receptor or receptor group.

Table 10-25 Benthic and Intertidal Ecology – Potential Interactions between Impacts

Construction and Operation and Maintenance

	BEN-C-01	BEN-C-03	BEN-C-05	BEN-C-07	BEN-O-01	BEN-O-02	BEN-O-03	BEN-O-05	BEN-O-07	BEN-O-08	BEN-O-11
Temporary habitat loss / physical disturbance (BEN-C-01)		Yes	Yes	Yes	No	No	No	No	No	No	No
Increased SSCs and re-deposition (BEN-C-03)	Yes		Yes	No	No	No	No	No	No	No	No
Remobilisation of contaminated sediments (Offshore ECC) (BEN-C-05)	Yes	Yes		No	No	No	No	No	No	No	No
Disturbance from noise and vibration (BEN-C-07)	Yes	No	No		No	No	No	No	No	No	No
Temporary habitat loss / physical disturbance (BEN-O-01)	No	No	No	No		No	Yes	Yes	Yes	No	No
Habitat loss / alteration (BEN-O-02)	No	No	No	No	No		Yes	No	No	No	Yes
Increased suspended sediments and sediment re-deposition (BEN-O-03)	No	No	No	No	Yes	Yes		Yes	No	No	No
Remobilisation of contaminated sediments (Offshore ECC) (BEN-O-05)	No	No	No	No	Yes	No	Yes		No	No	No
Disturbance from noise and vibration (BEN-O-07)	No	No	No	No	Yes	No	No	No		No	No
Interactions of EMFs (BEN-O-08)	No	No	No	No	No	No	No	No	No		No
Colonisation of introduced substrate (BEN-O-11)	No	No	No	No	No	Yes	No	No	No	No	

Decommissioning

The details and scope of offshore decommissioning works will be determined by the relevant regulations and guidance at the time of decommissioning and provided in the Offshore Decommissioning Plan (see Commitment ID CO21 in **Volume 2, Appendix 6.3 Commitments Register**).

For this assessment, it is assumed that interactions during the decommissioning phase would be of similar nature to, and no worse than, those identified during the construction phase.

Table 10-26 Interaction Assessment – Phase and Lifetime Effects

Receptor	Impact ID	Highest Significance Level			Phase Assessment	Lifetime Assessment
		Construction	Operation	Decommissioning		
Benthic habitats and species within the offshore development area	BEN-C-01 BEN-O-01 BEN-D-01	Minor Adverse	Minor Adverse	TBC – Assumed no greater than construction	**Construction**: No greater than individually assessed impact. **Operation**: No greater than individually assessed impact. **Decommissioning**: No greater than individually assessed impact.	No greater than individually assessed impacts. As with the phase assessment, all potential effects are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases. Effects from decommissioning are temporary in nature, limiting their potential to result in a synergistic or greater impact with those considered in other phases.
Benthic habitats and species within the offshore development area	BEN-O-02 BEN-D-02	Minor Adverse	Minor Adverse	TBC – Assumed no greater than construction	**Construction**: No greater than individually assessed impact. **Operation**: No greater than individually assessed impact. **Decommissioning**: No greater than individually assessed impact.	No greater than individually assessed impacts. As with the phase assessment, all potential effects are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases. Effects from decommissioning are temporary in nature, limiting their potential to result in a synergistic or greater impact with those considered in other phases.
Benthic habitats and species within the offshore development area	BEN-C-03 BEN-O-03 BEN-D-03	Minor Adverse	Minor Adverse	TBC – Assumed no greater than construction	**Construction**: No greater than individually assessed impact. **Operation**: No greater than individually assessed impact. **Decommissioning**: No greater than individually assessed impact.	No greater than individually assessed impacts. As with the phase assessment, all potential effects are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases. Effects from decommissioning are temporary in nature, limiting their potential to result in a synergistic or greater impact with those considered in other phases.
Benthic habitats and species within the offshore development area	BEN-C-05 BEN-O-05 BEN-D-05	Negligible	Negligible	TBC – Assumed no greater than construction	**Construction**: No greater than individually assessed impact. **Operation**: No greater than individually assessed impact. **Decommissioning**: No greater than individually assessed impact.	No greater than individually assessed impacts. As with the phase assessment, all potential effects are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases. Effects from decommissioning are temporary in nature, limiting their potential to result in a synergistic or greater impact with those considered in other phases.

Receptor	Impact ID	Highest Significance Level			Phase Assessment	Lifetime Assessment
		Construction	Operation	Decommissioning		
Benthic habitats and species within the offshore development area	BEN-C-07 BEN-O-07 BEN-D-07	Negligible	Negligible	TBC – Assumed no greater than construction	**Construction**: No greater than individually assessed impact. **Operation**: No greater than individually assessed impact. **Decommissioning**: No greater than individually assessed impact.	No greater than individually assessed impacts. As with the phase assessment, all potential effects are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases. Effects from decommissioning are temporary in nature, limiting their potential to result in a synergistic or greater impact with those considered in other phases.
Benthic habitats and species within the offshore development area	BEN-O-08	Minor Adverse	Minor Adverse	TBC – Assumed no greater than construction	**Construction**: No greater than individually assessed impact. **Operation**: No greater than individually assessed impact. **Decommissioning**: No greater than individually assessed impact.	No greater than individually assessed impacts. As with the phase assessment, all potential effects are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases. Effects from decommissioning are temporary in nature, limiting their potential to result in a synergistic or greater impact with those considered in other phases.
Benthic habitats and species within the offshore development area	BEN-O-11 BEN-D-11	Minor Adverse	Minor Adverse	TBC – Assumed no greater than construction	**Construction**: No greater than individually assessed impact. **Operation**: No greater than individually assessed impact. **Decommissioning**: No greater than individually assessed impact.	No greater than individually assessed impacts. As with the phase assessment, all potential effects are non-significant and localised in nature, limiting the potential for different impacts to interact across the different phases. Effects from decommissioning are temporary in nature, limiting their potential to result in a synergistic or greater impact with those considered in other phases.

370. Interactions are assessed by development phase ("phase assessment") to see if multiple impacts could increase the overall effect significance experienced by a single receptor or receptor group during each phase. Following from this, a lifetime assessment is undertaken which considers the potential for multiple impacts to accumulate across the construction, operation and decommissioning phases and result in a greater effect on a single receptor or receptor group. When considering synergistic effects from interactions, it is assumed that the receptor sensitivity remains consistent, while the magnitude of different impacts is additive.

10.11 Monitoring Measures

371. Where required, monitoring requirements will be described, further developed and agreed with stakeholders prior to construction based on the In-Principle Monitoring Plan (IPMP) and taking account of the final detailed design of the Project.

372. Due to the use of the Dogger Bank region by multiple industries, such as offshore wind, oil and gas extraction and commercial fishing, there exists a large amount of existing data on the habitat and species composition of the Dogger Bank, and by association, the Offshore Development Area. Therefore should monitoring requirements be required, it is intended that they are focused on habitats / species where there is substantial uncertainty regarding their presence and / or the predicted effects on them.

10.12 Summary

373. This chapter has provided a characterisation of the baseline environment for benthic and intertidal ecology based on both existing and site-specific survey data.

374. The INNS recorded in the site-specific surveys included the polychaete *G. gracilis*. This species was first recorded in 1970 in Liverpool Bay and had been previously reported from South Africa and North America, from where it was originally described. Although the method of introductions is unknown, this species is likely to have been introduced from the United States east coast through trans-Atlantic shipping. In the British Isles, this species is common in Liverpool Bay in sandy gravel at depths greater than 15m and widespread in the southern Irish Sea (Eno *et al*., 1997) and in Europe it has been recorded in Bay of Douarnenez in France (Ifremer, 2004). In the site-specific survey, two individuals of *G. gracilis* were recorded at station ST137.

375. There are 12 biotopes and five habitats that were identified across the benthic and intertidal ecology survey area, with the biotope *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand (MB5236) and *Amphiura brachiata* with *Astropecten irregularis* and other echinoderms in circalittoral muddy sand (MC5215) typifying the majority of Array Area. The offshore ECC and Characterisation Area were split between a number of the 12 biotopes and five habitats.

376. Some of the habitats and biotopes recorded are, or are representative of, UK BAP priority habitats and include 'Subtidal sands and gravel', 'Piddocks with Sparse Associated Fauna in Sublittoral Very Soft Chalk or Clay', 'seapens and burrowing megafauna' and 'ocean quahog'. Aggregations of cobbles at 15 stations were evaluated for the potential of Annex I habitat 'Reef' (geogenic). The overall assessment for the aggregations of cobbles was of 'low resemblance' or 'medium resemblance' to a stony reef. However, it is unlikely to represent Annex I habitat under the current marine nature conservation legislation.

377. The entirety of the intertidal zone for each potential landfall has been classified as the biotope 'Barren littoral coarse sand' (MA5231) and will be avoided through the adoption of trenchless techniques (see CO23 in **Table 10-4**).

378. The assessment has established that there will be some **minor adverse** residual effects during the construction, operation and decommissioning phases of the Project, all of which are considered **not significant** in EIA terms. Effects are generally localised in nature, being restricted to the Project's boundaries and immediate surrounding area.

379. **Table 10-27** presents a summary of the preliminary results of the assessment of likely significant effects on Benthic and intertidal ecology during the construction, operation and decommissioning of the Project.

10.13 Next Steps

380. Consultation and stakeholder engagement will continue to be undertaken through the ES stage, addressing feedback where relevant on this PEIR chapter. of the chapter will also be updated to consider the updated habitat characterisation report following the updated 2024/2025 benthic surveys.

Table 10-27 Summary of Potential Effects Assessed for Benthic and Intertidal Ecology

Impact ID	Impact and Project Activity	Embedded Mitigation Measures	Receptor	Receptor Sensitivity	Impact Magnitude	Effect Significance	Additional Mitigation Measures	Residual Effect	Monitoring Measures
BEN-C-01	Temporary habitat loss / physical disturbance from installation of foundations, cables, seabed preparation, sandwave levelling and indentations on the seabed from jack-up vessels.	CO23, CO24, CO26	Benthic habitats and species within the offshore development area.	**Low – High**	**Negligible**	**Negligible – Minor Adverse (not significant)**	N/A	**Negligible – Minor Adverse (not significant)**	See **Section 10.4.3**
BEN-C-03	Increased SSC and sediment re-deposition from installation of foundations, cables and any erosion or other protection.	CO23, CO24, CO26		**Not Sensitive - Medium**	**Negligible**	**Negligible – Minor Adverse (not significant)**		**Negligible – Minor Adverse (not significant)**	See **Section 10.4.3**
BEN-C-05	Remobilisation of contaminated sediments from installation of export cables into the seabed.	CO23, CO24, CO26		**Low**	**Negligible**	**Negligible (not significant)**		**Negligible (not significant)**	See **Section 10.4.3**
BEN-C-07	Disturbance from noise and vibration from pile driving during construction activities, UXO clearance.	CO22		**Negligible**	**Low**	**Negligible (not significant)**		**Negligible (not significant)**	See **Section 10.4.3**
BEN-O-01	Temporary habitat loss / physical disturbance from maintenance activities, cable repairs and reburial.	CO23, CO24, CO26, CO28, CO29	Benthic habitats and species within the offshore development area.	**Low – High**	**Negligible**	**Negligible – Minor Adverse (not significant)**	N/A	**Negligible – Minor Adverse (not significant)**	See **Section 10.4.3**
BEN-O-02	Habitat loss / alteration from presence of foundations, cable / scour protection, any erosion or other protection.	CO23, CO24, CO26, CO28, CO29		**High**	**Negligible**	**Minor Adverse (not significant)**		**Minor Adverse (not significant)**	See **Section 10.4.3**
BEN-O-03	Increased SSC and sediment re-deposition from operation and maintenance activities.	CO23, CO24, CO26, CO28, CO29		**Not Sensitive - Medium**	**Negligible**	**Negligible – Minor Adverse (not significant)**		**Negligible – Minor Adverse (not significant)**	See **Section 10.4.3**
BEN-O-05	Remobilisation of contaminated sediments - offshore ECC during operation and maintenance activities.	CO23, CO24, CO26, CO28, CO29		**Negligible**	**Negligible**	**Negligible (not significant)**		**Negligible (not significant)**	See **Section 10.4.3**
BEN-O-07	Disturbance from noise and vibration from vessel activity and presence of operational wind turbines.	CO22		**Negligible**	**Low**	**Negligible (not significant)**		**Negligible (not significant)**	See **Section 10.4.3**

Impact ID	Impact and Project Activity	Embedded Mitigation Measures	Receptor	Receptor Sensitivity	Impact Magnitude	Effect Significance	Additional Mitigation Measures	Residual Effect	Monitoring Measures
BEN-O-08	Interactions of EMFs from presence of operational cables.	CO23, CO24, CO26, CO28, CO29		**Negligible (not relevant)**	**Low**	**Minor Adverse (not significant)**		**Minor Adverse (not significant)**	See **Section 10.4.3**
BEN-O-11	Colonisation of introduced substrate from presence of sub-sea structures, including foundation structures.	CO23, CO24, CO26, CO28, CO29		**Not Sensitive - Medium**	**Negligible**	**Negligible - Minor Adverse (not significant)**		**Negligible – Minor Adverse (not significant)**	See **Section 10.4.3**
Decommissioning									
BEN-D-01 BEN-D-02 BEN-D-03 BEN-D-05 BEN-D-07 BEN-D-11	The details and scope of offshore decommissioning works will be determined by the relevant regulations and guidance at the time of decommissioning and provided in the Offshore Decommissioning Programme (see Commitment ID CO21 in **Volume 2, Appendix 6.3 Commitments Register**). For this assessment, it is assumed that interactions during the decommissioning phase would be of similar nature to, and no worse than, those identified during the construction phase.								

References

BEIS (2019). Record Of The Habitats Regulations Assessment Undertaken Under Regulation 5 Of The Offshore Petroleum Activities (Conservation Of Habitats) Regulations 2001 (As Amended).

British Geological Survey [BGS], (2002). Strategic Environmental Assessment – SEA 2 and 3. (Technical Report 008 Rev1 – Geology). Department of Trade and Industry (DTI) https://assets.publishing.service.gov.uk/media/5a7a2a8340f0b66a2fc005f6/TR-SEA3-Geology.pdf

British Geological Survey [BGS], (2024). BGS Quaternary Deposit Thickness @Offshore Geoindex Accessed 29/07/2024.

Blanchard, M., (1997). Spread of the slipper limpet *Crepidula fornicate* (L.1758) in Europe. Current state and consequences. Scientia Marina, 61, Supplement 9, 109-118. Available from: http://scimar.icm.csic.es/scimar/index.php/secId/6/IdArt/290/

Blanchard, M., (2009). Recent expansion of the slipper limpet population (*Crepidula fornicata*) in the Bay of Mont-Saint-Michel (Western Channel, France). Aquatic Living Resources, 22 (1), 11-19. DOI https://doi.org/10.1051/alr/2009004

Bohn, K., Richardson, C.A., and Jenkins, S.R., (2015). The distribution of the invasive non-native gastropod *Crepidula fornicata* in the Milford Haven Waterway, its northernmost population along the west coast of Britain. Helgoland Marine Research, 69 (4), 313.

Bohn, K., Richardson, C., and Jenkins, S., (2012). The invasive gastropod *Crepidula fornicata*: reproduction and recruitment in the intertidal at its northernmost range in Wales, UK, and implications for its secondary spread. Marine Biology, 159 (9), 2091-2103. DOI https://doi.org/10.1007/s00227-012-1997-3

Bohn, K., Richardson, C.A., and Jenkins, S.R., (2013a). Larval microhabitat associations of the non-native gastropod *Crepidula fornicata* and effects on recruitment success in the intertidal zone. Journal of Experimental Marine Biology and Ecology, 448, 289-297. DOI https://doi.org/10.1016/j.jembe.2013.07.020

Bohn, K., Richardson, C.A. and Jenkins, S.R., (2013b). The importance of larval supply, larval habitat selection and post-settlement mortality in determining intertidal adult abundance of the invasive gastropod *Crepidula fornicata*. Journal of Experimental Marine Biology and Ecology, 440, 132-140. DOI https://doi.org/10.1016/j.jembe.2012.12.008

Boles, L. C. and Lohmann, K. J. (2003). True navigation and magnetic maps in spiny lobsters. Nature, 421 (6918), pp.60–63.

Bos, O.G., Witbaard, R., Lavaleye, M.S.S., Moorsel, G.W.N.M., Teal, L.R., Van Hal, R., Van der Hammen, T., Ter Hofstede, R., Van Bemmelen, R.S.A., Witte, R.H. and Geelhoed, S.C.V., (2011). Biodiversity hotspots on the Dutch Continental Shelf: a marine strategy framework directive perspective (No. C071/11). IMARES.

Briffa, M. and Elwood, R.W., (2000). The power of shell rapping influences rates of eviction in hermit crabs. Behavioural Ecology, 11(3), pp.288-293.

BRIG (2011). UK Biodiversity Action Plan: Priority Habitat Descriptions. JNCC, Peterborough.

Cameron, A. and Askew, N. (2011). EUSeaMap-Preparatory Action for development and assessment of a European broad-scale seabed habitat map final report. EUSeaMap Final Report.

Cefas (2004). Offshore Wind Farms: Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA requirements: Version 2.

Cefas (2010). Strategic Review of Offshore Wind Farm Monitoring Data Associated with FEPA licence conditions, with input from the Food and Environment Research Agency (FERA) and the Sea Mammal Research Unit (SMRU).

Cefas (2012). Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy project [online]. Available at: Guidelines for Data Acquisition to Support Marine Environmental Assessments of Offshore Renewable Energy Projects | Tethys (pnnl.gov) [Accessed August 2024].

Chartered Institute of Ecology and Environmental Management (CIEEM) (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine.

Cooper and Brew, (2013). Impacts on the Physical Environment [online]. Available at: https://www.researchgate.net/profile/David-Brew-2/publication/271836605-Impacts-on-the-Physical-Environment/links/54d370560cf28e06972832e4/Impacts-on-the-Physical-Environment.pdf [Accessed August 2024].

Cottier-Cook, E. J., Beveridge, C., Bishop, J. D. D., Brodie, J. Clark, P. F., Epstein, G., Jenkins, S. R., Johns, D. J. Loxton, J. MacLeod, A., Maggs, C., Minchin, D., Mineur, F., Sewell J. & Wood, C.A. (2017). Non-Native species. Marine Climate Change Impact Partnership [MCCIP]: Science Review, 47-61. doi:10.14465/2017.arc10.005-nns

Dannheim, J., Bergström, L., Birchenough, S.N., Brzana, R., Boon, A.R., Coolen, J.W., Dauvin, J.C., De Mesel, I., Derweduwen, J., Gill, A.B. and Hutchison, Z.L., (2020). Benthic effects of offshore renewables: identification of knowledge gaps and urgently needed research. ICES Journal of Marine Science, 77(3), pp.1092-1108.

De Montaudouin, X. & Sauriau, P.G., (1999). The proliferating Gastropoda *Crepidula fornicate* may stimulate macrozoobenthic diversity. Journal of the Marine Biological Association of the United Kingdom, 79, 1069-1077. DOI https://doi.org/10.1017/S0025315499001319

De Montaudouin, X., Blanchet, H. & Hippert, B., (2018). Relationship between the invasive slipper limpet *Crepidula fornicate* and benthic megafauna structure and diversity, in Arcachon Bay. Journal of the Marine Biological Association of the United Kingdom, 98 (8), 2017-2028. DOI https://doi.org/10.1017/s0025315417001655

Defra (2005). Nature Conservation Guidance on Offshore Windfarm Development. A guidance note on the implications of the EC Wild Birds and Habitats Directives for developers undertaking offshore windfarm developments. Version R1.9. 13.

Defra (2014). East Inshore and East Offshore Marine Plans. Available at: https://www.gov.uk/government/publications/east-inshore-and-east-offshore-marine-plans. [Accessed August 2024].

Defra (2016). Holderness Inshore MCZ Factsheet. [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment-data/file/492320/mcz-holderness-factsheet.pdf [Accessed January 2023].

Defra (2017). Holderness Offshore rMCZ Post-survey Site Report. Contract Reference: MB0120, Report Number: 44. Version 4. February 2017.

DEFRA (2021). Northeast Inshore and North East Offshore Marine Plan. Available at: https://www.gov.uk/government/publications/the-north-east-marine-plans-documents. [Accessed August 2024].

Diesing, M., Ware, S., Foster-Smith, B., Stewart, H., Long, D., Vanstaen, K., Forster, R. and Morando, A., (2009). Understanding the marine environment: seabed habitat investigations of the Dogger Bank offshore draft SAC. Joint Nature Conservation Committee, Peterborough. JNCC Report No. 429, 89 pp., 5 Appendices.

Dogger Bank B (2023). Dogger Bank B UXO crater survey results, June 2023.

Dulvy, N.K., Rogers, S.I., Jennings, S., Stelzenmüller, V., Dye, S.R. and Skjoldal, H.R., (2008). Climate change and deepening of the North Sea fish assemblage: a biotic indicator of warming seas. Journal of Applied Ecology, 45(4), pp.1029-1039.

EEA (2022). EUNIS habitat classification. [Online]. Available at: https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification-1 [Accessed August 2024].

Eggleton, J., Murray, J., McIlwaine, P., Mason, C., Noble-James, T., Hinchen, H., Nelson, M., McBreen, F., Ware, S. & Whomersley, P. (2017). Dogger Bank SCI 2014 Monitoring R&D Survey Report. JNCC/Cefas Partnership Report, No. 11.

Ellis, J.R., Maxwell, T., Schratzberger, M. and Rogers, S.I., (2011). The benthos and fish of offshore sandbank habitats in the southern North Sea. Journal of the Marine Biological Association of the United Kingdom, 91(6), pp.1319-1335.

Eno, N.C., Clark, R. A. & Sanderson W. G. (1997). Non-native marine species in British waters: a review and directory. Joint Nature Conservation Committee [JNCC].

European Union (2013). Council Directive 2013/17/EU. Official Journal of the European Union.
Folk, R.L. (1954). The distinction between grain size and mineral composition in sedimentary-rock nomenclature. The Journal of Geology, 62 (4), pp.344–359.

Forewind (2014). Dogger Bank Creyke Bank Environmental Statement: Chapter 12- Marine and Intertidal Ecology. [Online]. Available at: https://tethys.pnnl.gov/sites/default/files/publications/Dogger-Bank-ES-Chapter-12.pdf [Accessed December 2024].

Golding, N., Dinwoodie, K., Golob, E., O'Connor, J., Taylor, J., van Rein, H. & Webb, K. (2021). The BIG PICTURE II: Benthic Imagery Workshop Report. JNCC Report No. 686, JNCC, Peterborough, ISSN 0963-8091.

Good, S.A., Corlett, G.K., Remedios, J.J., Noyes, E.J. and Llewellyn-Jones, D.T., (2007). The global trend in sea surface temperature from 20 years of advanced very high resolution radiometer data. Journal of climate, 20(7), pp.1255-1264.

Government Digital Service [GDS] (2021). Strategy for England's wildlife and ecosystem services, biodiversity 2020 indicators Trends in pressure on biodiversity - invasive species. [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment-data/file/925441/20-Pressure-from-invasive-species-2020-accessible.pdf [Accessed August 2024].

Grall J. & Hall-Spencer J.M. (2003). Problems facing maerl conservation in Brittany. Aquatic Conservation: Marine and Freshwater Ecosystems, 13, S55-S64. DOI https://doi.org/10.1002/aqc.568

Harrower, C., A., Rorke, S., L. &. Roy, H. E. (2021). England Biodiversity Indicators 2021. Pressure from invasive species. Technical background document. Centre for Ecology & Hydrology. [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment-data/file/1025357/20-TB-Invasive-spp.pdf [Accessed August 2023].

Hein, C.J., FitzGerald, D.M. and Barnhardt, W.A., (2007). Holocene evolution of the Merrimack Embayment, Northern Massachusetts, interpreted from shallow seismic stratigraphy. In Coastal Sediments' 07 (pp. 856-866).

Heinisch, P. and Wiese, K. (1987). Sensitivity to movement and vibration of water in the North Sea shrimp *Crangon crangon* L. Journal of crustacean biology, 7 (3), pp.401–413.

Helmer, L., Farrell, P., Hendy, I., Harding, S., Robertson, M. and Preston, J., (2019). Active management is required to turn the tide for depleted Ostrea edulis stocks from the effects of overfishing, disease and invasive species. PeerJ, 7, p.e6431.

Hiddink, J. G., Burrows, M. T. and García Molinos, J. (2015). Temperature tracking by North Sea benthic invertebrates in response to climate change. Global Change Biology, 21 (1), pp.117–129.

Hinz, H., Capasso, E., Lilley, M., Frost, M. & Jenkins, S.R., (2011). Temporal differences across a bio-geographical boundary reveal slow response of sub-littoral benthos to climate change. Marine Ecology Progress Series, 423, 69-82. DOI https://doi.org/10.3354/meps08963

Hiscock, D.R. and Bell, S. (2004). Physical impacts of aggregate dredging on sea bed resources in coastal deposits. Journal of Coastal Research, 20 (10), 101-114.

HM Government (2011). UK Marine Policy Statement. The Stationery Office Limited. [Online]. Available at: http://www.official-documents.gov.uk/ [Accessed August 2024].

Horridge, G. A. (1966). Some recently discovered underwater vibration receptors in invertebrates. In: Some contemporary studies in marine science: a collection of original scientific papers presented to Dr. SM Marshall in recognition of her contribution with the late Dr. AP Orr to marine biological progress. George Allen and Unwin.

Hutchison, Z. L., Secor, D. H. and Gill, A. B. (2020). The interaction between resource species and electromagnetic fields associated with electricity production by offshore wind farms. Oceanography, 33 (4), pp.96–107.

Ifremer. (2004). Benthic subtidal communities in Bay of Douarnenez (France). Direction d e l'Environnement et de L'Aménagement Littoral Département d'Écologie Côtière Laboratoire Biodiversité Benthique. Available at: https://archimer.ifremer.fr/doc/00431/54254/56103.pdf [Accessed August 2024].

Irving, R. (2009). The identification of the main characteristics of stony reef habitats under the Habitats Directive. Summary report of an inter-agency workshop 26-27 March 2008. p.44. Available at: https://hub.jncc.gov.uk/assets/21693da5-7f59-47ec-b0c1-a3a5ce5e3139 [Accessed August 2024].

IUCN (2024). The IUCN Red List for Threatened Species [online]. Available at: https://www.iucnredlist.org/ [Accessed August 2024].

JNCC (2011). Dogger Bank SAC Selection Assessment. [Online]. Available at: https://data.jncc.gov.uk/data/98f5e14d-7242-4b32-84fe-f110c5e37300/DoggerBank-SelectionAssessment-v9.pdf [Accessed August 2024].

JNCC (2015). SACFOR abundance scale used for both littoral and sublittoral taxa from 1990 onwards [online]. http://www.jncc.defra.gov.uk/page-2684 [Accessed January 2025].

JNCC (2016). UK Biodiversity Action Plan Priority Habitat Descriptions; Subtidal Sands and Gravels [online]. Available at: https://data.jncc.gov.uk/data/c9721550-e422-4181-805d-2a0b58afa9d7/UKBAP-BAPHabitats-54-SubtidalSandsGravels.pdf [Accessed August 2024].

JNCC (2019). Dogger Bank MPA. [Online]. Available at: https://jncc.gov.uk/our-work/dogger-bank-mpa/#relevant-documentation [Accessed [Accessed August 2024].

JNCC (2021). Holderness Offshore MPA [online]. Available at: https://jncc.gov.uk/our-work/holderness-offshore-mpa/ [Accessed August 2024].

JNCC (2022a). The marine habitat classification for Britain and Ireland Version 15.03. https://mhc.jncc.gov.uk/about/

JNCC (2022b). Flamborough Head - Special Areas of Conservation. [Online]. Available at: https://sac.jncc.gov.uk/site/UK0013036 [Accessed [Accessed August 2024].

JNCC (2023). JNCC Marine Habitat Classification. Available at: https://mhc.jncc.gov.uk/ [Accessed August 2024].

JNCC (2025). 1110 Sandbanks which are slightly covered by sea water all the time [online]. Available at: https://sac.jncc.gov.uk/habitat/H1110/#:~:text=Sandbanks%20which%20are%20slightly%20covered%20by%20sea%20water,or%20other%20areas%20greater%20than%2020%20m%20deep%29.

John, S.A., Challinor, S.L., Simpson, M., Burt, T.N. & Spearman, J. (2000). Scoping the assessment of sediment plumes from dredging. CIRIA Publication.

Kaiser, M.J., Bergmann, M., Hinz, H., Galanidi, M., Shucksmith, R., Rees, E.I.S., Darbyshire, T. and Ramsay, K., (2004). Demersal fish and epifauna associated with sandbank habitats. Estuarine, Coastal and shelf science, 60(3), pp.445-456.

Kerckhof, F., Degraer, S. & Rumes, B. (2011). Offshore intertidal hard substrata: a new habitat promoting non-indigenous species in the Southern North Sea: an exploratory study In: Offshore wind farms in the Belgian Part of the North Sea: Selected findings from the baseline and targeted monitoring. Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models, Marine ecosystem management unit, Brussels, pp.27–37.

Knight, J. H. (1984). Studies on the biology and biochemistry of *Pholas dactylus* L.

Krönche, I. & Knust, R. (1995). The Dogger Bank: a special ecological region in the central North Sea. Helgoländer Meeresuntersuchungen, 49, pp.335–353.

Long, D. (2006). BGS detailed explanation of seabed sediment modified Folk classification.

Love, M.S., Nishimoto, M.M., Clark, S. and Bull, A.S., (2015). Identical response of caged rock crabs (genera Metacarcinus and Cancer) to energized and unenergized undersea power cables in Southern California, USA. Bulletin, Southern California Academy of Sciences, 114(1), pp.33-41.

Love, M.S., Nishimoto, M.M., Snook, L., Schroeder, D.M. and Scarborough Bull, A., (2017). A comparison of fishes and invertebrates living in the vicinity of energized and unenergized submarine power cables and natural sea floor off southern California, USA. Journal of Renewable Energy, 2017.

Lovell J.M, Findlaya M.M, Moateb R M and Yanc H.Y (2005). The hearing abilities of the prawn Palaemon serratus. Comparative Biochemistry and Physiology, Part A 140 89 – 100.

Marine Scotland. (2021). The smothering impact of Didemnum vexillum. Available at: https://blogs.gov.scot/marine-scotland/2021/05/28/the-smothering-impact-of-didemnum-vexillum/ [Accessed March 2025].

MarLIN (2021). Marine Evidence based Sensitivity Assessment (MarESA). [Online]. Available at: https://www.marlin.ac.uk/sensitivity/sensitivity-rationale [Accessed August 2024].

McNeill, G., Nunn, J. & Minchin, D., (2010). The slipper limpet *Crepidula fornicate*. Linnaeus, 1758 becomes established in Ireland. Aquatic Invasions, 5 (Suppl. 1), S21-S25. DOI https://doi.org/10.3391/ai.2010.5.S1.006

MMO (2014). Review of Post-Consent Offshore Wind Farm Monitoring Data Associated with Licence Conditions, with input from the British Trust for Ornithology (BTO), National Physical Laboratory (NPL) and the SMRU.

MMO (2022). The Dogger Bank Special Area of Conservation (Specified Area) Bottom Towed Fishing Gear Byelaw 2022. Available at: https://www.gov.uk/government/publications/the-dogger-bank-special-area-of-conservation-specified-area-bottom-towed-fishing-gear-byelaw-2022. [Accessed December 2023].

Natural England (2022). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards; Phase III: Expectations for data analysis and presentation at examination for offshore wind applications.

Newell, R.C., Seiderer, L.J., Robinson, J.E., Simpson, N.M., Pearce, B & Reeds, K.A. (2004). Impacts of overboard screening on sea bed and associated benthic biology community structure in relation to marine aggregate extraction. Technical Report to the Office of the Deputy Prime Minister and Minerals Industry Research Organisation. Project No. SAMP 1.022, Marine Ecological Surveys Ltd, St. Ives, Cornwall.

Norro, A., Rumes, B. and Degraer, S., (2011). Characterisation of the operational noise, generated by offshore wind farms in the Belgian part of the North Sea. Offshore wind farms in the Belgian part of the North Sea. Selected findings from the baseline and targeted monitoring, p.162.

Ordtek. (2018). Strategic Unexploded Ordnance (UXO) Risk Management – Seabed Effects During Explosive Ordnance Disposal (EOD). Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-001533-Appendix%2005.02%20Norfolk%20Vanguard%20Detonation%20Effects%20of%20UXO.pdf. [Accessed August 2024].

Ørsted (2022). Hornsea Project Four Volume A2, Chapter 2: Benthic and Intertidal Ecology. https://infrastructure.planninginspectorate.gov.uk/wpcontent/ipc/uploads/projects/EN010098/EN010098-002021-Hornsea%20Project%20Four%20-%20Other-%20A2.2%20Benthic%20and%20Intertidal%20Ecology.pdf. [Accessed November 2024].

OSPAR Commission (2024). List of Threatened and/or Declining Species & Habitats. https://www.ospar.org/work-areas/bdc/species-habitats/list-of-threatened-declining-species-habitats

Parker, J., Fawcett, A., Banks, A., Rowson, T., Allen, S., Rowell, H., Harwood, A., Ludgate, C., Humphrey, O., Axelsson, M., Baker, A. & Copley, V. (2022). Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications. Natural England. Version 1.2. 140 pp. Available at: https://naturalengland.blog.gov.uk/2022/04/13/offshore-wind-best-practice-advice-to-facilitate-sustainable-development. [Accessed August 2024].

PINS Advice Note Ten: Nationally Significant Infrastructure Projects: Advice on Cumulative Effects Assessment (2024).

Powell-Jennings, C. & Callaway, R., (2018). The invasive, non-native slipper limpet *Crepidula fornicate* is poorly adapted to sediment burial. Marine Pollution Bulletin, 130, 95-104. DOI https://doi.org/10.1016/j.marpolbul.2018.03.006.

Preston, J., Fabra, M., Helmer, L., Johnson, E., Harris-Scott, E. & Hendy, I.W., (2020). Interactions of larval dynamics and substrate preference have ecological significance for benthic biodiversity and *Ostrea edulis*. Linnaeus, 1758 in the presence of *Crepidula fornicata*. Aquatic Conservation: Marine and Freshwater Ecosystems, 30 (11), 2133-2149. DOI https://doi.org/10.1002/aqc.3446

Roberts, L., Harding, H.R., Voellmy, I., Bruintjes, R., Simpson, S.D., Radford, A.N., Breithaupt, T. and Elliott, M., (2016). Exposure of benthic invertebrates to sediment vibration: from laboratory experiments to outdoor simulated pile-driving. In Proceedings of Meetings on Acoustics 4ENAL (Vol. 27, No. 1, p. 010029). Acoustical Society of America.

Rowden, A.A., Jones, M.B. & Morris, A.W., (1998). The role of *Callianassa subterranea* (Montagu) (Thalassinidea) in sediment resuspension in the North Sea. Continental Shelf Research, 18, 1365-1380.

Royal HaskoningDHV (2024). Dogger Bank D Scoping Report (Part 1 & 2). Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010144/EN010144-000069-EN010144%20-%20Scoping%20Report%20-%20Part%201.pdf & https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010144/EN010144-000070-EN010144%20-%20Scoping%20Report%20-%20Part%202.pdf [Accessed September 2024].

RWE (2024). Environmental Statement, Volume 7, Chapter 9 – Benthic and Intertidal Ecology [online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010125/EN010125-000464-7.9%20ES%20Chapter%209%20-%20Benthic%20and%20Intertidal%20Ecology.pdf [Accessed January 2025].

Schrieken, N., Gittenberger, A., Coolen, J.W.P. and Lengkeek, W., (2013). Marine fauna of hard substrata of the Cleaver Bank and Dogger Bank. Nederlandse Faunistische Mededelingen, 41, pp.69-78.

Scott, K., Harsanyi, P. and Lyndon, A.R., (2018). Understanding the effects of electromagnetic field emissions from Marine Renewable Energy Devices (MREDs) on the commercially important edible crab, *Cancer pagurus* (L.). Marine Pollution Bulletin, 131, pp.580-588.

Stiger-Pouvreau, V. & Thouzeau, G., (2015). Marine Species Introduced on the French Channel-Atlantic Coasts: A Review of Main Biological Invasions and Impacts. Open Journal of Ecology, 5, 227-257. DOI https://doi.org/10.4236/oje.2015.55019

The British Standards Institution (2015). Environmental impact assessment for offshore renewable energy projects –Guide. PD 6900:2015.

Tillin, H. M. (2022a). *Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand: Marine Evidence–based Sensitivity Assessment (MarESA) Review. Available at: doi:https://www.marlin.ac.uk//assets/pdf/habitats/marlin-habitat-11332019-03-12.pdf [Accessed March 2025].

Tillin, H.M. (2022b). *Mediomastus fragilis, Lumbrineris spp*. and venerid bivalves in circalittoral coarse sand or gravel. In Tyler-Walters H. Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. Available at: https://www.marlin.ac.uk/habitats/detail/382/mediomastus-fragilis-lumbrineris-spp-and -venerid-bivalves-in-circalittoral-coarse-sand-or-gravel [Accessed March 2025].

Tillin, H.M. & Hill, J.M., (2016). Piddocks with a sparse associated fauna in sublittoral very soft chalk or clay. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: https://www.marlin.ac.uk/habitat/detail/152

Tillin, H.M. & Budd, G., (2016). *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 04-08-2022]. Available from: https://www.marlin.ac.uk/habitat/detail/62

Tillin, H.M., Houghton, A.J., Saunders, J.E. Drabble, R. and Hull, S.C. (2011). Direct and indirect impacts of aggregate dredging. Science Monograph Series No. 1. MEPF 10/P144.

Tillin, H.M., Marshall, C., Gibb, N. & Garrard, S. L. (2020). *Sabellaria spinulosa* on stable circalittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 04-08-2022]. Available from: https://www.marlin.ac.uk/habitat/detail/377.

Tyler-Walters, H., Williams, E., Mardle, M.J. & Lloyd, K.A. (2022). Sensitivity Assessment of Contaminant Pressures - Approach Development, Application, and Evidence Reviews. MarLIN (Marine Life Information Network), Marine Biological Association of the UK, Plymouth, pp. 192.

Van Moorsel, G. (2011). Species and habitats of the international Dogger Bank. EcoSub, Doorn. https://www.researchgate.net/publication/259802329-Species-and-habitats-of-the-international-Dogger-Bank

Ware and Kenny (2011). Guidance for the Conduct of Benthic Studies at Marine Aggregate Extraction Sites.

Weinert, M., Mathis, M., Kröncke, I., Neumann, H., Pohlmann, T. and Reiss, H., (2016). Modelling climate change effects on benthos: Distributional shifts in the North Sea from 2001 to 2099. Estuarine, Coastal and Shelf Science, 175, pp.157-168.

Weinert, M., Mathis, M., Kröncke, I., Pohlmann, T. and Reiss, H., (2021). Climate change effects on marine protected areas: Projected decline of benthic species in the North Sea. *Marine Environmental Research*, *163*, p.105230.

Wentworth, C. K. (1922). A scale of grade and class terms for clastic sediments. The journal of geology, 30 (5), pp.377–392.

Whiteside, P.G.D., Ooms, K. and Postma, G.M. (1995). Generation and decay of sediment plumes from sand dredging overflow. Proceedings of the 14th World Dredging Congress. Amsterdam, The Netherlands. World Dredging Association, 877 – 892.

Wyn & Brazier (2001). Joint Nature Conservation Committee (JNCC) Marine Monitoring Handbook.

Xodus (2021). Northern Endurance Partnership Scoping Report for Offshore Environmental Impact Assessment. Available at: https://eastcoastcluster.co.uk/wpcontent/themes/nep/report.pdf [Accessed December 2023].

List of Figures, Tables and Plates

List of Tables

Table 10-1 Summary of Relevant National Policy Statement Requirements for Benthic and Intertidal Ecology 6
Table 10-2 Technical Consultation Undertaken to Date on Benthic and Intertidal Ecology 11
Table 10-3 Benthic and Intertidal Ecology – Impacts Scoped into the Assessment 13
Table 10-4 Embedded Mitigation Measures Relevant to Benthic and Intertidal Ecology 15
Table 10-5 Indicative Embedded Mitigation Measures Included in the Outline PEMP 16
Table 10-6 Realistic Worst-Case Scenarios for Impacts on Benthic and Intertidal Ecology 17
Table 10-7 Desk-Based Sources for Benthic and Intertidal Ecology Data 22
Table 10-8 Site-Specific Survey Data for Benthic and Intertidal Ecology 23
Table 10-9 Tolerance and recoverability scale definitions 24
Table 10-10 Sensitivity matrix 24
Table 10-11 Definition of value for benthic and intertidal ecology receptors 25
Table 10-12 Definition of Magnitude of Impacts 25
Table 10-13 Benthic and Intertidal Ecology Significance of Effect Matrix 26
Table 10-14 Definition of Effect Significance 26
Table 10-15 Biotope Classifications 30
Table 10-16 Designated Sites for Benthic Features Within / In the Vicinity of the Project 39
Table 10-17 The Sensitivity of Biotopes to Temporary Physical Disturbance 44
Table 10-18 The sensitivity of biotopes to increased SSC 47
Table 10-19 The Sensitivity of Biotopes to Physical Change to Another Seabed 52
Table 10-20 The Sensitivity of Biotopes to Introduction or Spread of INNS 56
Table 10-21 Benthic and Intertidal Ecology – Potential Cumulative Effects 59
Table 10-22 Short List of Plans / Projects for the Benthic and Intertidal Ecology Cumulative Effect Assessment 60
Table 10-23 Predicted and as Built Habitat Loss / Alteration for Screened in Operational Schemes within the Dogger Bank (using the Dogger Bank SAC area of 12,331km^2 as a reference) 64
Table 10-24 Benthic and Intertidal Ecology – Inter-Relationships with Other Topics 66
Table 10-25 Benthic and Intertidal Ecology – Potential Interactions between Impacts 68
Table 10-26 Interaction Assessment – Phase and Lifetime Effects 69
Table 10-27 Summary of Potential Effects Assessed for Benthic and Intertidal Ecology 72

List of Figures

Figure 10-1 Benthic and Intertidal Ecology Study Area 12
Figure 10-2 Benthic and Intertidal Ecology Designated Sites 40

List of Acronyms

Acronym	Definition
AL	Action Level
BAP	Biodiversity Action Plan
BEIS	Department for Business, Energy & Industrial Strategy
BGS	British Geological Survey
BTO	British Trust for Ornithology
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effects Assessment
CIEEM	Chartered Institute of Ecology and Environmental Management
DBA	Dogger Bank A
DBB	Dogger Bank B
DBC	Dogger Bank C
DBD	Dogger Bank D
DBS	Dogger Bank South
DCO	Development Consent Order
DML	Deemed Marine Licence
ECC	Export Cable Corridor
EEA	European Economic Area
EGL	Eastern Green Link
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EPP	Evidence Plan Process
ERM	Effects Range Median
ES	Environmental Statement
ETG	Expert Topic Group
EUNIS	European Nature Information System
FEPA	Food and Environment Protection Act 1985
GDS	Government Digital Service
HDD	Horizontal Directional Drilling
HRA	Habitat Regulations Assessment
HVDC	High Voltage Direct Current
INNS	Invasive Non-Native Species
IPMP	In-Principle Monitoring Plan
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LOD	Limit of Detection
MARPOL	International Convention for the Prevention of Pollution from Ships
MCA	Maritime Coastguard Agency
MCZ	Marine Conservation Zone
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MPCP	Marine Pollution Contingency Plan
MPS	Marine Policy Statement
NOAA	National Oceanic and Atmospheric Administration
NPL	National Physical Laboratory
NPS	National Policy Statement

Acronym	Definition
NSIP	Nationally Significant Infrastructure Project
OBMP	Outline Benthic Monitoring Plan
OD	Ordnance Datum
OSP	Offshore Substation Platform
OSPAR	Oslo and Paris Commission
PCB	Polychlorinated Biphenyls
PEIR	Preliminary Environmental Information Report
PEL	Probable Effect Limit
PEMP	Project Environmental Management Plan
PSD	Particle Size Distribution
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
SCI	Site of Community Importance
SMRU	Sea Mammal Research Unit
SQG	Sediment Quality Guidelines
SSC	Suspended Sediment Concentrations
SST	Sea Surface Temperature
TBT	Tributyltin
TEL	Threshold Effect Level
THC	Total Hydrocarbon Content
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UXO	Unexploded Ordnance
WER	Water Environment Regulations

Acronym	Definition
WTG	Wind Turbine Generator
ZOI	Zone of Influence