

DOGGER BANK D WIND FARM

Preliminary Environmental Information Report

Report to Inform Appropriate Assessment (Part 1 of 3)

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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.
Area of Search	Broad geographical areas within which further site selection work would be undertaken to identify potential options for siting infrastructure elements associated with the Project.
Array Area	The area within which the wind turbines, inter-array cables and offshore platform(s) will be located.
Birkhill Wood Substation	The onshore grid connection point for DBD identified through the Holistic Network Design process. Birkhill Wood Substation which is being developed by National Grid Electricity Transmission and does not form part of the Project.
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.
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.
DBD	Dogger Bank D (DBD) Offshore Wind Farm, also referred to as the Project in this PEIR.
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.

Term	Definition
Embedded Mitigation	Embedded mitigation includes: <ul style="list-style-type: none">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); andMeasures 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.
Energy Storage and Balancing Infrastructure (ESBI)	A range of technologies such as battery banks to be co-located with the Onshore Converter Station, which provide valuable services to the electrical grid such as storing energy to meet periods of peak demand and improving overall reliability.
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.
Grid Connection	The offshore and onshore electricity transmission network connection to Birkhill Wood Substation.
Habitats Regulations	The Conservation of Habitats and Species Regulations 2017 (as amended), and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended)(for plans and projects beyond UK territorial waters (12 nautical miles). Such regulations set out the requirement for Competent Authorities to consider whether a development will have a likely significant effect (LSE) on a European site (now known as part of the National Site Network). Where LSE are likely and a project is not directly connected with or necessary to the management of that site(s), an appropriate assessment (AA) is required of the implications of the plan or project for that site(s) in view of its conservation objectives.
Haul Roads	Temporary tracks set aside to facilitate transport access during onshore construction works.

Term	Definition
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).
Jointing Bays	Underground structures constructed at regular intervals along the onshore export cable corridor to facilitate the joining of discrete lengths of the installation of cables.
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.
Link Boxes	Structures housing electrical equipment located alongside the jointing bays in the onshore export cable corridor and the transition joint bay at the landfall, which could be located above or below ground.
Mean High Water Springs	MHWS is the average of the heights of two successive high waters during a 24-hour period.
Micro-Siting	An embedded mitigation measure that involves siting the specific location of the infrastructure to avoid or minimise impacts to receptors.
Mitigation	<p>Any action or process designed to avoid, prevent, reduce or, if possible, offset potentially significant adverse effects of a development.</p> <p>All mitigation measures adopted by the Project are provided in the Commitments Register.</p>
Monitoring	<p>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.</p> <p>All monitoring measures adopted by the Project are provided in the Commitments Register.</p>
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 Cables	Cables which bring electricity from the offshore platform(s) to the transition joint bay at landfall.
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.

Term	Definition
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.
Onshore Converter Station (OCS) Zone	The area within which the Onshore Converter Station and Energy Storage and Balancing Infrastructure will be located in vicinity of Birkhill Wood Substation.
Onshore Converter Station (OCS)	A compound containing electrical equipment required to stabilise and convert electricity generated by the wind turbines and transmitted by the export cables into a more suitable voltage for grid connection into Birkhill Wood Substation.
Onshore Development Area	The area in which all onshore infrastructure associated with the Project will be located, including any temporary works area required during construction and permanent land required for mitigation and enhancement areas, which extends landward of Mean Low Water Springs. There is an overlap with the Offshore Development Area in the intertidal zone.
Onshore Export Cables	Cables which bring electricity from the transition joint bay at landfall to the Onshore Converter Station zone (HVDC cables) and from the Onshore Converter Station zone onwards to Birkhill Wood Substation (HVAC cables).
Onshore Export Cable Corridor (ECC)	The area within which the onshore export cables will be located, extending from the landfall to the Onshore Converter Station zone and onwards to Birkhill Wood Substation.
Project Design Envelope	<p>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.</p> <p>The Project Design Envelope incorporates flexibility and addresses uncertainty in the DCO application and will be further refined during the EIA process.</p>
Safety Zones	A statutory, temporary marine zone demarcated for safety purposes around a possibly hazardous offshore installation or works / construction area.
Scoping Opinion	<p>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.</p> <p>The Scoping Opinion for the Project was adopted by the Secretary of State on 02 August 2024.</p>
Scoping Report	<p>A request by the Applicant made to the Planning Inspectorate for a Scoping Opinion on behalf of the Secretary of State.</p> <p>The Scoping Report for the Project was submitted to the Secretary of State on 24 June 2024.</p>

Term	Definition
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.
Temporary Construction Compounds	Areas set aside to facilitate the construction works for the onshore infrastructure, which include the landfall construction compound, main and intermediate construction compounds for onshore export cable works and OCS and ESBI construction compounds.
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.
Transition Joint Bay (TJB)	An underground structure at the landfall that houses the joints between the offshore and onshore export cables.
Trenching	Open cut method for cable or duct installation.
Trenchless Techniques	<p>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.</p> <p>Trenchless techniques included in the Project Design Envelope include Horizontal Directional Drilling (HDD), auger boring, micro-tunnelling, pipe jacking / ramming and Direct Pipe.</p>
Wind Turbines	Power generating devices located within the DBD Array Area that convert kinetic energy from wind into electricity.

1 Introduction

1.1 Overview

1. As part of its third licensing round in 2008, The Crown Estate identified the Dogger Bank Zone, located between 125km and 290km off the east coast of Yorkshire, as one of the nine offshore wind farm development zones in the UK. Following the 2008 licensing round, four project areas were identified within the zone to take to development consent, namely Creyke Beck A, Creyke Beck B, Teesside A and Teesside B. In 2015, development consent was granted for all four project areas.
2. In 2017, the four project areas were restructured under new ownership arrangements. Creyke Beck A, Creyke Beck B and Teesside A were renamed as Dogger Bank A (DBA), Dogger Bank B (DBB) and Dogger Bank C (DBC) respectively and would progress collectively as the Dogger Bank Wind Farm in three build-out phases by SSE Renewables, Equinor and Vårgrønn. Teesside B was renamed as Sofia Offshore Wind Farm and would be progressed separately from the Dogger Bank Wind Farm by RWE.
3. In 2021, an opportunity was identified by SSE Renewables and Equinor (hereafter 'the Applicant') to maximise the capacity of the third phase of the Dogger Bank Wind Farm, namely DBC, such that additional capacity of up to 1.5GW of renewable energy could potentially be consented and constructed in the eastern part of the original DBC site. This new development phase is known as Dogger Bank D, and is an independent project being promoted by a separate commercial entity from the previous phases of the Dogger Bank Wind Farm.
4. The DBD Array Area covers an area of approximately 262km² and is located approximately 210km off the Yorkshire coast at its closest point, with its eastern boundary located approximately 160m west of the Dutch Exclusive Economic Zone (EEZ).
5. In 2023 The Crown Estate confirmed that a Plan-Level Habitats Regulation Assessment (HRA) would be undertaken to assess the collective environmental impact at plan level of DBD together with six other offshore wind projects identified in either The Crown Estate's Offshore Wind Leasing Round 3, or The Crown Estate's 2021 Offshore Wind Extensions opportunity, collectively known as the Capacity Increases Programme (CIP).
6. In March 2025, The Crown Estate notified the Secretary of State of the conclusions reached under the Plan-Level HRA. In May 2025, the Secretary of State confirmed that TCE has adequately assessed the impacts of the plan on protected sites within the National Site Network and endorsed the outcome of the Plan-Level HRA to proceed with the CIP.

1.2 Background

7. In accordance with Regulation 10 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (hereafter 'the EIA Regulations'), the Applicant submitted a Habitats Regulations Assessment (HRA) Screening Report for consultation on 19 December 2023.
8. In March 2024, National Energy System Operator (NESO) published the "South Cluster HND Impact Assessment", which confirmed a radial connection to a new substation to be built in East Riding of Yorkshire (known as "Birkhill Wood Substation") was confirmed as the revised and optimal design for the Project. As a result, the Project was refined to remove the previously incorporated Hydrogen Production Facility (which was assessed in the original Dogger Bank D HRA Screening Report (**Appendix A.2 Dogger Bank D HRA Screening and HRA Addendum Reports**)). The Project is therefore now being developed to connect into Birkhill Wood, a proposed new 400kV substation located in the East Riding of Yorkshire, in compliance with the NESO Transitional Centralised Strategic Network Plan (tCSNP2).
9. The HRA Screening Report submitted in December 2023 was based on the project description at the time of writing. Given the nature of the Project changes (the change of grid connection location and removal of the Hydrogen Production Facility) a further detailed site selection exercise was undertaken for the onshore and offshore export cables and amendments to both the onshore and offshore Development Areas were made. The HRA Screening Report was updated through the provision of an Addendum (as per **Appendix A.2 Dogger Bank D HRA Screening and HRA Addendum Reports**) and consulted on with stakeholders in August 2024.
10. The Project includes a switching station for the purposes of facilitating coordination with an interconnector, if taken forward. It would operate at a single voltage to collect the electricity from multiple sources. This Switching Station will facilitate the interconnection of the transmission system of the DBD windfarm to a potential secondary connection point in addition to connecting to the UK grid. The secondary connection point is not included in this DCO application. This option would increase energy security for the UK.

1.3 Habitats Regulations Assessment

11. In England and Wales, the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and elements of Council Directive 2009/147/EC on the conservation of wild birds (the Birds Directive) are implemented under (i) the Conservation of Habitats and Species Regulations 2017 (as amended by The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019) (the ‘Habitats Regulations’) onshore and up to 12 nautical miles (nm) offshore and (ii) the Conservation of Offshore Marine Habitats and Species Regulations 2017 between 12 and 200nm offshore. The Habitats Regulations (as they are collectively known) require the Secretary of State to consider whether a plan or project has the potential to have an adverse effect on the integrity and features of a National Site Network site (e.g. SPA, SAC), known as an Appropriate Assessment (AA). This shall also include any Natura 2000 sites where transboundary impacts extend outwith the UK border.

1.4 Purpose of this Document

12. The purpose of this RIAA’ is to provide the information necessary for, and as required by, the competent authority to carry out the Appropriate Assessment of the Project on the integrity of European and Ramsar sites. The HRA process derives from the requirements of specific European Directives, and the UK Regulations that implement their requirements in national law, which are outlined in **Section 3** of this report. This RIAA is submitted alongside the Preliminary Environmental Information Report (PEIR) to support statutory consultation under the DCO process and inform Stage 1 ‘Screening’ and Stage 2 ‘Appropriate Assessment’ of the HRA process (see **Section 3.3** for further detail).

1.5 Consultation

13. Consultation responses received from stakeholders with regards to the HRA process for the Project are presented in **Appendix A.1 Dogger Bank D HRA Consultation Responses**. Where the responses are relevant to specific topics, they are detailed in the following assessment sections:
- Annex I Marine Habitats – **Section 5**;
 - Annex II Terrestrial Ecology and Ornithology – **Section 6**;
 - Annex II Marine and Intertidal Ornithology – **Section 7**;
 - Annex II Migratory Fish – **Section 8**; and
 - Annex II Marine Mammals – **Section Error! Reference source not found.**
14. **Table 1-1** presents the different stages and activities associated with engagement regarding the RIAA topics.

Table 1-1 Key Consultation and Engagement regarding RIAA Topics

Event	Objectives
All topics	
HRA Screening Report	Stage 1 Screening of the Sites and Species screened in or out of the assessment.
HRA Addendum	Update to the Stage 1 Screening of the Sites and Species screened in or out of the assessment following significant project changes.

15. **Table 1-2** presents the Evidence Plan Process meetings held to date for the RIAA technical topics.

Table 1-2 Evidence Plan Process Groups and Meetings to Date for the Project

Group		Members	Date(s) of Meeting
ETG1	Marine Physical Processes, Benthic Ecology, and Fish Ecology (EIA and HRA)	<ul style="list-style-type: none">• Natural England• MMO• Cefas• North Eastern Inshore Fisheries and Conservation Authority (NEIFCA)• The Wildlife Trusts	<ul style="list-style-type: none">• First Meeting: 13th September 2023• Second Meeting (MPP Only): 22nd July 2024• Third Meeting: 30th October 2024
ETG2	Offshore Ornithology (EIA and HRA)	<ul style="list-style-type: none">• Natural England• MMO• RSPB	<ul style="list-style-type: none">• First Meeting: 25th October 2023• Second Meeting: 23rd May 2024• Third Meeting: 21st October 2024
ETG3	Marine Mammal Ecology and Underwater Noise (EIA and HRA)	<ul style="list-style-type: none">• Natural England• MMO• Cefas• The Wildlife Trusts• Whale and Dolphin Conservation (written consultation only)	<ul style="list-style-type: none">• First Meeting: 21st November 2023• Second Meeting: 17th October 2024

Group		Members	Date(s) of Meeting
ETG4	Offshore Ornithology Compensation (HRA)	<ul style="list-style-type: none">Natural EnglandMMORSPB Supported by specific meetings held with other stakeholders as appropriate	<ul style="list-style-type: none">First Meeting: 28th May 2024Second Meeting: 6th November 2024
ETG5	Seabed Compensation (HRA) and Measures of Equivalent Environmental Benefit (MEEB)	<ul style="list-style-type: none">Natural EnglandMMOCefasJNCC Supported by specific meetings held with other stakeholders as appropriate	<ul style="list-style-type: none">First Meeting: 16th October 2023Second Meeting: 2nd May 2024Third Meeting: 28th November 2024
ETG6	Onshore Ecology, Ornithology, and Land Use	<ul style="list-style-type: none">Environment AgencyNatural EnglandYorkshire Wildlife TrustEast Riding of Yorkshire CouncilRSPB	<ul style="list-style-type: none">First Meeting: 14th September 2023Second Meeting: 2nd October 2024

2 Project Description

2.1 Introduction

16. This chapter presents a description of the key offshore and onshore infrastructure components of the Project for the purpose of informing the Appropriate Assessment and subsequent comments received by Statutory Nature Conservation Bodies (SNCBs) and the Planning Inspectorate (PINS).

17. The NPS EN-3 (Department of Energy and Climate Change (DECC), 2011) recognises the design envelope approach which states in paragraph 2.6.42:

‘Owing to the complex nature of offshore wind farm development, many of the details of a proposed scheme may be unknown to the applicant at the time of the application to the IPC [the Secretary of State], possibly including:

- Precise location and configuration of turbines and associated development;
- Foundation type;
- Exact turbine tip height;
- Cable type and cable route; and
- Exact locations of offshore and/or onshore substations’.

18. NPS EN-3 (paragraph 2.6.43) continues:

‘Where details are still to be finalised, applicants should explain in the application which elements of the proposal have yet to be finalised, and the reason why this is the case. Where flexibility is sought in the consent as a result, applicants should, to the best of their knowledge, assess the likely worst case environmental, social and economic effects of the proposed development to ensure that the impacts of the project as it may be constructed have been properly assessed.

The development of the design of Project and its parameters is an iterative process and continues to be developed, therefore the description of the key components is indicative and intended to provide sufficient flexibility to accommodate further refinement leading up to submission of the Development Consent Order (DCO) application. A range of design parameters and construction, operation and maintenance (O&M) and decommissioning methodologies are being considered in the project design envelope. This approach has been widely used in the consenting of offshore wind farms and is consistent with the Planning Inspectorate Advice Note Nine: Rochdale Envelope (Planning Inspectorate, 2018) which states that:

‘The Rochdale Envelope assessment approach is an acknowledged way of assessing a Proposed Development comprising EIA development where uncertainty exists, and necessary flexibility is sought’.

19. The project design envelope is intended to enable potential for coordination with other local developments and futureproofing in line with the National Policy Statements (NPS). This will provide opportunities for reducing cumulative impacts on the environment and communities by ensuring efficiency in the development of transmission infrastructure.

20. The key offshore components of the Project comprise the following and are illustrated on **Plate 2-1**:

- Wind turbines (**Section 2.3.1.1**);
- Inter-array cables (**Section 2.3.1.7**);
- Offshore export cables (**Section 2.3.2**);
- Offshore platform(s), including Offshore Converter Station(s) and an Offshore Switching Station (hereafter collectively referred to as offshore platforms unless specified) (**Section 2.3.1.4**);
- Foundation structures for wind turbines and offshore platforms (**Section 2.3.1.2** and **Section 2.3.1.4.1**); and
- Scour and cable protection (**Section 2.3.1.5.3** and **Section 2.3.2.1.7**).

21. The key onshore components of the Project comprise the following and are illustrated on **Plate 2-1**:

- Landfall and associated transition joint bay and link box (**Section 2.3.3**);
- Onshore export cables and associated jointing bays and link boxes (**Section 2.3.4**); and
- Onshore Converter Station and a co-located Energy Storage and Balancing Infrastructure (**Section 2.3.5**).

2.2 Indicative Project Infrastructure

22. **Figure 2-1** identifies the Offshore and Onshore Project Areas. **Table 2-1** sets out which infrastructure components are located in which area.

23. This RIAA has been prepared using a realistic worst-case scenario approach for the Project (which includes an element of flexibility to allow for coordination with an OHA).

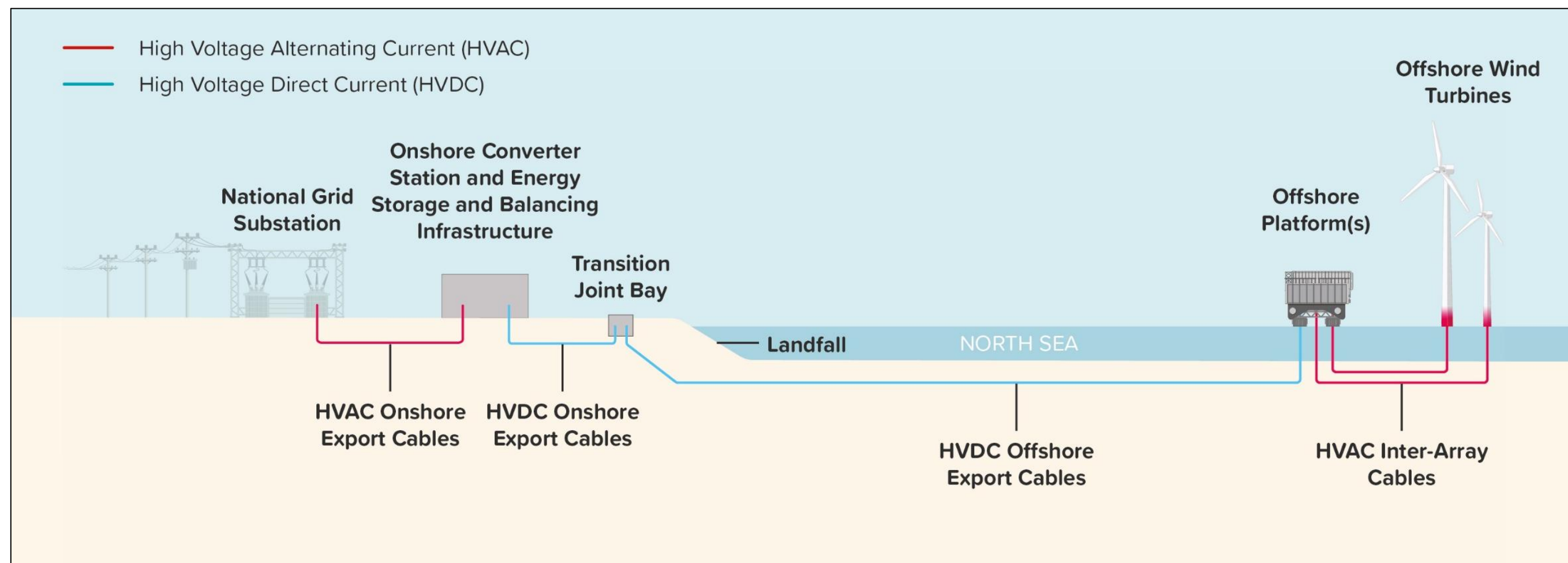


Plate 2-1 Overview of the Project's Infrastructure

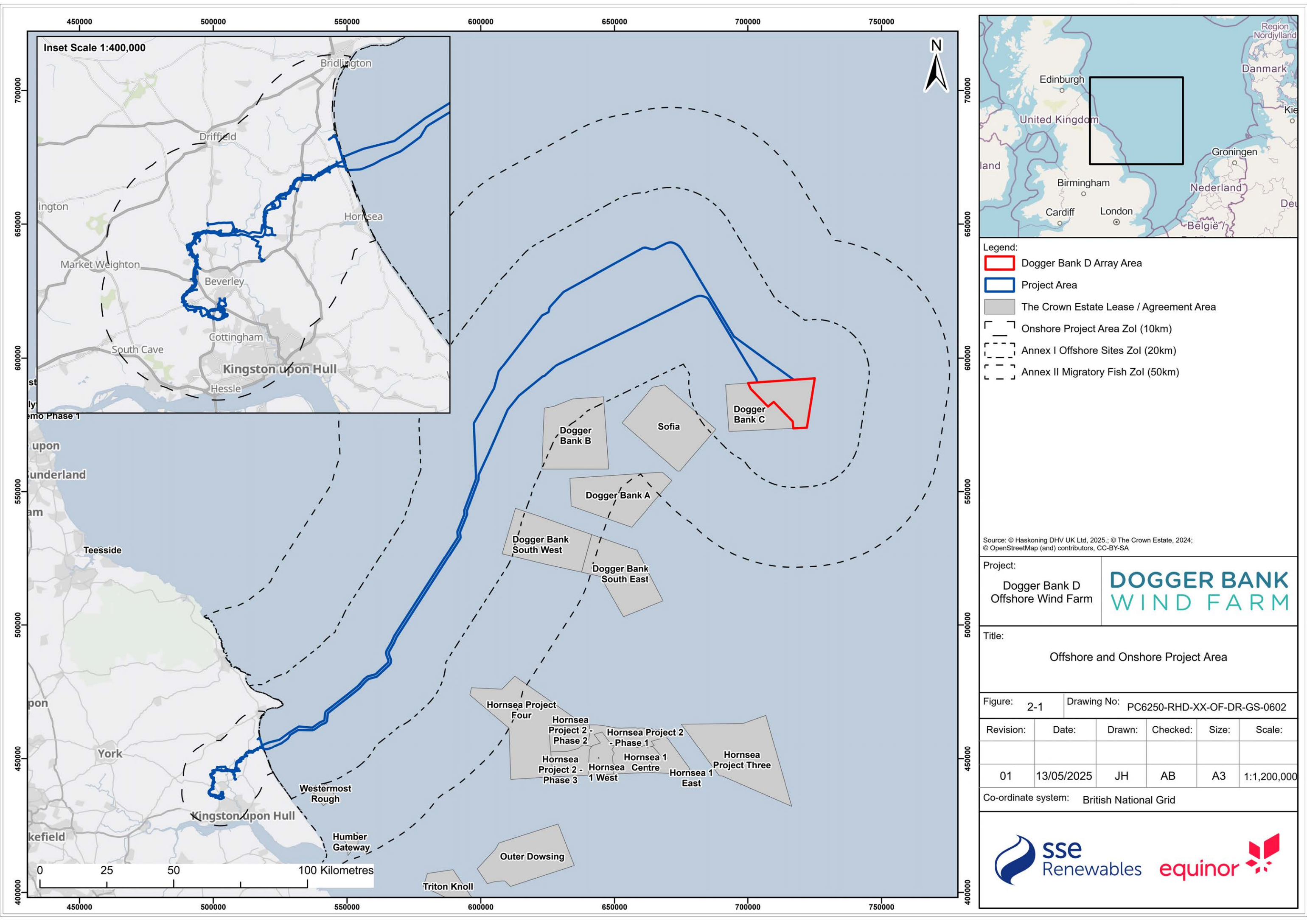


Table 2-1 Key Indicative Parameters for the Realistic Worst-Case Scenario Assessed in the HRA Screening Report Addendum

Feature	Indicative Parameter
General Parameters	
Distance to shore from the Array Area (at its closest point)	210km.
Array Area	262km ² .
Array Area water depths	21m to 35m at Lowest Astronomical Tide (LAT).
Offshore Infrastructure Parameters	
Maximum number of wind turbines	113
Minimum rotor diameter (m)	236
Maximum wind turbine rotor diameter	337m.
Minimum blade clearance	27.96m above LAT.
Maximum blade tip height above Highest Astronomical Tide (HAT) (m)	370
Maximum hub height above HAT (m)	201.5
Wind turbine foundation options under consideration	Potential foundation types include monopiles, piled jackets and suction bucket jackets.
Scour protection options for wind turbine foundations	Potential options include protective aprons, mattresses or matting (concrete or rock filled bags), flow energy dissipation (frond) devices and rock and gravel placement.
Maximum number of offshore platforms	Maximum of two offshore platform structures.
Offshore platform foundation options under consideration	Potential foundation types include monopiles, piled jackets, suction bucket jackets, elevator platform and gravity bases.
Scour protection options for offshore platform foundations	Potential options include protective aprons, mattresses (concrete or rock filled bags), flow energy dissipation (frond) devices, and rock and gravel placement.
Maximum total inter-array cable length	Up to 400km.
Offshore export cable electrical current	HVDC.
Maximum number of offshore export cables	Maximum of two cables.

Feature	Indicative Parameter
Maximum number of trenches	Two trenches.
Maximum offshore export cable length	800km (two cables in two trenches of 400km)
Landfall Infrastructure Parameters	
Proposed landfall installation method	Trenchless methodology.
Maximum number of exit pits	Three (including one spare)
Maximum number of Transition Joint Bays (TJB)	One
Maximum permanent TJB area	30m ²
Indicative temporary landfall construction compound area	12,500 m ² (including construction footprint of TJB and underground link box)
Onshore Infrastructure Parameters	
Maximum number of onshore export cables	Maximum of four cables.
Proposed onshore export cable installation methods	Open trenching methods, with trenchless techniques where required.
Maximum number of trenches	Four trenches.
Maximum onshore export cable length	Up to approximately 50km for HVDC cables from the landfall to the Onshore Converter Station(s) (OCS(s)), with up to an additional 5km for HVAC cables from OCS(s) to the Birkhill Wood Substation.
Indicative temporary construction corridor width for HVDC onshore export cables (m)	32m
Indicative temporary construction corridor width for onshore export cables (m)	HVDC: 32m (50m at trenchless crossing locations). HVAC: 55m (60m at trenchless crossing locations).
Maximum developable area for OCS and ESBI (ha)	25ha (this area includes, but is not limited to, the platform footprint, landscaping, access, drainage and attenuation but exclude areas for ecological mitigation / enhancement).

24. **Table 2-1** sets out key indicative parameters for the Project infrastructure. The parameters have been identified using the Applicant's knowledge of previous offshore wind developments and future changes in the market to elements such as wind turbine dimensions. These parameters will continue to be refined through the EIA process based on realistic worst-case scenarios, which will be fully justified in the ES and associated RIAA.

2.3 Project Infrastructure Description

2.3.1 Dogger Bank D Array Area

25. The wind turbines will be located within the DBD Array Area which is located approximately 210km off the north-east coast of England (at its closest point) in the North Sea, immediately to the east of the DBC Offshore Wind Farm, covering an area of approximately 262km² (**Figure 2-1**). Water depths in this area range from approximately 21m to 35m below LAT.

2.3.1.1 Wind Turbine Parameters and Installation

26. The final selection of wind turbines will be made once further surveys, technical development and engagement with the supply chain have been undertaken with the final decision made post-consent. This section therefore sets maximum (and minimum, where appropriate) worst-case parameters (**Table 2-1**) that are carried forward into the relevant sections.

27. The conventional three-bladed horizontal-axis wind turbines, which will be selected by the Project, include the following key components (see **Plate 2-2**):

- Rotor (comprising three wind turbine blades and a hub to connect the three blades to the rest of the turbine);
- Nacelle housing the electrical generator, gearbox and the control electronics; and
- Tower, consisting of a tubular steel structure affixed to the wind turbine foundation.

28. The final wind turbine layout will not be determined until the post-consent phase, taking into account several parameters such as ground conditions, wind resource and the size of the wind turbine that is selected for construction. Factors such as Search and Rescue (SAR) considerations, as well as supply chain and market conditions will also influence the eventual layout of the Array Area, therefore a final layout will not be submitted with this RIAA, nor with the DCO application. However, an indicative layout representative of the worst-case has been used for modelling purposes.

29. An outline layout is provided in the relevant sections based upon a minimum wind turbine separation distance of 3.5 times the rotor diameter (1,416m for the largest turbine option and 826m for the smallest turbine option) for up to 113 turbines.

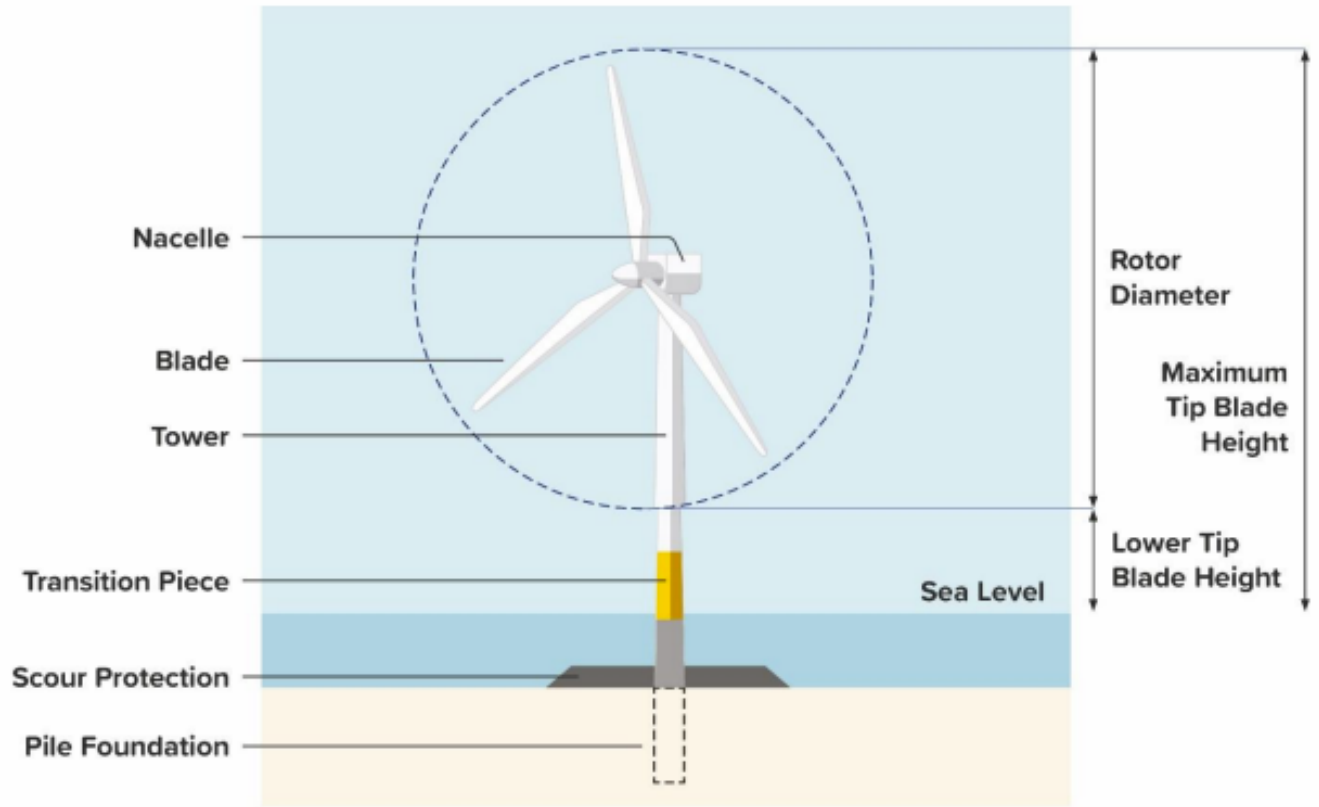


Plate 2-2 Indicative Wind Turbine Schematic

2.3.1.2 Wind Turbine Foundations

30. The wind turbine foundation type(s) selected will ultimately depend on the final detailed site investigations, engineering design studies and the procurement process. At this stage, the following options are being considered based upon what is currently known about the site conditions:

- Monopiles;
- Piled jackets; and
- Suction bucket jackets.

31. The final foundation type that is selected will be fabricated offsite and stored at a suitable port facility where they will be loaded onto a suitable installation vessel or barge and transported to the Array Area.

2.3.1.2.1 Monopiles

32. Monopile foundations typically consist of a single tubular piece, formed out of a number of rolled steel plates welded together, that is driven into the seabed by impact piling or vibro-piling. The assessments of effects for disturbance from piling at the Project will be undertaken assuming the use of noise reduction technology at the ES stage, assuming that monopiles remain within the project design and a significant effect is predicted. Updated guidelines will be taken into account regarding the use of noise reduction at the time of DCO submission. In areas of firmer ground conditions drilling of the seabed may be required prior to piling. This is only considered for the installation of monopile foundations in the assessment as it provides the worst-case assessment in terms of drill arisings. The drill arisings (spoil) would be disposed of adjacent to the foundation location, from a vessel pipe that would be above or slightly below the sea surface. At the point of disposal, the spoil will be expected to settle onto the seabed in the immediate vicinity of each foundation.
33. A separate transition piece (TP) is typically fitted on top of the monopile via a bolted or grouted connection which will include ladders, a boat landing feature, a small crane and a flange for connection to the wind turbine tower. However, recently there have been a number of projects using TP-less monopiles that have this additional infrastructure embedded into the monopile itself.
34. The monopile foundation parameters, which form part of the Project Design Envelope, are presented in **Table 2-2** and indicated on **Plate 2-3**.

Table 2-2 Project Design Envelope - Monopile Wind Turbine Foundations Parameters

Parameter	Value
Diameter of monopile at seabed (m)	18
Maximum column diameter (m)	18.5
Maximum hammer energy required for piling (kJ)	8,000
Pile penetration depth below seabed (m)	60
Drilling (if required)	
Percentage of locations to be drilled	50
Drill diameter (m)	18
Volume of drill arisings per pile (m³)	15,270
Total volume of drill arisings (m³)	870,390

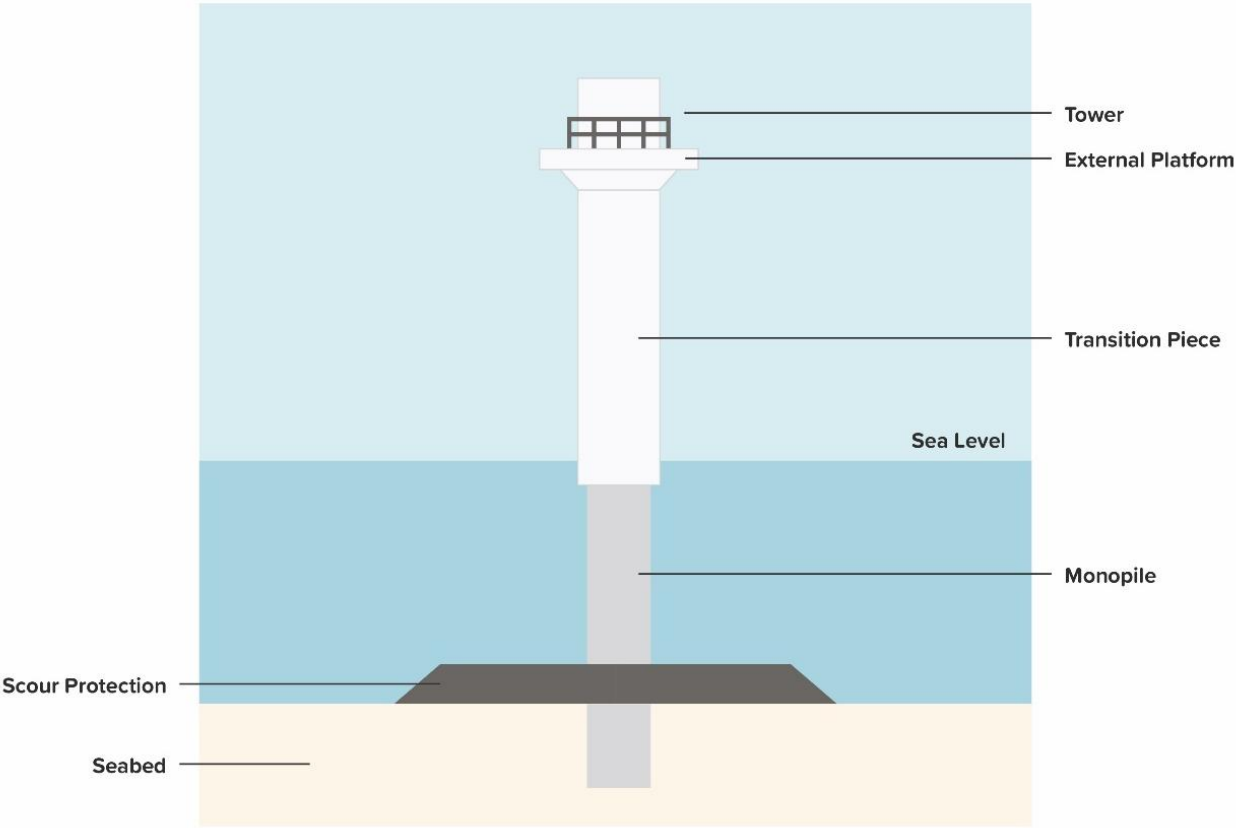


Plate 2-3 Indicative Monopile Foundation Schematic

2.3.1.2.2 Piled Jackets

35. Piled jacket foundations are formed of a tubular steel pieces welded into a lattice that are then fastened to the seabed with steel pin-piles that are piled through the legs of the jacket. The pin-piles are connected to the jacket legs via a grouted or deformed connection. Unlike monopiles, there is no separate TP that is affixed onto the top of a piled jacket foundation as the TP and ancillary infrastructure is embedded into the design of the jacket.
36. The installation process typically comprises the following stages:
- A piling template is placed on the seabed;
 - Piles are installed;
 - The piling templates are recovered for re-use; and
 - Jackets are then lowered onto the piles.
 - Jacket secured to piles, typically via grouted connection.
- Or:
- Jackets are lowered onto the seabed;

- Piles are installed through jacket legs or pile sleeves; and
- Jacket secured to piles, typically via grouted connection.

37. Pin-pile installation methodology is similar to that used for monopiles and, depending on approach, will take approximately 24 hours for the piling operations and then approximately another 24 hours for the jacket installation and the grouting. Although it is possible that drilling may be required for piled jackets, the volume of drill arisings will be less than that for monopile foundations above and is therefore not considered here.
38. The parameters for the piled jacket foundations, which form part of the Project Design Envelope, are presented in **Table 2-3** and indicated on **Plate 2-4**.

Table 2-3 Project Design Envelope - Piled Jacket Wind Turbine Foundations

Parameter	Value
Number of legs per foundation	4
Number of pin-piles per leg	2
Number of pin-piles per foundation	8
Maximum pin-pile diameter (m)	5
Maximum hammer energy required for piling (kJ)	5,000
Maximum pile penetration depth below seabed (m)	80

2.3.1.2.3 Suction Bucket Foundations

39. Multi-leg suction bucket foundations are similar in design to the multi-leg piled jacket foundations, discussed in **Section 2.3.1.2.2**, as both feature a steel lattice structure. However, unlike the piled jacket foundations, the suction bucket foundations are not secured to the seabed through piling. Instead, they use multiple suction buckets that are embedded into the seabed by creating a negative pressure through pumping water out from inside the bucket. The difference in pressure pushes the bucket into the seabed, creating a seal. Pumping is ceased once the buckets’ reach the desired depth.
40. Targeted seabed levelling will be required for suction bucket foundations to ensure that all of the buckets are placed onto the seabed at the same level.

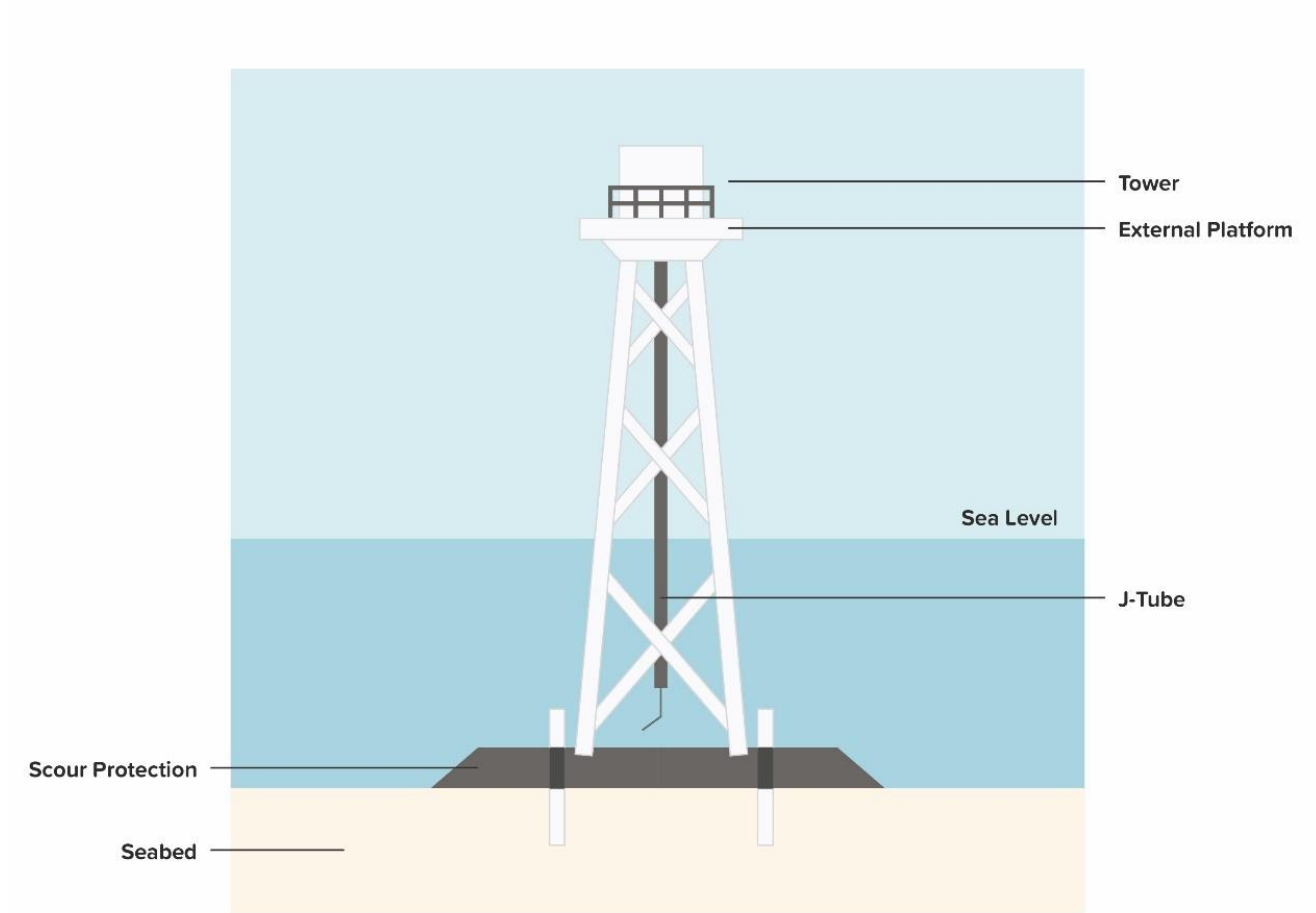


Plate 2-4 Indicative Piled Jacket Foundation Schematic

41. The installation process typically comprises the following stages:
- The jacket is lowered onto the seabed;
 - Water is pumped from the bucket(s); and
 - At the desired depth, the pump is turned off.
42. A single suction bucket jacket installation is expected to take approximately 24 hours, on average, from vessel arrival to vessel departure, assuming no weather delays. The suction jacket foundation piling foundation parameters, which form part of the Project Design Envelope, are presented in **Table 2-4** and indicated on **Plate 2-5**.

Table 2-4 Project Design Envelope - Suction Bucket Wind Turbine Foundations

Parameter	Value
Maximum number of legs (buckets) per foundation	4
Suction bucket diameter (m)	18.75
Suction bucket penetration depth below seabed (m)	17.5

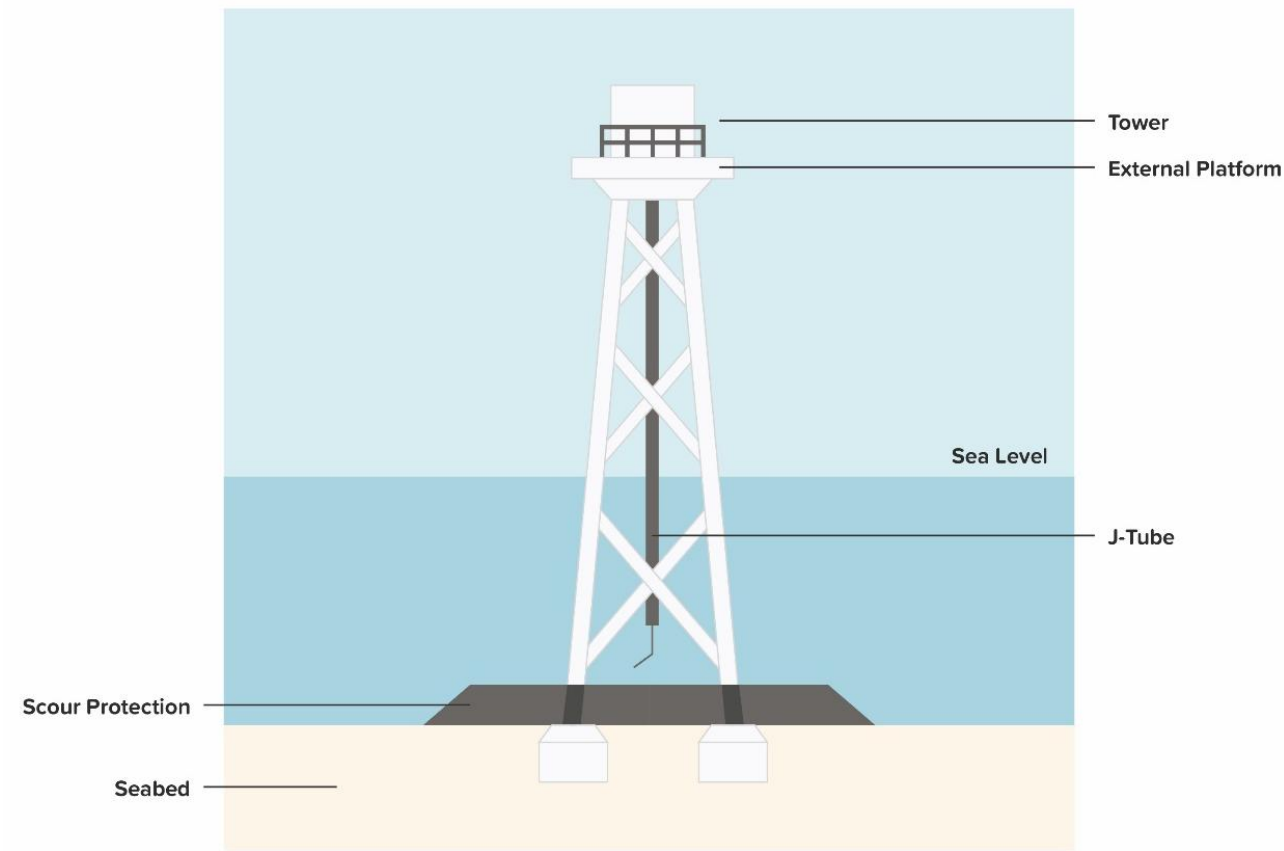


Plate 2-5 Indicative Suction Bucket Foundation Schematic

43. Monosuction bucket foundations which utilise a single bucket per foundation are not being taken forward for the Project.

2.3.1.3 Wind Turbine Installation

44. A detailed wind turbine installation procedure will be provided prior to construction. However, it is likely that the installation sequence will generally adhere to the conventional method listed below (details of the installation works specifically related to the foundations are given in **Section 2.3.1.2**):
- The wind turbine components (blades, pre-assembled nacelle and tower) will be loaded onto a suitable wind turbine installation vessel at the marshalling port (likely to be within the UK or Europe);
 - The installation vessel will transit to the Array Area where the components will be individually lifted via a crane onto the pre-installed foundation and transition piece. The tower will be installed first, after which the nacelle is placed on top. The hub is then rotated to allow the blades to be installed individually onto the hub. Technicians will fasten components in place once they are assembled. The installation vessel will typically use jack-up legs or dynamic positioning to ensure it is stable during the installation sequence;
 - Alternatively, the wind turbine components may be loaded onto barges or dedicated transport vessels at the marshalling port and installed by an installation vessel that remains on site throughout the installation campaign; and
 - Once the wind turbine is assembled or a string of turbines, cable connections and offshore commissioning can commence.
45. Each installation vessel or barge may be assisted by a range of support vessels. These are typically smaller vessels such as tugs, guard vessels, anchor handling vessels, or similar. It is assumed that these vessels will make the same general movements to and from around the wind farm area as the installation vessels they are supporting. See **Section 2.3.2.3** for further details of vessel types, numbers, and movements.

2.3.1.4 Offshore Platforms

46. The offshore platform(s) are structures that will collect the electricity from the turbines and house electrical equipment that supports critical functions to maximise the efficiency of transmission. This will include changing the voltage (transformer) and type of current (converter). The Project will include up to two offshore platforms, with one serving as the primary platform for onwards transmission to the UK grid connection point. This primary platform will contain the following key infrastructure:
- Transformers;
 - Switchgear;
 - Valves;
 - DC disconnectors;

- Other electrical power systems;
 - Instruments, meters and control systems;
 - Auxiliary power system;
 - Navigation, aviation, and safety marking and lighting;
 - Storage; and
 - Cranes.
47. The second offshore platform will be used as a switching station for the purposes of facilitating coordination with an interconnector cable, if taken forward (as discussed in **Section 2.1**). It will operate at a single voltage to collect the electricity from multiple sources. This switching station will facilitate the interconnection of the transmission system of the DBD windfarm to a potential secondary connection point, in addition to the existing connection into the UK grid. However, the connection between the Switching Station to the secondary connection point is not included in this DCO application.
48. The offshore platform(s) will be located within the Array Area with the specific location to be confirmed post-consent following further detailed site investigations. The platform(s) will not be permanently manned but during the operational phase they will receive periodic visits from staff via boat or helicopter.
49. At this stage the exact parameters of the offshore platform(s) are not known, however, if two platforms are taken forward it is considered that the parameters of each platform will be smaller than if one larger platform is taken forward.
50. Indicative offshore platform parameters which form part of the Project Design Envelope for Offshore Platform(s) are provided in **Table 2-5**. It is noted that a single large or two small platforms are mutually exclusive.

Table 2-5 Project Design Envelope - Offshore Platform(s) Topside

Parameter	Value	
	Two platforms (per platform)	One platform
Indicative topside length (m)	75	125
Indicative topside width (m)	60	90
Indicative topside height (m above LAT)	50	65
Indicative topside footprint (m ²)	4,500	11,250

2.3.1.4.1 Offshore Platform(s) Foundations

51. The offshore platform topside will be installed upon a foundation(s) that is attached to the seabed. As with the wind turbine foundations, a number of options are being considered at this stage, listed below:
- Monopiles;
 - Piled jacket foundation;
 - Suction bucket foundation;
 - Gravity base foundation; and
 - Arup Concept Elevating (ACE) platform.
52. Monopile, piled jacket and suction bucket foundations are all also considered for use as the wind turbine foundations. Therefore, full details on the design of these foundations are provided in **Section 2.3.1.2**. However, due to the different size and nature of the offshore platform(s), the maximum design parameters for the foundations that will be used to support them are not consistent with the wind turbine foundations. The project design envelopes for monopile, piled jacket and suction bucket foundations to support the offshore platform(s) are listed in **Table 2-6**, **Table 2-7**, and **Table 2-8**, respectively.

Table 2-6 Project Design Envelope - Offshore Platform(s) Monopile Foundations

Parameter	Value	
	Two Platforms	One Platform
Number of monopiles	12 (2 platforms x 6 monopiles)	10
Diameter of monopile at seabed (m)	18	
Maximum column diameter (m)	18	
Maximum hammer energy required for piling (kJ)	8,000	
Pile penetration depth below seabed (m)	100	
Drilling (if required)		
% of locations to be drilled	50	
Drill diameter (m)	15	
Volume of drill arisings per pile (m³)	17,670	
Total volume of drill arisings (m³)	106,020 (6 monopiles)	

Table 2-7 Project Design Envelope - Offshore Platform(s) Piled Jacket Foundations

Parameter	Value	
	Smaller Design	Larger Design
Number of legs per foundation	8	20
Number of pin-piles per leg	4	
Number of pin-piles per foundation	24	60
Maximum pin-pile diameter (m)	5	
Maximum hammer energy required for piling (kJ)	5,000	
Maximum pile penetration depth below seabed (m)	100	

Table 2-8 Project Design Envelope - Offshore Platform(s) Suction Bucket Foundations

Parameter	Value	
	Smaller Design	Larger Design
Maximum number of legs (buckets) per foundation	8	20
Suction bucket diameter (m)	20	
Suction bucket penetration depth below seabed (m)	20	
Suction bucket height above seabed (m)	10	

2.3.1.4.1.1 Gravity Base Foundations

53. Gravity base foundations are concrete or steel structures that are floated or transported by barge to site and then ballasted when in the correct location and deposited onto the seabed. This foundation type is stable by way of its sheer weight. They vary in shape but typically consist of a wide base footprint to provide stability, with a number of columns rising through the water column and splash zone to provide support to the topsides at the defined interface level. The Project Design Envelope for gravity base foundations for the offshore platform(s) is provided in **Table 2-9** and indicated on **Plate 2-6**.

Table 2-9 Project Design Envelope - Offshore Platform(s) Gravity Base Foundations

Parameter	Value	
	Smaller Design	Larger Design
Number of legs per foundation in the water column	6	
Diameter of legs (m)	15	18
Dimension of base on seabed (m)	60 x 60	90 x 90
Height of base off seabed (m)	15	

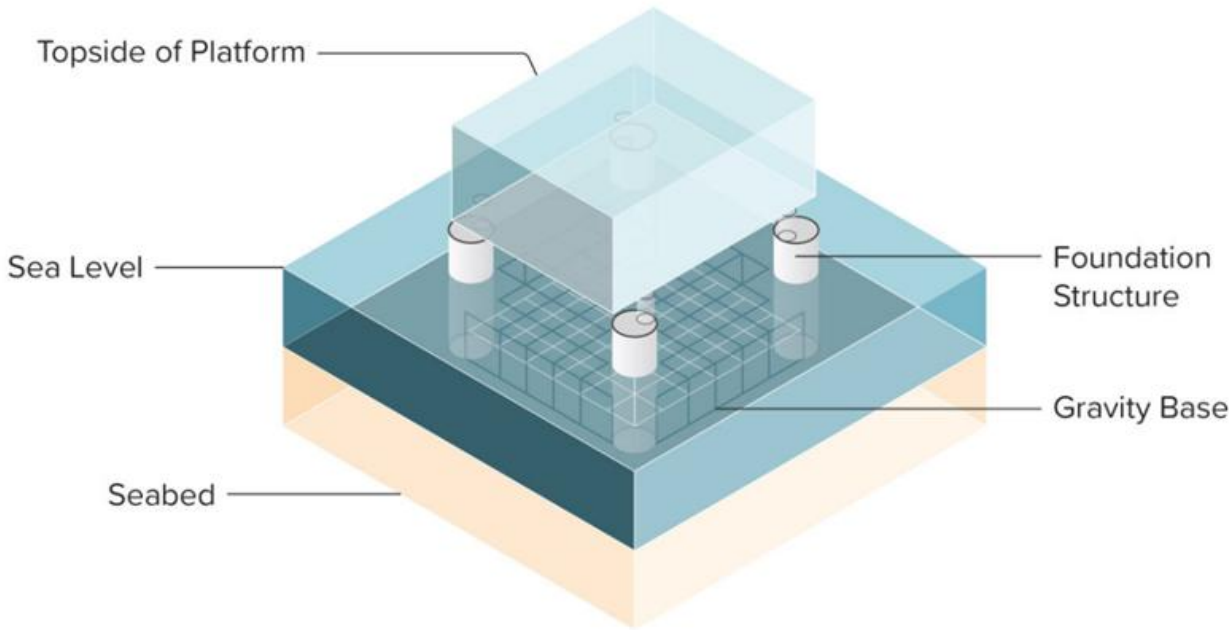


Plate 2-6 Indicative Gravity Base Foundation Schematic

2.3.1.4.1.2 Arup Concept Elevating Platform

54. The Arup Concept Elevating (ACE) platform is a self-installing fixed design for offshore platforms, consisting of a jack-up leg system that is integrated with the topsides with lattice legs that can be lowered onto the seabed where skirts penetrate the upper sediments and are secured via suction. The lattice legs are based on a jack-up design, with the jacking facilities separate from the legs as a centre-hole strand-jacking system commonly used on land for heavy lift operations. The suction skirt design provides the stability for the platform without the requirement for any piling work. The Project Design Envelope for ACE foundations for the offshore platform(s) is provided in **Table 2-10** and indicated on **Plate 2-7**.

Table 2-10 Project Design Envelope - Offshore Platform(s) ACE Foundations

Parameter	Value	
	Smaller Design	Larger Design
Maximum number of legs per foundation	4	6
Footprint of lattice leg (m)	16 x 16	
Footing footprint on seabed (m x m)	32 x 32	
Seabed penetration of footprint (m)	6	
Total height of concrete footing (m)	7	

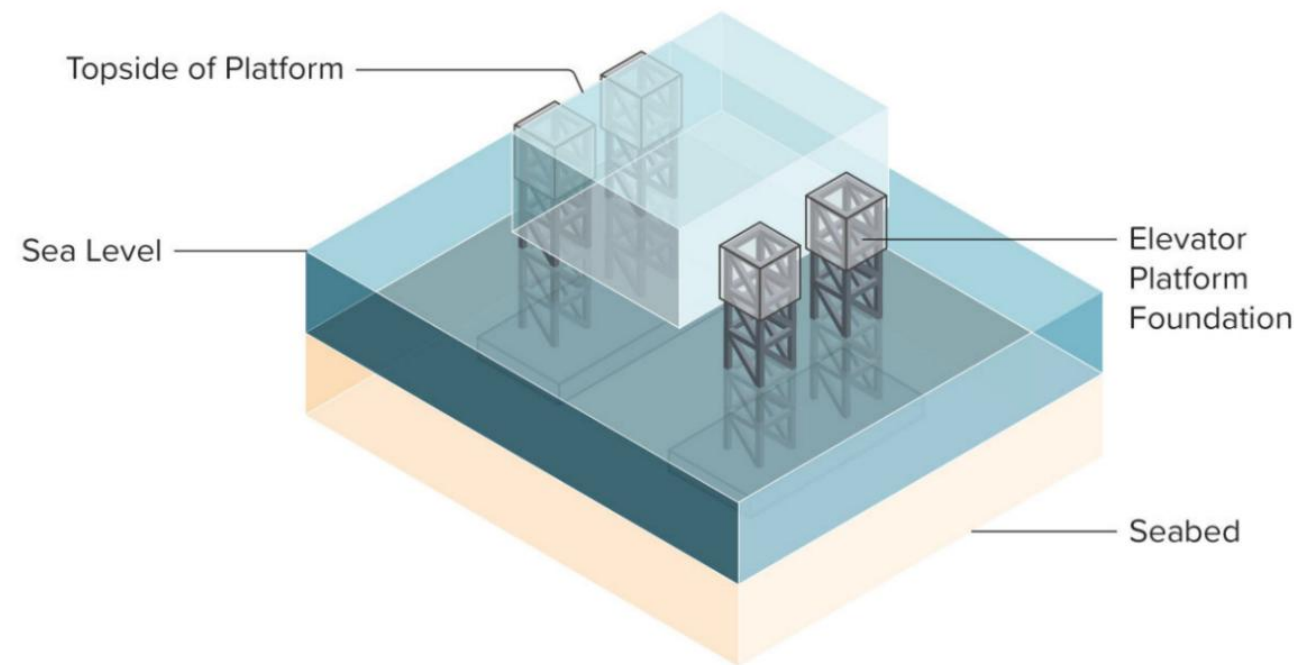


Plate 2-7 Indicative Arup Concept Elevating Platform Foundation Schematic

2.3.1.4.2 Offshore Platform Installation

55. Depending on the exact configuration of the foundation design and scale of the topsides, the topsides will either be installed via an offshore lift (a), or a “float-through” approach (b):
- a. The offshore lift is the standard method of installing topsides onto foundations where the mass and dimensions are within the capabilities of available heavy lift vessels (HLVs). The topside is transported to the offshore site by barge where the HLV lifts the structure from the barge and over the foundations. The topside is then lowered onto the foundation with an arrangement of bumpers and guides providing alignment with interface positions before final set-down. The topside is then secured to the foundation via bolted or welded connections.
 - b. The float-through approach will be used where the topsides mass or dimensions exceed the capacity of available HLVs. The foundation will be designed for sufficient available draft and column spacing to allow a transport vessel to pass through the foundation with the topside on board. The vessel is then ballasted to lower the topside on to the interface points, where an arrangement of guides will ensure alignment, following this, the topsides would be secured to the foundation via bolted or welded connections.
56. The ACE platforms are designed and fabricated as an integrated topsides and foundation solution. These components will therefore be fabricated as-one onshore, which simplifies the offshore installation process as the structure can be floated out to the required position where the jacket legs are lowered to interface with the seabed and subsequently lift the topsides to the required elevation where it is secured.

2.3.1.5 Pre-Installation Foundation Works for Wind Turbines and Offshore Platforms

57. Prior to commencement of installation activities, surveys will be undertaken to confirm that the seabed is clear of any obstructions (including archaeological, benthic, and unexploded ordnance (UXO)) in order to inform micro-siting of infrastructure, clearance operations, and seabed preparation to avoid potentially sensitive (or dangerous) receptors. The pre-construction surveys will also be designed for environmental monitoring purposes.
58. Depending on the type of foundations selected for the wind turbines and the offshore platform(s), some degree of seabed preparation (e.g. UXO, boulder and sandwave clearance) may be required to provide a level surface upon which the foundation will be installed, or to deposit scour protection to protect the structural integrity of the foundation during operations. The following sections describe the Project Design Envelope in relation to these ancillary works to the foundations.

2.3.1.5.1 Unexploded Ordnance

59. UXO clearance may be required for foundation and cable installation (see **Section 2.3.2.1.1**).
60. The North Sea is heavily littered with UXO from World War I and World War II, and it is common to encounter these during surveys and construction. UXO pose a risk to health and safety where they coincide with locations of planned infrastructure and vessel activity, and therefore a strict approach to identify and, if required, dispose of UXO must be adhered to. If UXO are confirmed, the hierarchy to manage the risk is to avoid them entirely, followed by removing them (often called 'lift and shift'), and the last resort is to detonate them in-situ.
61. At this stage of the Project, it is not possible to determine if any UXO would be present in the Offshore Development Area, nor how many UXO would require detonation. The results of the pre-construction geophysical survey will be analysed by an appropriate UXO contractor or consultant to determine a list of potential UXO targets for investigation. A UXO identification survey (often combined with an archaeological Remotely Operated Vehicle (ROV) survey) will then be undertaken prior to construction to ascertain whether any of the potential UXOs can be confirmed as such. This UXO identification and clearance procedure will be subject to individual Marine Licence application(s) upon receipt of the target list from the UXO specialist in the post-consent phase.

2.3.1.5.2 Dredging

62. Some of the foundation types will require levelling and dredging of the soft mobile sediments. It is likely that dredging will not be required for monopile and piled jacket foundations as they do not necessarily rely on a completely level seabed. However, suction bucket and gravity base (which includes ACE) foundations will require a level seabed to ensure the stability of the foundation.
63. If suction bucket or gravity base foundations are selected, vessels such as a Trailing Suction Hopper Dredger (TSHD) will be used to remove the required amount of sediment to level the seabed. The spoil will likely be side-cast adjacent to the foundation locations. In some cases, it may be necessary to place a layer of gravel on the seabed prior to the installation of gravity base foundations.

2.3.1.5.3 Scour Protection

64. Scour is a hydrodynamic process which results in seabed erosion and subsequent 'scour hole' formation around wind turbines and offshore platform(s) foundations and may compromise the structural integrity of the structures over time. Scour protection is the primary mitigative measure to prevent this from occurring and involves the deposit of a material around the foundation to protect the seabed around the structure.

65. Several types of scour protection exist, including (but not exclusively); mattress protection, sand bags, rock bags, and flow modifiers. However, the most common method of scour protection involves the deposit of large quantities of rock placement around the foundation base.
66. The full method of scour protection installation will be decided post-consent. However, a typical approach is to deposit a layer of small rocks (the filter layer) where the foundation will be, and to install the foundation on or through the filter layer. Afterwards, a layer of larger, higher graded rock is deposited on top (the armour layer) to protect the seabed at the foundation base. The filter layer can also be laid after the foundation has been installed and it is possible to avoid two layers by using a heavier rock material with a wider gradation.
67. The quantity of scour protection required for the Project will vary depending on the foundation types that are selected for the wind turbines and the offshore platform(s). The project design envelopes per wind turbine and offshore platform foundation are provided in **Table 2-11** and **Table 2-12**, respectively. Note the worst-case foundation types are suction bucket for wind turbines and monopiles for offshore platform(s).

Table 2-11 Project Design Envelope - Scour Protection around Wind Turbine Foundations

Parameter	Value		
	Monopiles	Piled Jacket	Suction Bucket
Scour protection area per foundation including structure footprint (m ²)	556,751	784,220	1,617,482
Scour protection volume per foundation (m ³)	962,195	1,012,480	4,043,705

Table 2-12 Project Design Envelope - Scour Protection around Offshore Platform(s) Foundations

Parameter	Value				
	Monopiles	Piled Jacket	Suction Bucket	Gravity Base	ACE
Scour protection area including structure footprint (m ²)	50,000	20,000	44,000	30,000	18,000
Scour protection volume (m ³)	75,000	30,000	60,000	40,000	10,000

2.3.1.6 Aids to Navigation, Lighting and Colour Scheme

68. The Project will be designed and constructed in compliance with the requirements of the Civil Aviation Authority (CAA), Maritime and Coastguard Agency (MCA) and Trinity House (the General Lighthouse Authority) in respect to all aids to navigation. This includes the lighting and marking of all offshore structures above the sea surface. The location of all infrastructure will be submitted to the UK Hydrographic Office (UKHO) so that the Admiralty Charts can be updated accordingly (refer to the design commitments listed in **Table 2-1**).
69. Throughout the construction phase, buoys will be used to mark the boundary of the Offshore Development Area. The extent of these will be confirmed with Trinity House prior to deployment.
70. The colour scheme of the wind turbines is typically off white to light grey, and the surface-piercing section of the foundation structures tend to be bright yellow, and will be confirmed until post-consent, ensuring compliance with MGN 654.

2.3.1.7 Inter-Array Cables

71. Inter-array cables carry the High Voltage Alternating Current (HVAC) electricity generated from the individual turbines and link it to the offshore platform(s), where it is converted to High Voltage Direct Current (HVDC). The wind farm is typically designed so that a group of turbines can be linked together on the same cable ‘string’ to maximise the efficiency of the cabling network. It is assumed that, should inter-platform cabling be required to transmit electricity between two platforms, this is included within the definition and parameters of the inter-array cables.
72. The inter-array cables will consist of a number of cores, usually made from copper or aluminium, and a fibre optic cable, surrounded by layers of insulation material and armour to protect the cable from damage.
73. The Project Design Envelope for the inter-array cables is provided in **Table 2-13**.

Table 2-13 Project Design Envelope - Inter-Array Cables

Parameter	Value
System voltage (kV)	Up to 132
Total inter-array cable length (km)	400

2.3.2 Offshore Export Cable Corridor

74. Offshore export cables transmit the HVDC electricity generated by the wind farm from the offshore platform(s) to the landfall. They are typically larger in size than inter-array cables as they transport a larger amount of electricity. The design of the cables will be broadly similar to that of the inter-array cables (**Section 2.3.1.7**), although there will be up to two export cables to transmit the electricity and one fibre optic cable, which may also be bundled together with the export cable. The fibre optic cable enables the communication and transfer of data for monitoring of the cable condition.
75. Further information on buried and non-buried cables is provided in **Section 2.3.2.1.6** and **Section 2.3.2.1.7**. The Project Design Envelope for the offshore export cables is provided in **Table 2-14**.

Table 2-14 Project Design Envelope – Offshore Export Cables

Parameter	Value
Description of transmission configuration	Up to 2 HVDC cables, and 1 fibre optic cable
Number of trenches	2
HVDC cable voltage (kV)	Up to 500 kV
HVDC cable length (km)	800 (two cables in two trenches of 400km length)

2.3.2.1 Cable Installation Procedures

2.3.2.1.1 UXO Identification and Clearance

76. A description in relation to the identification and clearance of UXO is presented in **Section 2.3.1.5**.

2.3.2.1.2 Boulder Clearance

77. Geophysical surveys will be undertaken prior to construction. The results of these surveys will be analysed to assess the presence of boulders on the export cable and inter-array cable routes. It is not always possible to microsite around large boulder fields, they can cause cable exposure and cause damage to the cable installation equipment. Therefore, a boulder clearance campaign may be required, depending on the density of the boulders that are confirmed.
78. Boulders can be cleared through a variety of means, the most common of which is a grab tool mounted on a Remotely Operated Vehicle (ROV). However, in the event of a high-density boulder field, a clearance plough may also be used.

2.3.2.1.3 Sandwave Clearance

79. Sandwaves are mobile bedforms that are formed through marine processes, they may prevent the cable burial tools from operating efficiently or pose a risk of cable exposure. To prevent this from occurring, clearance of the sandwaves may be undertaken, allowing the cables to be buried below the level where natural sandwave movement occurs. This may also be a requirement for some foundation types, such as suction bucket or gravity base.
80. At this early stage, the Project is not currently able to define the extent, or lack thereof, of sandwaves in the Array Area or Offshore ECC. Assumptions have therefore been made about the amount of sandwave clearance that will be required relating to cable installation, with 100% of the offshore export cable assumed to required clearance within the Dogger Bank SAC, and 20% of the offshore export cable requiring clearance outside of the Dogger Bank SAC, although it is anticipated this will be refined for the ES upon receipt of more geophysical data. An indicative inter-array cable layout is not available for this PEIR submission, therefore sandwave clearance on the inter-array cabling has been considered qualitatively. Quantitative modelling and re-assessment will be included at the ES stage. The Project Design Envelope for sandwave clearance activities is provided in **Table 2-15**.

Table 2-15 Project Design Envelope - Sandwave Clearance

Parameter	Value
Offshore Export Cables	
Width of dredging corridor (m)	35
Sandwave clearance requirement (km)	230.4
Total cleared area (km ²)	8.064

2.3.2.1.4 Pre-Lay Grapnel Run

81. Following a pre-lay survey and potential boulder clearance works, a Pre-Lay Grapnel Run (PLGR) will be undertaken prior to cable laying operations to ensure the route is clear of obstructions such as discarded trawling gear or abandoned cables. A vessel will be mobilised with grapnels, chains, and recovery winch to undertake the works.

2.3.2.1.5 Out of Service Cable Removal

82. Where the export or inter-array cables cross out-of-service (OoS) cables, the OoS cable will be removed from the seabed prior to cable installation. It is likely the section of OoS cable intersecting with the ECC will be de-trenched, secured and cut and recovered to the vessel.

2.3.2.1.6 Cable Burial

83. Inter-array and offshore export cables will be buried beneath the seabed wherever possible. The full installation method and target burial depth will be defined post-consent based on a detailed cable burial risk assessment. Currently, pre-trenching (whereby the cable is laid after trenching has occurred), post-lay burial (whereby the cable is buried after it is laid on the seabed from a suitable cable lay vessel) and simultaneous lay and burial techniques are all options. The following burial methodologies are being considered for both cable types:
- Jet-trenching (jetting);
 - Ploughing (jet assisted); and
 - Mechanical trenching (mechanical cutting-jet assisted).
84. It may be the case that just one or a combination of the methodologies above are used for the Project. The Project Design Envelope for cable burial techniques is provided in **Table 2-16**, and details of the methods are in the following sub-sections.

Table 2-16 Project Design Envelope - Cable Burial Techniques

Parameter	Value		
	Jet-Trenching	Ploughing	Mechanical Trenching
Offshore Export Cables			
Target cable burial depth (m)	3.5		
Trench width (m)	5		
Width of disturbance (m)	15	15	15
Area of disturbance (km ²)	8.28	3.6	1.92
Inter-Array Cables			
Target cable burial depth (m)	3.5m		
Trench width (m)	5		

Parameter	Value		
	Jet-Trenching	Ploughing	Mechanical Trenching
Width of disturbance (m)	10	15	10
Area of disturbance (km ²)	3.2	2.4	1.6

2.3.2.1.6.1 Jet-Trenching (Jetting)

85. This method involves using high-pressure water jets into the seabed to fluidise and displace the seabed sediment. It often forms a rectangular trench into which the cable will settle under its own weight. Jetting is suitable for use in sands and low to medium strength clays, but coarse gravels and high strength clays are likely to limit the performance of the tool. The cover is provided by means of natural backfill, and multiple passes may be required in order to achieve the target depth of lowering or depth of cover requirements.

2.3.2.1.6.2 Ploughing

86. This method uses a forward blade to cut through the seabed and displace the sediment to create a trench and is suitable for high strength clays. The cable can be laid into the trench for later backfilling or laid onto the seabed before being ploughed into position; however, simultaneous lay and burial is the most common approach.

2.3.2.1.6.3 Mechanical Trenching (Jet-Assisted)

87. This method involves the mechanical cutting of a trench whilst temporarily placing the excavated sediment adjacent to the trench. The cable is then laid, and the trench is backfilled using the sediment. This approach is most suitable for high strength cohesive clay sediments and weak rock, and significant quantities of sand and gravel are likely to hinder the performance of the tool as it relies on the ripping action of cohesive soils. The cutter is often fitted with a depressor which guides the cable through fluidised material.

2.3.2.1.7 Inter Array and Export Cable Protection

88. In some areas it may not be possible to achieve full burial of the cable for example, due to hard geology, dense boulder fields or cable crossings. In these instances, cables will be laid on the surface upon which cable protection will be installed to minimise the risk of snagging and other hazards. Cable protection will also likely be required where the inter-array cables enter the wind turbines and offshore export cables enter the offshore platform(s) via a J-tube. There will likely be a Cable Protection System (CPS) installed around the cable before it is pulled into the structures to protect it, although secondary protection may also be required.

89. Cable protection may consist of one or more of the following methods:

- Rock placement;
- Concrete mattresses;
- Rock bags;
- Flow dissipation devices; and
- Protection with cast iron shells.

90. The amount of cable protection that will be required will be determined upon further site investigations into the ground conditions, prior to construction. The assumed quantity required is based on 20% of the offshore export cable route (160km) and 10% of the inter-array cable (40km) requiring protection. The Project Design Envelope for inter-array and offshore export cable protection measures, excluding protection required at cable crossings or CPS, is provided in **Table 2-17**.

Table 2-17 Project Design Envelope - Cable Protection

Parameter	Value
Width of rock berm protection (m)	10
Height of rock berm protection (m)	1.5
Offshore Export Cables	
Total length of cables requiring protection (km)	160
Total footprint of protection (m ²)	1,600,000 (based on two trenches of 800,000m ² each)
Total volume of protection (m ³)	1,320,000
Inter-Array Cables	
Total length of cables requiring protection (km)	40
Total footprint of protection (m ²)	400,000
Total volume of protection (m ³)	330,000

91. There are several existing cable and pipeline assets (and others planned) that cross the Offshore ECC. The crossing methodology and design will be confirmed post-consent in a proximity agreement with the asset owners; however, it is anticipated that pre-lay concrete mattresses would be used at crossings. Mattresses are expected to be 6m in length and 3m in width, laid lengthwise on the cable route and centred on the crossing point. No crossings with existing assets are anticipated with the inter-array cable route, but a maximum of five possible internal crossings with DBD assets have been considered.
92. The Project Design Envelope for cable and pipeline crossings is provided in **Table 2-18**.

Table 2-18 Project Design Envelope – Cable and Pipeline Crossings

Parameter	Value
Length of cable crossing (m)	100
Width of cable crossing (m)	10
Length of pipeline crossing (m)	300
Width of pipeline crossing (m)	16
Export Cables (noting that none are identified within the Dogger Bank SAC)	
Total number of cable & pipeline crossings	38 (19 per cable)
Total footprint of protection for all crossings (m ²)	60,800
Total volume of protection for all crossings (m ³)	24,100
Inter-Array Cables	
Total number of cable crossings	5
Total footprint of protection for all crossings (m ²)	5,000
Total volume of protection for all crossings (m ³)	4,125

2.3.2.2 Use of Oils, Fluids and Materials – Offshore Infrastructure

93. Offshore infrastructure contains a number of oils, fluids and other substances, used during construction and operation. Oils within the wind turbines will be biodegradable where possible and all chemicals will be certified to the relevant standard. The following substances are typical in offshore wind farm infrastructure, although this list is not considered exhaustive:

- Hydraulic and gear oil;
- Nitrogen;
- Ester oil;
- Diesel fuel
- Sulphur hexafluoride; and
- Glycol.

2.3.2.3 Construction Vessels

94. During the construction of the Project, a variety of vessels will be used for the installation, support and transport of equipment and infrastructure to the Array Area, Offshore ECC, and landfall. The exact number and specification of vessels will not be known until nearer construction. An indication of the number of each type of vessel on site at any one time during the construction phase and the number of round trips between port and the Offshore Development Area (defined as port to site and back to port) is summarised in **Table 2-19**. Due to construction sequencing, not all vessel types will be on site at the same time, but it is anticipated that there may be a maximum of 90, although this is highly conservative.

Table 2-19 Project Design Envelope – Indicative Construction Vessels

Vessel Type	Peak Vessels (On-Site at the Same Time)	Round Trips
Site preparation vessels (boulder clearance vessel, Construction Support Vessel (CSV), survey vessels including Uncrewed Surface Vehicles (USV), geotechnical survey Jack-Up Vessel (JUV))	18 (not including USVs)	243
Wind turbine foundation vessels (including for foundation installation, support and transport)	30	1,921
Wind turbine vessels (including for scour protection, wind turbine installation, support, transport and commissioning)	33	2,825

Vessel Type	Peak Vessels (On-Site at the Same Time)	Round Trips
Offshore platform vessels (including for foundation and topside installation, support, transport and commissioning)	38	146
Inter-array cable vessels (including for cable installation, support and commissioning)	13	1,884
Offshore export cable vessels (including for cable installation, support and landfall)	23	376
Other vessels	4	132
Total	90	7,527

2.3.2.3.1 Jack-Ups and Anchoring

95. The methodology for several of the construction phases will involve the use of a Jack-Up Vessel (JUV) for anchoring. JUVs are installation vessels that lower three or more legs onto the seabed and lift themselves out of the water to provide a stable platform to conduct works. This is particularly useful for the construction of heavy infrastructure, such as craning of the wind turbines or offshore platform topside. The legs of the JUV directly impact the seabed through the ‘jacking-up’ process. The Project Design Envelope for the use of JUVs is provided in **Table 2-20**.

Table 2-20 Project Design Envelope - Jack-Up Vessels

Parameter	Value
Combined leg footprint (m ²)	2,400
JUV operations per wind turbines and OPs	575
Total area impacted by JUVs over construction period (m ²)	1,380,000

96. In some instances, anchoring is a suitable alternative to JUVs during construction. There are still direct impacts on the seabed as a result of the multiple anchors dropped to secure the vessel, but it is less commonly used because Dynamic Positioning (DP) is a more efficient means to position the vessel.
97. The Project Design Envelope for anchoring (for all construction activities where it is considered) is provided in **Table 2-21**. The footprint for deployment and recovery of one anchor is assumed to be 100m².

Table 2-21 Project Design Envelope - Anchoring

Vessel Type	Parameter	Value
Array infrastructure vessels	Total footprint of anchoring operations (m ²)	201,160
Offshore export cable vessels	Total footprint of anchoring operations (m ²)	21,600
Total	Total footprint of anchoring operations (m²)	222,760

2.3.2.4 Helicopter Movements

98. There will be a requirement for helicopters to travel to and from the Offshore Development Area to assist with construction activities. The indicative helicopter type for construction will be a medium sized offshore transport helicopter and the maximum number of round trips during construction is 2,730.

2.3.2.5 Safety Zones

99. Safety zones help to ensure a safe distance is maintained between the wind farm structures (wind turbines and offshore platform(s)) and vessels. Safety zone applications will be made post-consent under The Electricity (Offshore Generating Stations) (Safety Zones) (Applications Procedures and Control of Access) Regulations 2007 and will be subject to approval prior to the start of construction. The safety zones that may be applied are summarised in **Table 2-22**. Further information on safety zones is provided in **Chapter 15 Shipping and Navigation**.

Table 2-22 Expected Safety Zones

Project Stage	Potential Safety Zone
Construction and Commissioning	During the construction phase, a safety zone radius of 500m while construction vessels are present will be required, which typically reduces to within 50m of an asset whilst no construction vessels are present, returning to 500m if a vessel returns.
Operation	During the operational phase, safety zones are not generally required but may be subject to ongoing monitoring and review.
Maintenance (Major)	A safety zone radius of 500m while major maintenance is in progress (i.e. during the use of jack-up vessel or similar).
Decommissioning	During decommissioning a safety zone radius of up to 500m at the end of the working life of a wind turbine foundation or platform when it is being removed will be required.

2.3.2.6 Offshore Operation and Maintenance

100. The Operations and Maintenance (O&M) phase of the Project is anticipated to be 35 years, during which a number of routine, and potentially unplanned, activities will be required. An outline O&M plan will be submitted with the DCO application that will contain further detail on the activities expected to be required and how they will be licenced. The O&M strategy will be finalised once the technical specification of the wind farm is known. The O&M strategy will ensure that all infrastructure is maintained in safe working order and to maximise operational efficiency throughout the lifetime of the project.

101. O&M activities are grouped into two categories:

- Preventative maintenance – planned activities such as scheduled maintenance of the wind turbines, offshore platform(s) and foundations, geophysical, benthic and other surveys; modifications and retrofit campaigns; and
- Corrective maintenance – activities such as repairs, replacements and remedial works to the wind turbines, offshore platform(s), foundations, scour protection and cables.

2.3.2.6.1 Operation and Maintenance Port

102. It is likely that the existing Dogger Bank O&M facility at the Port of Tyne will be used (and expanded if necessary) as the base of operations for the Project. However, if this is not the case, a suitable alternative will be selected in the north-east of England.

2.3.2.6.2 Vessel Operations

103. In order to perform the O&M activities, a variety of vessels and helicopters will be required to transport personnel and equipment to enable the execution of the works. These can also be grouped into two categories:

- Routine – vessels and helicopters that are permanently assigned to the wind farm or visiting in a planned, routine manner; and
- Ad-hoc – vessels and helicopters, normally specialised in their nature, to perform specific tasks usually linked to corrective maintenance.

104. It is likely that the Service Operation Vessels (SOV) will be operated from the Port of Tyne where the existing Dogger Bank O&M facility is. However, this is subject to a detailed review and if this is not feasible a suitable alternative in the north-east of England will be selected. All other vessels are unlikely to be operated from the Port of Tyne, but rather any port in the North Sea basin.

105. The anticipated types and quantities of vessels used for the routine maintenance activities are provided in **Table 2-23**.

Table 2-23 Project Design Envelope – Indicative O&M Vessel and Helicopter Use

Vessel Type	Use	Value
SOVs (including daughter crafts)	Preventative and corrective maintenance on wind turbines, foundations and offshore platform(s)	Three vessels at any one time. Permanently stationed on site (excluding crew changes). 26 trips of two-week duration to the Array Area per year. Maximum of 39 visits of shorter duration.
Platform Supply Vessels (PSVs) / Offshore Supply Vessels (OSVs)	Preventative and corrective maintenance on offshore platform(s)	One vessel at any one time. 12 trips of two-week duration to the Array Area per year.
Survey vessels such as OSVs, Offshore Construction Vessels (OCVs) and/or Unmanned Surface Vessels (USVs)	Various surveys of seabed assets to assess integrity	Two vessels at any one time (maximum of six USVs at any one time). Annual trips to the array area and export cable of three-month duration (35 trips over the lifetime).
Wind turbine installation vessel, JUV, HLV, OCV	Corrective maintenance – major component repair or replacement	Ad-hoc requirement – one vessel at any one time. Up to seven visits per wind turbine over life (two-week duration). Up to 10 visits to offshore platform over life (two-week duration).
Cable Lay Vessel (CLV) with OCV/OSV in support	Corrective maintenance – cable repair or replacement	Ad-hoc requirement – one to three vessels at any one time. Up to 15 visits to Array Area and 35 visits to export cable corridor over life (three-month duration).
OSV and OCVs	Corrective maintenance of foundations – anode replacement, J-tube replacement	Ad-hoc requirement – One vessel at any one time. Up to two visits to Array Area over life (four-week duration)
Fall Pipe Vessel, OSV, OCV	Corrective maintenance – cable remedial burial, cable protection replacement, scour protection rectification	Ad-hoc requirement – one vessel at any one time. Up to two visits to Array Area and export cable corridor per year (four-week duration).
Crew change helicopter	Preventative and corrective maintenance, crew change activities, urgent return to shore	30 return trips per year.

2.3.2.7 Decommissioning

106. At the end of the operational life of the Project, it is anticipated that all infrastructure above the seabed will be completely removed. Decommissioning will typically occur through a reverse methodology to construction and involve similar quantities of vessels and equipment. In many cases throughout the environmental assessment, the impacts during the decommissioning phase are scoped out as they will be equivalent to or less than the impacts during construction.
107. The submission of a decommissioning programme is expected to be required pre-construction, as this is conditional under Section 106 of the Energy Act 2004. The initial decommissioning programme will be signed off by the relevant authority prior to construction and will then be updated throughout the lifetime of the Project. A final decommissioning programme will also require approval from the MMO prior to any decommissioning works actually taking place.

2.3.2.8 Repowering

108. Repowering may be considered once the Project reaches the end of its design life. If repowering is taken forward and if the specifications and design of the new infrastructure fall outside the consent parameters of this Project, it will be considered a new Project and outside the scope of this document.

2.3.3 Landfall

2.3.3.1 Description of Landfall Project Infrastructure

109. The landfall project infrastructure includes a TJB and associated underground link box to enable the connection between the offshore and onshore export cables. The offshore export cables will come ashore on land south-east of Skipsea and will be jointed to the onshore export cables at the TJB, which will be located at the landward extent of the landfall.
110. Due to the cliff height, coastal erosion rates and environmental sensitivities at the landfall, the cable ducts will be installed using a trenchless technique (see **Section 2.3.4.3.10** for details on the trenchless techniques included in the Project Design Envelope). The ducts will be installed from the TJB to a subtidal exit location on the seabed located below MLWS, and the offshore export cables will be pulled ashore through these pre-installed ducts.
111. It is proposed that up to three cable ducts would be installed to accommodate the two offshore export cables brought ashore. It is likely that two cable ducts would be required, but an allowance for a spare duct has been made for contingency purposes.

112. **Plate 2-8** provides an indicative cross-section of landfall trenchless installation works. Given that no open cut trenching is proposed for landfall construction, and a trenchless installation exit in the subtidal zone will be used, there is no requirement for dewatering or temporary water exclusion using cofferdams or other similar temporary structures in the intertidal zone.
113. A number of trenchless installation trajectories are currently being considered in the Project Design Envelope. The final design will exit in the subtidal zone, but could potentially exit within or outside of the Holderness Inshore Marine Conservation Zone (MCZ). The interface between the Offshore and Onshore Development Areas at the landfall has been defined to include the intertidal zone and allow for the onwards routeing of offshore and onshore export cables.
114. The final landfall design and construction methodology, including the trenchless installation trajectory, will be subject to further pre-construction surveys, engineering studies and offshore vessel considerations and confirmed at detailed design stage post-consent.
115. The TJB is an underground structure where the offshore and onshore export cables are joined in a clean, dry environment. The TJB is constructed using reinforced concrete slabs and may either have reinforced concrete walls with a reinforced concrete cover or comprise of the slab only with cement bound sand and other suitable soils used as backfill to protect the cable joints.
116. The TJB will be sited inland with a sufficient setback distance from the cliff top to provide space for temporary construction logistics and account for natural coastal erosion plus climate change allowance, ensuring that the installed cable ducts remain buried throughout the Project's operational lifetime.
117. An underground link box will be installed in proximity to the TJB to allow inspection and monitoring of cable joints during operation. The link box at the landfall comprises a similar reinforced concrete enclosure to the TJB but will be smaller in footprint. The link box will be installed with a manhole cover at ground level to provide access and are typically marked / protected by bollards, fences or similar of approximately 1.2m to 2m in height (where required and agreed with the relevant landowners).
118. The final design and location of the TJB and associated underground link box will be determined during detailed design post-consent. Where agreed with the relevant landowners and subject to detailed design and construction requirements, the link box at the landfall will be located at or as close to field boundaries as reasonably practicable. An example TJB and link box arrangement at the landfall is shown on **Plate 2-9**.

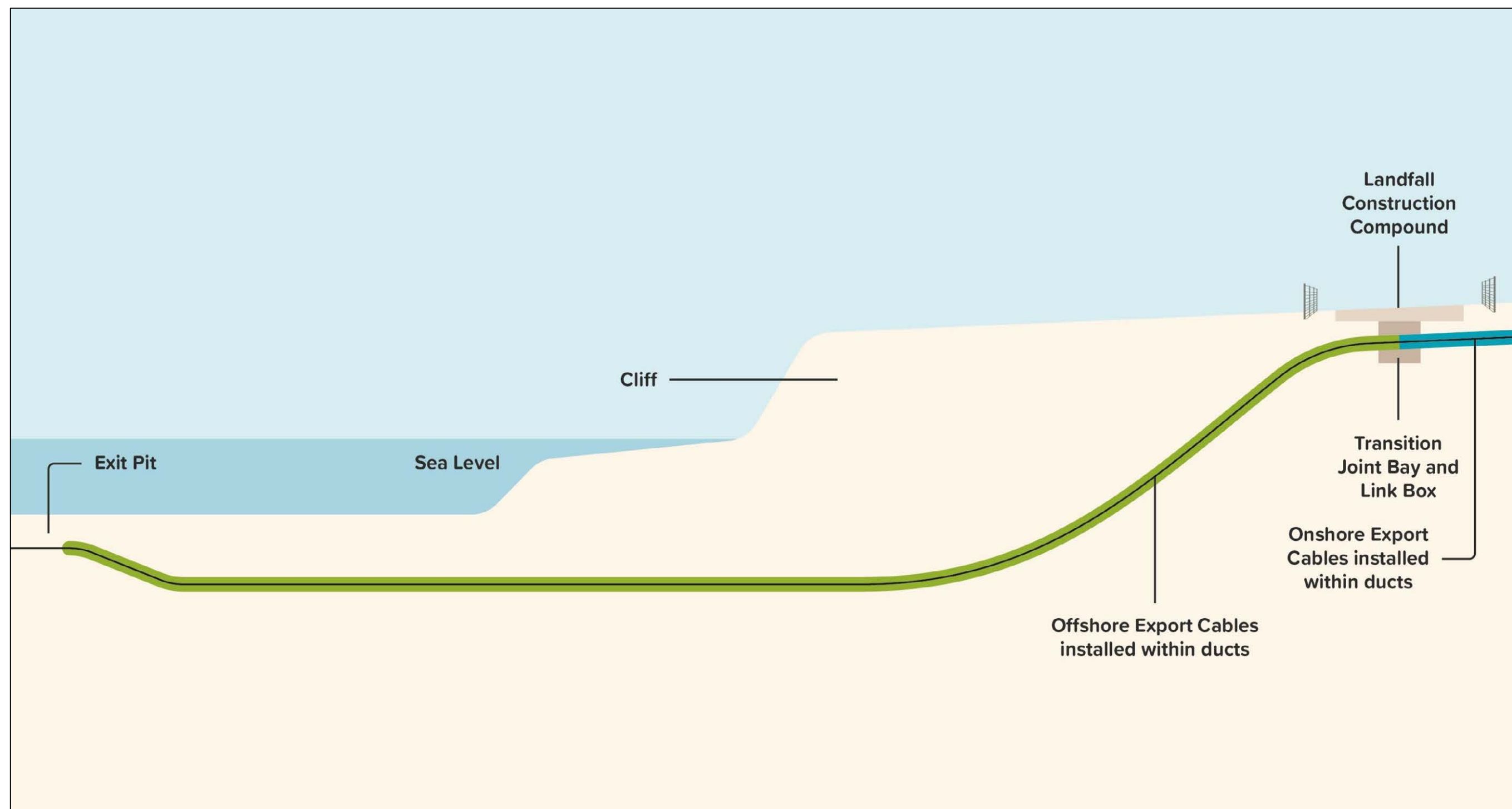


Plate 2-8 Indicative Cross-Section of Landfall Trenchless Installation Works



Plate 2-9 Example TJB during Construction (Left) (Source: Dogger Bank C) and Example Underground Link Box during Operation (Right, Note: Only manhole cover to the underground link box will be visible at ground level) (Source: Dogger Bank A & B)

119. **Table 2-24** provides the key design parameters for the landfall infrastructure which form part of the Project Design Envelope.

Table 2-24 Project Design Envelope – Landfall Infrastructure Parameters

Parameter	Value
Maximum number of landfall cable ducts	3 (including 1 spare)
Maximum number of exit pits	3 (including 1 spare)
Indicative drill exit location (m LAT)	5 to 10 (subtidal exit below MHWS)
Maximum horizontal length of trenchless installation (m)	2,000
Indicative minimum depth of trenchless installation at cliff (m)	5
Maximum number of TJB at landfall	1

Parameter	Value
Maximum permanent TJB area (m ²)	30
Maximum number of underground link box at landfall	1
Maximum permanent underground link box area (m ²)	10
Maximum TJB and underground link box burial depth (m)	3
Maximum number of landfall construction compound	1
Indicative temporary landfall construction compound area (m ²)	12,500 (including construction footprint of TJB and underground link box)
Indicative haul road width at landfall (m)	7

2.3.3.2 Landfall Construction Activities

120. To enable the connection of the offshore and onshore export cables at the TJB, the main landfall construction activities are likely to include:

- Pre-construction activities and surveys;
- Topsoil stripping;
- Construction of the landfall construction compound;
- Construction of accesses and temporary haul road to enable site access and movement of plant, equipment and personnel;
- Trenchless duct installation works, including excavation of entry and exit pits, drilling operations and pull-in of cable ducts from barges or vessels offshore (alternatively, ducts may be pushed from onshore);
- Excavation and construction of the TJB and underground link box;
- Pull-in of the offshore export cables through the pre-installed ducts;
- Jointing of the onshore and offshore export cables at the TJB;
- Backfilling of the TJB;
- Cable testing and commissioning; and
- Site demobilisation and reinstatement works.

121. General construction practices, including construction drainage, fencing and signage, lighting, vegetation clearance and soil handling, for the onshore landfall construction works are expected to be similar to those undertaken for onshore export cable works, which are presented in **Section 2.3.4.3.4** to **Section 2.3.4.3.8**.
122. Offshore, landfall construction vessels (including but not limited to jack-up barges, multi-cat vessels and other small work boats) will be used to excavate or dredge the exit pits in the subtidal zone prior to trenchless installation works at the landfall. Following from this, vessels will be positioned at the exit pits to assist with installation activities such as handling the drill head, connecting the offshore export cables for pull-in and dive support, as well as onwards laying and burial of the offshore export cables.
123. Based on the indicative construction programme (see **Section 2.4**), the duration of landfall construction works is anticipated to be approximately three years, which would include one year of trenchless installation works. There may be a gap in the construction programme between the installation of the cable ducts and cable pull-in and jointing activities at the landfall to allow flexibility and account for variations in the timings of offshore and onshore export cable installation works. This gap will not alter the nature and sequencing of offshore and onshore construction activities required at the landfall. Therefore, the duration and scale of disturbance impacts at the landfall as assessed in the relevant technical sections (**Section 6**) remain the same regardless of the gap in the construction programme.

2.3.3.2.1 Landfall Construction Compound and Construction Accesses

124. A temporary landfall construction compound will be established onshore to accommodate construction plant and equipment such as the trenchless installation equipment, cable ducts (if installed by pushing from onshore) and welfare facilities. The compound will be used for trenchless duct installation, TJB and link box construction, cable pull-in and jointing activities. The landfall construction compound will be in place for the entire duration of landfall construction works.
125. Access to the landfall construction compound will be via Hornsea Road (B1242), and a haul road of up to 7m wide will be constructed to provide safe vehicular access to the site. **Plate 2-10** provides an illustration of a typical landfall construction compound.
126. There will be no direct access to the beach from the compound, with the only access to the beach being via an emergency access route. This will be located along the beach running south to the landfall from an emergency laydown area at the end of North Turnpike Road. No permanent access improvement works will be undertaken along the beach, but temporary works to extend North Turnpike Road to connect to the beach and maintain ramp access in the event of coastal erosion may be required. This access and laydown area will only be in place for the duration of landfall construction works and used in the event of emergencies such as in response to a drilling fluid frac-out event.



Plate 2-10 Example of a Landfall Construction Compound (Note: Compound will be dependent on the selected trenchless installation technique at landfall) (Source: Dogger Bank A & B)

2.3.3.2.2 Trenchless Duct Installation

127. Prior to trenchless installation works, a temporary working platform will be established, and entry pits will be excavated within the landfall construction compound to allow the trenchless installation equipment to be positioned in place. Exit pits will be excavated or dredged in the subtidal zone to capture drill arisings, drilling fluid and the drill head when it emerges from the seabed.
128. Trenchless installation of cable ducts will involve drilling a bore through which the ducts will be pulled into position from the exit pit. Alternatively, installation of cable ducts may involve pushing the ducts into the bore from land. Trenchless installation will start from the entry pits and travel underneath the beach before emerging from the seabed at the exit pits.

129. Trenchless installation operations may involve the use of drilling fluid, which is typically a mixture of water, bentonite and other additives. Drilling fluid would be continuously pumped through the installation equipment to the entry pit to facilitate the removal of spoil, stabilise the bore and lubricate the installation of cable ducts. A drilling fluid management system will be implemented at the landfall construction compound to control the volume of drilling fluid used, process and recycle returned drilling fluid and monitor the risk of frac-out events. Steps will be taken to control the volume of drilling fluid entering the marine environment at the point of drill head punch-out. This may include reducing the concentration of additives / drilling fluid, as the drill head approaches the exit pits and installation of a return line to recover and recycle the drilling fluid from the exit pits. An alternative drilling fluid management system may be installed on offshore vessels.
130. Once the bore is in place, the cable ducts will be assembled off-site, floated into position at the drill exit location from vessels and pulled into the bore from the exit pits towards the entry pits. Alternatively, the cable ducts could be assembled onshore at the landfall construction compound and pushed into the bore from the entry pits towards the exit pits. Should there be a gap in the construction programme between the duct installation and the pull-in of the offshore export cables, the duct ends may be capped and buried to prevent sediment ingress, and the exit pits may be temporarily backfilled. Once installed, the ducts will be pigged using compressed air or water to remove any debris, and a messenger wire will also be installed within the ducts to facilitate cable installation. In the event of failure during duct installation, the bore would be filled, and a further attempt made at another bore.
131. Due to the trenchless nature of duct installation, prolonged periods of access restrictions or closures to the beach will not be required, but emergency landfall works may be required to be performed on the beach, which in those circumstances would involve short periods of restricted access.

2.3.3.2.3 Transition Joint Bay and Link Box Construction

132. The TJB and associated underground link box will be constructed within the landfall construction compound behind the entry pits. A pull-in winch and ancillary equipment will be installed for the cable pull-in operations. The TJB and link box may either be constructed during the completion of trenchless installation works or prior to the cable pull-in.
133. Construction activities will likely involve:
- Topsoil stripping;
 - Subsoil excavation;
 - Dewatering of the excavation using pumps (if required);

- Installation of the reinforced concrete slab base for the TJB (and if required, installation of reinforced concrete walls and roof structure following cable pull-in and jointing operations);
- Installation of the reinforced concrete chamber, manhole cover and bollards, fences or similar (if required) for the link box in proximity to the TJB; and
- Temporary backfill and subsequent re-excavation of the TJB using suitable backfill material (should there be a gap between TJB construction and cable pull-in and jointing).

2.3.3.2.4 Cable Pull-In and Jointing

134. Upon the arrival of offshore export cable installation vessels at the drill exit location, the exit pits and TJB will be re-exposed (as required), and the cable duct ends will be uncapped. The messenger wire pre-installed within the ducts will be retrieved and connected to the onshore cable winch. The winch wire will then be pulled through the ducts to the offshore cable installation vessel where the winch wire will be connected to the offshore export cable pull head. The pull-in winch at the landfall construction compound will be used to pull the offshore export cables through the pre-installed ducts towards the TJB. The offshore and onshore export cables will then be jointed at the TJB, and cable testing and commissioning will be undertaken.

2.3.3.2.5 Reinstatement and Site Demobilisation

135. Following cable pull-in and jointing operations, the cable ducts will be surrounded with bentonite or another suitable material, and both ends of the cable ducts will be sealed using flanges. The TJB will be backfilled with cement bound sand and excavated subsoil, and the exit pits will be backfilled with side-cast material or left to naturally backfill. Once installation is complete, the export cables will be buried at both ends.
136. Upon completion of landfall construction works, construction plant and equipment and vessels will be demobilised, and topsoil at the landfall construction compound (including the TJB) and along the haul road will be reinstated to pre-construction conditions as far as practicable.

2.3.3.3 Landfall Operation and Maintenance

137. Routine non-intrusive inspection works at the landfall is anticipated to consist of a visit to the TJB and associated underground link box every six months for cable joint inspection and monitoring. Personnel access would be taken from the manhole cover installed on top of the link box. As the haul road will not be in place during operation, suitable off-road vehicles will be used for access.
138. Maintenance of landfall infrastructure during operation is expected to be minimal. Unplanned emergency maintenance works to address faults will be undertaken as and when necessary and, depending on the nature of the repair, may involve intrusive works such as excavation of the TJB and removal and replacement of the faulty equipment with spare parts.

2.3.3.4 Landfall Decommissioning

139. The final decommissioning strategy of the Project's landfall infrastructure has not yet been decided. Where appropriate, the export cables and other buried infrastructure at the landfall, such as the TJB, underground link box and cable ducts, may be left in-situ. If the infrastructure is considered unsuitable to be left in-situ at the time of decommissioning, these components will be excavated and removed from the ground, and the land above will be reinstated. Where practicable, materials and components would be recovered and recycled.
140. The final decommissioning methodology will adhere to regulatory requirements and industry best practice at the time of decommissioning and outlined in the relevant decommissioning management plans for offshore and onshore works (i.e. Offshore Decommissioning Programme and Onshore Decommissioning Plan), which will be submitted and agreed with the relevant authorities pre-construction and prior to onshore decommissioning works respectively.

2.3.4 Onshore Export Cable Corridor

141. The onshore export cable works includes all the electrical transmission infrastructure required to connect the onshore export cables from the TJB at landfall to the OCS zone and onwards to the grid connection point at Birkhill Wood Substation.

142. For the purposes of the PEIR assessment, the Onshore Development Area includes a broad onshore ECC with a width of 200m. At certain locations, the corridor width varies for limited lengths to account for specific environmental, land or engineering constraints. The temporary and permanent land requirements for the onshore export cable infrastructure will be accommodated within this broad onshore ECC.
143. The onshore ECC will be further refined through site selection, consideration of stakeholder feedback and further engineering and environmental information and confirmed in the ES for the DCO application. The corridor width presented at ES stage will be sufficient to allow flexibility for micro-siting infrastructure within the onshore ECC during detailed design post-consent.

2.3.4.1 Description of Onshore Export Cables

144. Two types of onshore export cable systems will be required for the Project. These are up to 500kV High Voltage Direct Current (HVDC) cables and 400kV High Voltage Alternating Current (HVAC) cables¹. The primary method of cable installation for both types of cables will be ducted cable installation. The onshore export cables will be buried along the entire length of the onshore ECC.
145. The HVDC export cable system will consist of a maximum of a single circuit² laid in two trenches from the TJB at landfall to the OCS zone. The circuit will contain two HVDC power cables and one fibre optic cable. The HVAC export cable system will consist of a maximum of four circuits laid in four trenches from the OCS zone to Birkhill Wood Substation. Each circuit will contain three HVAC power cables and one fibre optic cable.
146. The power cables will be used for electricity transmission, while the fibre optic cables will enable communications between infrastructure components and performance monitoring during operation. The final cable system design for the HVDC and HVAC export cables will be determined during detailed design post-consent.
147. During construction, the standard corridor width for the HVDC export cable system will be approximately 32m and 55m for the HVAC export cable system. The temporary construction corridor will consist of the cable trenches, working areas for the jointing bays and link boxes, soil storage areas, temporary construction compounds, haul roads and other temporary infrastructure such as construction drainage. At trenchless crossing locations and where additional land is required for engineering flexibility, the corridor width would extend to approximately 50m for the HVDC export cable system and 60m for the HVAC export cable system.

1. ¹ HVDC and HVAC are two types of electricity transmission technologies. HVDC uses direct current and is suited for transmitting electricity over long distances to minimise transmission losses. HVAC uses alternating current to transmit electricity over short to medium distances and is used to ensure compatibility for grid connection into the national electricity transmission and distribution network.

2. ² Within this chapter, a cable circuit refers to a collection of cables, which for the onshore export cables, comprise power and fibre optic cables.

148. The majority of export cable works within the onshore ECC will be undertaken using open cut trenching. Where this method is not suitable, trenchless installation techniques will be adopted. For both HVDC and HVAC export cable systems, power and fibre optic cables will be pulled into pre-installed ducts laid within trenches where open cut trenching is used or bores where a trenchless installation technique is used.
149. Cable circuits are typically installed in a trefoil (cables banded together in a triangular shape) or flat (cables laid adjacent and horizontally) arrangement. **Plate 2-11** provides indicative cross-sectional drawings to illustrate the typical layout of the temporary construction corridor for the HVDC and HVAC export cable systems, noting that the arrangement of the cable circuits are also indicative. The final design and layout of the temporary construction corridor and circuit arrangement of the HVDC and HVAC export cable systems will be subject to further pre-construction surveys and engineering studies and confirmed during detailed design post-consent.
150. **Table 2-26** provides the key design parameters for the onshore export cables.

Table 2-25 Project Design Envelope – Onshore Export Cable Parameters

Parameter	Value
Maximum length of HVDC export cable corridor (km)	50 (from landfall to OCS zone)
Maximum length of HVAC export cable corridor (km)	5 (from OCS zone to Birkhill Wood Substation)
Maximum number of HVDC export circuits	1
Maximum number of HVAC export circuits	4
Maximum number of cable ducts for HVDC export cables	3 (including 2 power cable ducts and 1 fibre optic duct)
Maximum number of cable ducts for HVAC export cables	16 (including 12 power cable ducts and 4 fibre optic ducts)
Maximum number of trenches of HVDC onshore export cables	2
Maximum number of trenches of HVAC onshore export cables	4
Indicative width of trench at surface (m)	3
Target minimum cable burial depth using open cut trenching (m)	1.2
Target minimum cable burial depth using trenchless installation techniques (m)	3.5

Parameter	Value
Target maximum cable burial depth using trenchless installation techniques (m)	20
Indicative temporary construction corridor width for HVDC onshore export cables (m)	32 (50 at trenchless crossing locations)
Indicative temporary construction corridor width for HVAC onshore export cables (m)	55 (60 at trenchless crossing locations)
Indicative haul road width within temporary construction corridor (m)	6 (8.5 where passing places are required)
Indicative haul road passing place frequency (m)	250
Indicative number of main construction compounds for onshore export cable works	4
Indicative main construction compound area (m ²)	20,000 (per compound)
Indicative number of intermediate construction compounds for onshore export cable works	8
Indicative intermediate construction compound area (m ²)	5,625 (per compound)
Indicative number of trenchless crossing locations	70
Indicative trenchless installation compound area for HVDC export cables (m ²)	300 (5,625 for non-HDD techniques) (per compound)
Indicative trenchless installation compound dimensions for HVAC export cables ((m ²))	800 (5,625 for non-HDD techniques) (per compound)
Maximum land area temporarily disturbed during construction (m ²)	1,700,000
Indicative width of operational easement for HVDC export cables (m)	20
Indicative width of operational easement for HVAC export cables (m)	25

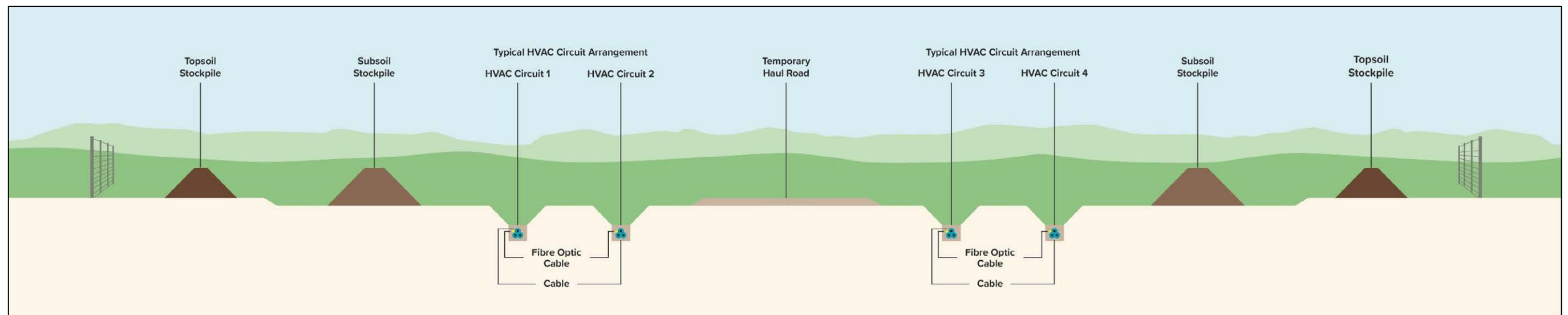
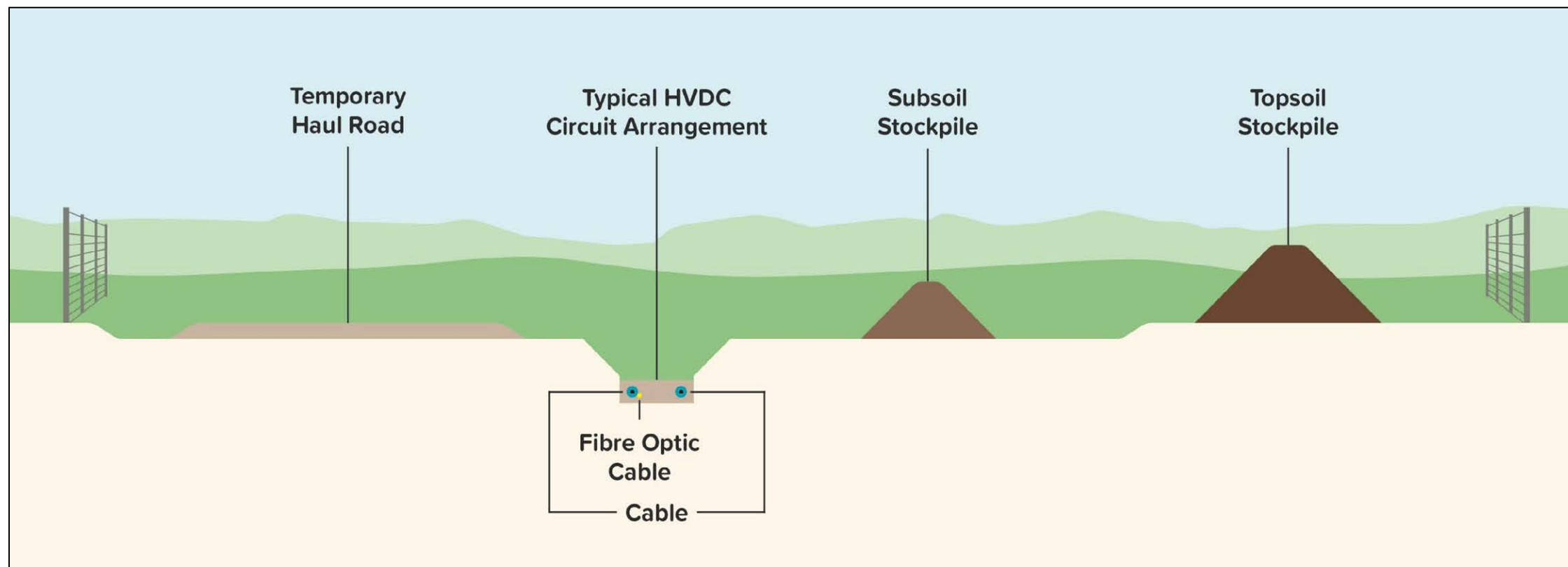


Plate 2-11 Indicative Cross-Sections of Temporary Construction Corridor for the HVDC Export Cables (top) and HVAC Export Cables (bottom)

2.3.4.2 Description of Jointing Bays and Link Boxes

151. Along the onshore ECC, jointing bays will be constructed at regular intervals to enable cable pull-in and jointing of discrete sections of onshore export cables. Jointing bays are underground reinforced concrete structures and are buried at depth, allowing land to be reinstated and returned to pre-construction conditions as far as practicable following completion of construction. Jointing bays are constructed using a cast in-situ concrete slab and may either have reinforced concrete walls with a reinforced concrete cover or comprise of the slab only with cement bound sand and other suitable soils used as backfill to protect the cable joints. Jointing bays along the onshore ECC are similar in appearance to the TJB at landfall (as illustrated on **Plate 2-12**).



Plate 2-12 Example of an Underground Link Box (Left) ((Source: Dogger Bank A & B) and an Above-Ground Link Box (Right) (Note: This includes temporary fencing during construction) (Source: Dogger Bank B)

152. Link boxes will be installed at regular intervals in proximity to jointing bays to allow for inspection and monitoring of cable joints during operation. Along the onshore ECC, link boxes may either be installed underground with a manhole cover at ground level to provide access or as above-ground structures. Underground link boxes comprise a similar reinforced concrete enclosure to the jointing bay but with a smaller footprint. Above ground link boxes will be constructed as metal or glass-reinforced plastic kiosks laid on concrete pads. Link boxes will be typically marked / protected by bollards, fences or similar of approximately 1.2m to 2m in height (where required and agreed with the relevant landowners). An example underground and above-ground link box are shown on **Plate 2-12**.

153. For the purposes of the PEIR assessment, it is assumed that at approximately 20 (see **Table 2-26**) link box locations for the HVDC export cables and all link box locations for the HVAC export cables will involve the use of above-ground link boxes.

Table 2-26 Project Design Envelope – Jointing Bay and Link Box Parameters

Parameter	Value
Indicative number of jointing bay locations along onshore ECC	62
Maximum permanent jointing bay area (m ²)	30 (per jointing bay)
Maximum jointing bay burial depth (m)	2.5
Indicative number of link box locations along onshore ECC	56
Maximum permanent underground link box area (m ²)	4 (per link box)
Maximum permanent above-ground link box area (m ²)	3 (per link box)
Maximum underground link box burial depth / above-ground link box height (m)	2
Maximum jointing bay and link box temporary construction area for HVDC export cables (m ²)	660 (per location)
Maximum jointing bay and link box temporary construction area for HVAC export cables (m ²)	1,040 (per location)

154. **Table 2-26** provides the key design parameters for jointing bays and link boxes within the onshore ECC. The final design, number and locations of the jointing bay and associated link boxes will be determined during detailed design post-consent. Where agreed with the relevant landowners and subject to detailed design and construction requirements, link boxes along the onshore ECC will be located at or as close to field boundaries as reasonably practicable.

2.3.4.3 Onshore Export Cable Construction Activities

155. The main construction works within the onshore ECC will be similar for both HVDC and HVAC export cables and are likely to include:
- Pre-construction activities and surveys;
 - Topsoil stripping;
 - Construction of temporary construction compounds;

- Construction of accesses and temporary haul roads to enable site access and movement of plant and equipment and personnel along the corridor;
 - Installation of other temporary infrastructure such as drainage, culverts and bridges to facilitate site access and construction works or where mitigation measures are required due to close proximity or crossing of sensitive receptors;
 - Excavation of cable trenches and installation of cable ducts using open cut trenching;
 - Installation of cable ducts using trenchless installation techniques to avoid obstacles;
 - Backfilling of cable trenches;
 - Excavation and construction of jointing bays and link boxes;
 - Pull-in of the onshore export cables and jointing at jointing bay locations;
 - Backfilling of jointing bays;
 - Cable testing and commissioning; and
 - Reinstatement and site demobilisation.
156. Prior to the commencement of construction, pre-construction surveys, such as ground investigations, geophysical, UXO, utility, drainage, topographical and environmental surveys, will be undertaken to inform the detailed design and construction methodology of onshore export cable works and ensure required mitigation works are in place. Pre-construction activities will also be undertaken to secure and prepare the site for construction works. Further details of pre-construction surveys and activities are provided in the **Outline Code of Construction Practice** (document reference 8.9) provided with the PEIR.
157. The onshore ECC will be segmented into corridor sections, with each section to constructed separately. Construction will progress along the entire length of the onshore ECC from the landfall to the OCS zone and onwards to Birkhill Wood Substation. Works will be undertaken concurrently at multiple sections at any given time to ensure construction efficiency. In any given section, the sequence of construction activities will be similar, as presented above, but the duration of construction at each section will depend on resource availability, length of section, weather and site conditions and other engineering challenges that may arise.
158. Based on the indicative construction programme (see **Section 2.4**), the duration of export cable works along the onshore ECC is anticipated to be approximately four years.

2.3.4.3.1 Temporary Construction Compounds

159. Three types of temporary construction compounds (shown on **Plate 2-13**, **Plate 2-14** and **Plate 2-15**) will be required for construction works within the onshore ECC:

- Main construction compounds, which will be positioned at strategic locations along the onshore ECC with good vehicular access from the public highway. These compounds will enable overall construction management throughout the duration of onshore export cable works and will serve as logistics hubs for activities such as controlling deliveries to site;
- Intermediate construction compounds will be positioned between the main construction compound locations and will be smaller in size than the main construction compounds. These compounds will serve as localised support bases for the main construction compounds as works in a corridor section pass through an area and will have direct access to the temporary construction corridor; and
- Trenchless installation compounds will be established at each location where a trenchless installation is undertaken at the entry and exit pits.



Plate 2-13 Example Main Construction Compound for Onshore Export Cable Works (Source: Dogger Bank C)



Plate 2-14 Example Intermediate Construction Compound for Onshore Export Cable Works (Source: Dogger Bank C)



Plate 2-15 Example Trenchless Installation Compound for Onshore Export Cable Works (Note: Compound dependent on the selected trenchless installation technique at each crossing) (Source: Dogger Bank C)

160. Main and intermediate construction compounds are anticipated to remain in place for approximately three years at each location. Trenchless installation compounds will be in place for the duration of trenchless installation works (approximately two years at each location).
161. The main construction compounds are likely to include laydown areas for construction materials and plant and equipment, storage areas for construction waste, bunded storage areas, vehicle parking areas, welfare facilities, wheel washing facilities, workshops and offices.
162. Intermediate construction compounds may house welfare facilities, workshops and offices, smaller laydown areas for construction materials and plant and equipment and storage areas for construction waste.
163. Trenchless installation compounds will house the trenchless installation equipment (such as HDD drilling rig), control room, power packs and generators, drilling fluid management system, laydown area for construction materials and plant and equipment, storage areas for construction waste, welfare facilities, workshops and offices.
164. Where there is no existing hardstanding, temporary construction compounds will be constructed by stripping and storing the topsoil for reinstatement, laying a geotextile membrane or similar directly on top of the subsoil and spreading crushed stone or other aggregates to create a suitable hardstanding area.
165. All temporary construction compounds for the onshore export cable works will be located within the Onshore Development Area. These locations will be confirmed for the DCO application and presented in the ES. The final micro-siting and layout of each temporary construction compound within the compound areas identified in the ES will be determined during detailed design post-consent.

2.3.4.3.2 Construction Accesses

166. Construction accesses are required to allow construction traffic to access and egress from the haul road and temporary construction compounds onto the public highway.
167. Where practicable, construction accesses have been identified using existing field accesses or other suitable access points from the public highway. These will be subject to further refinement for the DCO application and presented in the ES.
168. Construction accesses will comprise an area of concrete, asphalt or other suitable hardstanding material. To allow the accesses to be constructed and subsequently removed, a working area of approximately 10m has been included within the Onshore Development Area around each access and crossing point.

169. To allow construction traffic to egress safely from each access or crossing point, visibility splays have been identified to allow drivers to see oncoming traffic from both directions at a junction. Where visibility splay works are required, a working area with an offset of approximately 5m to the rear of the splay has been included within the Onshore Development Area to allow space for construction plant and equipment to operate.
170. Temporary modifications works to the public highway may be required to enable construction access at specific locations, such as where existing roads are too narrow to allow two-way movements. These modifications may include:
- Localised road or junction widening;
 - New or improved passing places and bellmouths;
 - Upgrades to the surfacing of existing farm tracks;
 - Relocation of street signs and furniture; and
 - Creation of new junctions off existing highways.
171. Traffic management measures to facilitate construction access are further detailed in the draft **Outline Construction Traffic Management Plan** (document reference 8.15) provided with the PEIR.
172. Further details on proposed construction accesses for the onshore ECC are provided in **PEIR Volume 1, Chapter 26 Traffic and Transport** of the PEIR. The final locations of construction access points, outline access design and details on the temporary modification works required will be confirmed for the DCO application and presented in the ES, with detailed access design to be determined post-consent.

2.3.4.3.3 Haul Road

173. A temporary haul road will be installed along the entire length of the onshore ECC to allow construction access to the temporary construction corridor, construction compounds and enable the movement of construction plant and equipment and personnel. The haul road will run parallel to the cable trenches with drainage and verges on either side. Passing places will be provided at regular intervals to allow safe two-way movements of vehicular traffic, plant and equipment.
174. Construction of the haul road will involve:
- Topsoil stripping;
 - Placement of a geotextile membrane, or similar protective matting, onto the subsoil; and
 - Placement of suitable graded aggregates to form hardstanding.

175. The final material specification and design of the haul road will be determined during detailed design post-consent and will be informed by ground investigations, load bearing requirements and any necessary protection of underground utilities and other third-party assets. Alternative design considerations will be considered as appropriate during detailed design stage such as the use of temporary metal trackways and geogrid reinforcement to reduce the thickness of hardstanding aggregates.
176. Where trenchless installation techniques are being used to bypass an obstacle, there may still be a requirement for the haul road to cross the obstacle. In these cases, temporary culverts or bridges may be installed to enable continuous access along the onshore ECC. At major obstacle crossings and sensitive locations such as main rivers, there will be a break in the haul road, which will continue on either side of the obstacle.
177. It is likely that the haul road will be removed and land reinstated as construction activities in each corridor section are completed. However, some sections of the haul road may be retained to maintain access for cable pull-in and jointing operations at remote jointing bay locations that could not be accessed from the public highway or due to other construction requirements. As a worst-case scenario, it is assumed within the PEIR that the haul road along the entire length of the onshore ECC may need to be retained until the completion of all onshore export cable construction activities. The extent of the haul road required to be retained will be determined upon completion of the duct installation works, with the intention to reinstate as much haul road as practicable.
178. Following the completion of onshore export cable works, the entire length of the haul road within the onshore ECC will be removed, and the land reinstated to its previous condition as far as practicable.

2.3.4.3.4 Construction Drainage

179. A temporary drainage system will be installed to manage surface water run-offs and flows during construction and connect into the local drainage network. Prior to construction, temporary drainage measures will be installed along the length of the temporary construction corridor. Post-construction, land drainage within the corridor will be reinstated to pre-construction conditions as practicable, including replacing any drains that were damaged or altered during construction.
180. The final temporary drainage design for onshore export cable works will be developed post-consent, taking into account existing land drainage, outfalls and other drainage features. The design will include a pre-construction and post-construction drainage scheme and detail works required where the temporary construction corridor intercepts land drainage during construction. Further details of temporary surface water management measures and approaches to the reinstatement and maintenance of land drainage to be adopted during construction are set out in the **PEIR Outline Code of Construction Practice** (document reference 8.9) provided with the PEIR.

181. Drainage ditches and watercourses which are expected to be encountered along the onshore ECC during construction have been assessed in **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** of the PEIR. The assessment includes details on how watercourses and land drainage are to be managed or diverted where interactions with the onshore export cable works are identified. Watercourses and drainage ditches will be identified, and their locations recorded during pre-construction topographical surveys of the onshore ECC.

2.3.4.3.5 Construction Fencing and Signage

182. Suitable demarcation fences will be established along the length of the temporary construction corridor and around temporary construction compounds to separate the works area from the general public. The type of temporary fencing will be dependent on the ground conditions and location requirements along the corridor and the nature of construction activities.
183. Discrete temporary works area such as at jointing bays and along construction accesses from the public highway may also be fenced off as required. Appropriate security measures such as gated access and signage will be implemented to ensure the general public is aware of the construction activities within the area.
184. Further details of construction fencing and signage are set out in the **PEIR Outline Code of Construction Practice** (document reference 8.9) within the PEIR.

2.3.4.3.6 Vegetation Clearance

185. Where vegetation (such as hedgerows and trees) is present within the temporary construction corridor, vegetation clearance such as removal or strimming may be required. Ecological and landscape mitigation such as adherence to seasonal constraints, pre-construction surveys and root protection areas will be adhered to as appropriate. Vegetation clearance will be limited to the required working width or area to enable construction activities within the temporary construction corridor and access to the corridor. Where hedgerows and trees can be avoided by micro-siting during detailed design, vegetation will be retained as practicable. Further details on ecological and landscape mitigation measures to be implemented during vegetation clearance works will be provided in the Outline Ecological Management Plan (EcoMP), Outline Landscape Management Plan (LMP) and Outline Arboricultural Method Statement which will be developed at the ES stage.

2.3.4.3.7 Soil Handling

186. Soil handling activities will be required within the temporary construction corridor to provide suitable ground for construction activities. Stripped topsoil and excavated subsoil will be stored as stockpiles within designated areas along the temporary construction corridor and adjacent to where it is removed where practicable to facilitate reinstatement once construction activities are complete.
187. Soil stockpiles will be created by:
- Clearing the area of any vegetation and waste arisings before forming stockpiles;
 - Stripping topsoil for areas to be used for subsoil storage;
 - Storing topsoil and subsoil layers separately;
 - Locating stockpiles away from trees, hedgerows, drains, watercourses or excavations;
 - Managing the site so that soil storage periods are kept as short as practicable;
 - Using tracked equipment wherever practicable to reduce soil compaction; and
 - Protecting stockpiles from erosion by sealing, seeding or covering them.
188. Stored topsoil and subsoil will be used for reinstatement at the site where it originated. Excess soil arisings will be used on site where practicable for earthworks and landscaping, with unsuitable material being removed from site for suitable recycling or disposal.
189. Further details of soil management measures to be adopted during construction are set out in the **Outline Code of Construction Practice** (document reference 8.9) within the PEIR.

2.3.4.3.8 Construction Lighting

190. Temporary lighting within the temporary construction corridor and temporary construction compounds will be dependent on the season, timing and the nature of construction activities. Construction activities will be typically undertaken during daylight hours, but construction lighting may be required where night time or continuous working is proposed or in low light conditions during normal working hours.
191. When lighting is necessary, directional task lighting will be used to minimise glare and nuisance. Temporary construction lighting will be designed and positioned to ensure the necessary levels for safe working and site security, minimise light spillage and prevent disturbance to surrounding residents, wildlife and passing drivers on railways and the public highway. Specific construction lighting measures will be determined during detailed design post-consent.

192. Further details of construction lighting are set out in the **Outline Code of Construction Practice** (document reference 8.9) within the PEIR.

2.3.4.3.9 Open-Cut Trenching Duct Installation

193. During excavation of the cable trenches, topsoil will be stripped from the temporary construction corridor, and the subsoil will be excavated to form trenches of the required dimensions. The depth of the trench will depend on the required cable burial depth based on locational constraints and will therefore vary along the onshore ECC and will be determined during detailed design post-consent. To prevent collapse of the trench side walls while the trench remains open, installation of appropriate shuttering or similar temporary support may be required. **Plate 2-16** provides an illustration of a typical open cut trench.

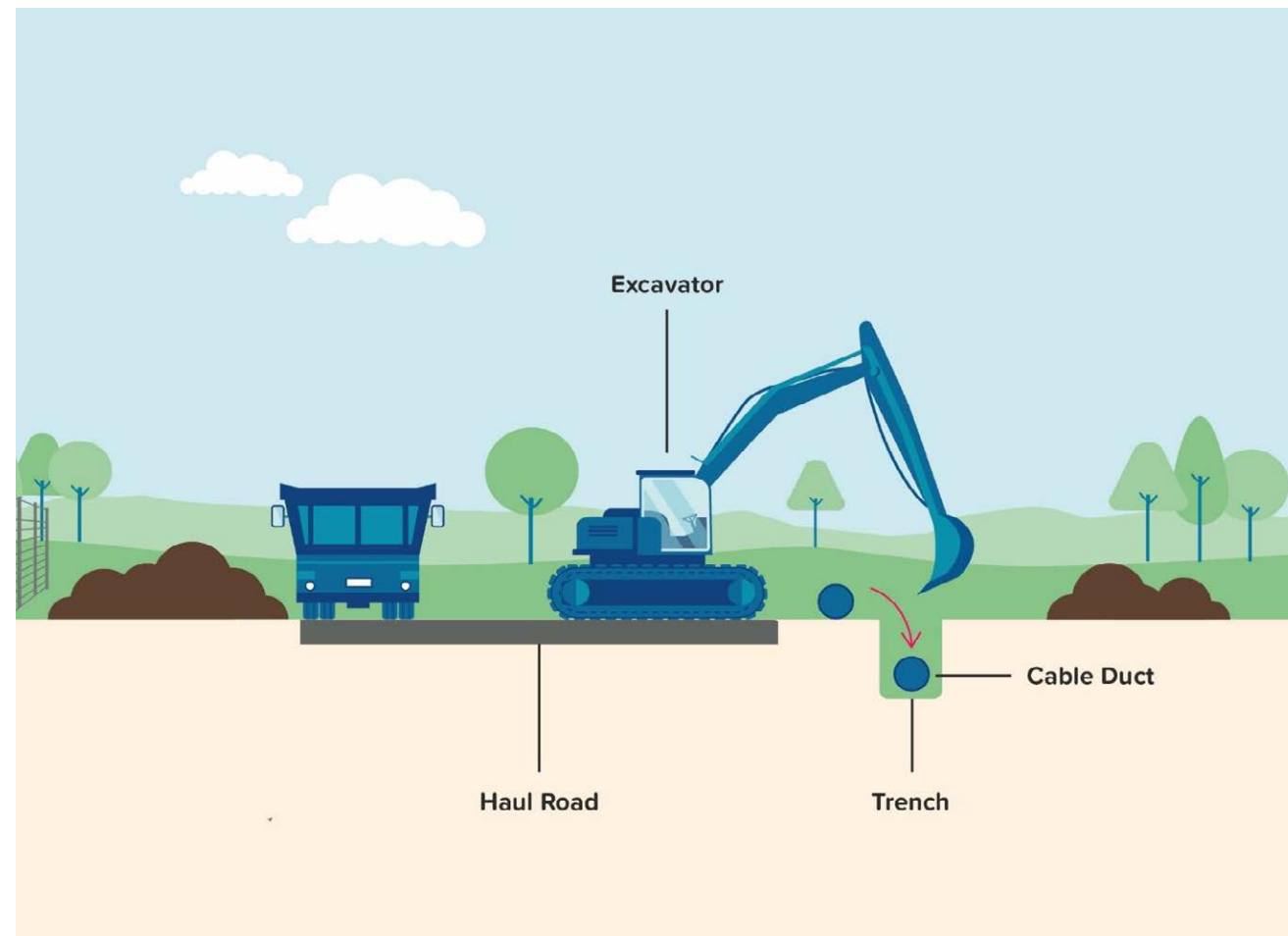


Plate 2-16 Indicative Cross-Section of Open Cut Trenching Duct Installation

194. The base of the cable trench will be prepared by removing obstructions such as rocks and depositing a layer of stabilised backfill (likely to be cement bound sand) as bedding material to provide protection under the cable ducts. During duct installation, dewatering of the trench using pumps may be required to provide a dry working environment. Cable ducts will be laid within the excavated trenches.
195. Following duct installation, the cable trenches will be backfilled with an imported thermally stabilised backfill (likely to be cement bound sand), ensuring that the ducts are encased within a consistent structural and thermal environment. Protective cable tiles or slabs and warning marker tape will be placed on top of the cable ducts to clearly demarcate the location of installed cables and reduce the risk of damage during future excavation works.
196. Backfilling of the cable trenches will be undertaken in stages using the stored subsoil, followed by the topsoil, to reinstate the trench to pre-construction conditions as practicable. As trenches will be backfilled and land reinstated as soon as practicable following completion of duct installation activities within each corridor section, the duration of open excavations along the onshore ECC will be minimised.

2.3.4.3.10 Obstacle Crossings

197. A draft Onshore Crossing Schedule is provided in **PEIR Volume 2, Appendix 4.3 Crossing Schedule - Onshore** within the PEIR to identify the locations of obstacle crossings along the onshore ECC and the proposed crossing methodologies at each location based on the design information available at this stage. The Onshore Crossing Schedule will be updated in the ES, considering stakeholder feedback and further engineering and environmental information, for the DCO application.
198. Each obstacle crossing will be individually reviewed during detailed design post-consent to confirm the crossing methodology based on pre-construction surveys and engineering design studies. Where flexibility is retained to either undertake duct installation using open cut trenching or a trenchless installation technique, the worst-case scenario will be assumed within the PEIR.

2.3.4.3.11 Trenchless Duct Installation Techniques

199. Where open cut trenching is unsuitable due to major obstacle crossings, trenchless installation techniques will be used to install the cable ducts by drilling underneath the surface constraints. The use of a trenchless installation technique will include, but are not limited to, the following crossing locations:
- Environment Agency's Main Rivers and any associated flood defence structures and Internal Drainage Board (IDB) owned or maintained drains;
 - Railway lines;

- Major roads (e.g. motorways, A roads and B roads);
- Internationally, nationally and locally designated ecological sites and other sensitive ecological / landscape features such as woodland areas; and
- Major third party assets (e.g. national gas mains, pipelines and onshore transmission assets associated with other energy infrastructure developments).

200. It is likely that Horizontal Directional Drilling (HDD) will be used at each trenchless crossing where practicable. However, several trenchless installation techniques are considered within the Project Design Envelope (as illustrated on **Plate 2-17** and **Plate 2-18**) to retain engineering flexibility. The specific type and crossing design at each trenchless crossing will be determined during detailed design post-consent based on ground investigations and other pre-construction surveys.

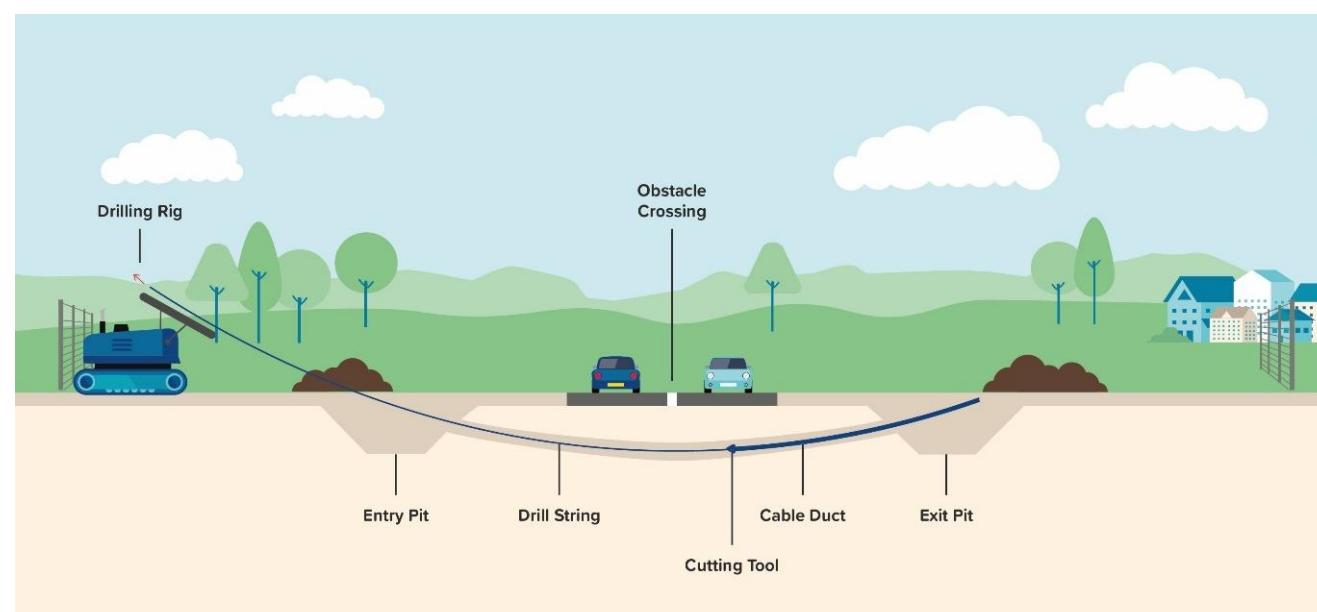


Plate 2-17 Indicative Cross-Section of Trenchless Duct Installation (Note: Arrangement dependent on the selected trenchless installation technique at each crossing. HDD anticipated to be the most common technique for trenchless obstacle crossings)

201. Prior to installation works, trenchless installation compounds will be established at the entry and exit pits on either side of the crossing. Trenchless installation of cable ducts will utilise a suitable trenchless installation equipment to drill a bore through which the ducts will be pulled into position from the exit pit, or alternatively, the drilling and installation of cable ducts can occur simultaneously by pushing the ducts forward as the bore is drilled from the entry pit.

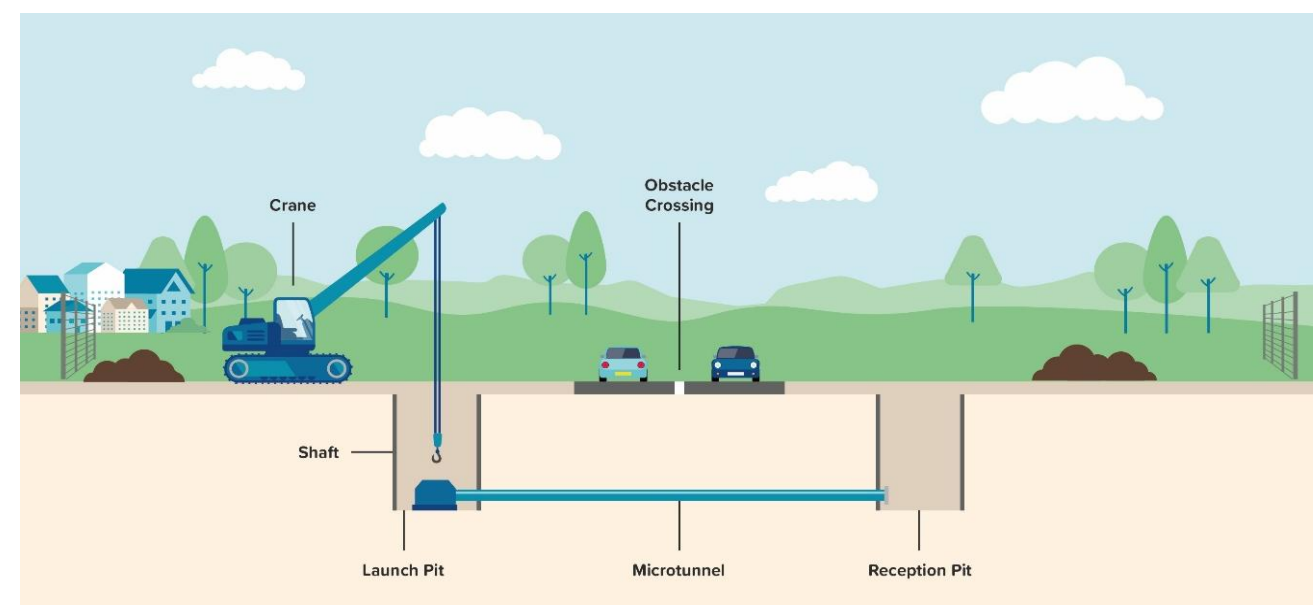


Plate 2-18 Indicative Cross-Section of Trenchless Duct Installation (Note: Arrangement dependent on the selected trenchless installation technique at each crossing, alternative techniques to HDD such as micro-tunnelling or pipe-jacking are also considered)

202. Trenchless installation will start from the entry pit and travel underneath the surface constraint before emerging at the exit pit. At specific crossings, trenchless installation works may require continuous working, depending on the length of the crossing and locational constraints. A description of each trenchless installation technique under consideration is provided below:

- HDD involves using a guided drilling rig to bore an initial narrow diameter pilot hole, followed by passing a larger cutting tool through to progressively enlarge the bore to the required diameter for duct installation. Once the drilling operation is complete, ducts are installed into the bore by pulling from the exit pit. HDD does not typically require the construction of deep temporary supported pits or shafts on either side of the crossing, and the entry and exit pits tend to be relatively small.
- Auger boring involves using a guided rotating auger head to bore a hole through the ground, with cutting spoil removed to the entry pit by auger flights rotating within a steel casing. Steel casing sections are welded together and pushed forward from the entry pit using a jacking system. Auger boring is suitable in most ground conditions, with the exception of sandy soil or where obstructions such as cobbles or boulders are present. Auger boring will require the construction of deep temporary supported pits or shafts on either side of the crossing and therefore the use of piling equipment.

- Micro-tunnelling involves using a tunnel boring machine that bores itself through the ground conveying spoil to the entry pit via conveyers. Pipe sections are jointed together and immediately follow the machine, which are installed into the bore by pushing from the entry pit using a jacking system. Micro-tunnelling can be used in most ground conditions, as the tunnel boring machine can be configured to suit the prevailing ground condition. Micro-tunnelling will require the construction of deep temporary supported pits or shafts on either side of the crossing and therefore the use of piling equipment.
- Pipe jacking or ramming involves the use of hydraulic jacks or a pneumatic pipe ramming hammer to drive forward pipe sections through the ground by physical force. Pipe sections are jointed together and placed behind a rotating cutting head or shield. Pipe jacking or ramming will require the construction of deep temporary supported pits or shafts on either side of the crossing and therefore the use of piling equipment.
- Direct pipe involves a hybrid method between HDD and micro-tunnelling. Direct pipe does not typically require the construction of deep pits on either side of the crossing, but temporary support may be required at the entry pit and therefore the use of piling equipment.

203. Depending on the technique, trenchless installation operations may involve the use of drilling fluid. Drilling fluid would be continuously pumped through the installation equipment to the entry pit to facilitate the removal of drill arisings, stabilise the bore and lubricate the installation of cable ducts. If drilling fluid is required, a drilling fluid management system would be implemented at the trenchless installation compound to control the volume of drilling fluid used, process and recycle returned drilling fluid and monitor the risk of frac-out events.

2.3.4.3.12 Minor Watercourse Crossings

204. Where minor watercourses such as field drains are to be crossed for duct installation works, this will be undertaken using open cut trenching combined with temporary damming and diversion of the watercourse.
205. The watercourse will be temporarily dammed at either side of the crossing point, typically using sandbags, straw bales or ditching clay, and water will be pumped across the dammed area for the duration of the duct installation works to maintain flow within the watercourse. The dammed area will be dewatered to provide a dry environment for open cut trenching as described in **Section 2.3.4.3.9**, and the excavated channel bed materials will be stored separately from the subsoil. Cable ducts will be installed at a depth that would avoid impacts to the active channel bed. **Plate 2-19** provides a typical illustration of temporary structures required for minor watercourse crossings.



Plate 2-19 Example Temporary Culvert Installation for Minor Water Crossings (Source: Dogger Bank C)

206. The specific methodology for minor watercourse crossing at each location will be confirmed during detailed design post-consent and agreed with the relevant authority or asset owner. Further details on measures to protect surface watercourses during construction are provided in the **Outline Code of Construction Practice** (document reference 8.9) provided with the PEIR.
207. Upon completion of duct installation works, reinstatement of the cable trenches will be undertaken to the pre-construction depth of the watercourse as practicable using the excavated subsoil and channel bed materials in the order they were removed. The temporary dams and diversions will then be removed to restore natural flow within the watercourse.
208. Haul road crossings of minor watercourses may also be required, which would involve installation of temporary culverts or bridges for the duration that the haul road is required. Construction of culverts and bridges will require temporary damming and diversion as per the methodology described above for duct installation works.

2.3.4.3.13 Minor Road and Public Rights of Way Crossings

209. Where minor roads, such as access tracks and unclassified roads, are to be crossed for duct installation works or the haul road, appropriate traffic management measures, which are fully detailed within the draft **Outline Construction Traffic Management Plan** (document reference 8.15) provided within the PEIR, will be implemented for the duration of works.
210. Where the temporary construction corridor crosses minor roads, temporary traffic crossing measures will be implemented to allow safe operation of construction vehicles and plant and equipment moving along the haul road. Single lane traffic management with signal controls to manage traffic movement will be used during duct installation works where appropriate. Where the width of the road does not allow for single lane traffic management, alternative methods such as temporary road closures or diversions for the duration of works may be used.
211. The road crossing methodology will be confirmed at detailed design stage post-consent and agreed with the relevant authority or asset owner. Should standard traffic management measures be considered unsuitable at the minor road crossing, a trenchless installation technique may be used instead.
212. Where Public Rights of Way (PRoW) are to be crossed for duct installation works or the haul road, appropriate temporary management measures such as temporary closures or diversions will be implemented to ensure continued and safe access by walkers, cyclists and horse riders, as described in the draft **Outline PRoW Strategy** (document reference 8.9.1) provided as part of the **Outline Code of Construction Practice** (document reference 8.9) within the PEIR. The PRoW crossing methodology will be confirmed at detailed design stage post-consent and agreed with the relevant authority or asset owner.
213. Open cut trenching of minor roads and PRoW will be undertaken as described in **Section 2.3.4.3.9**. Reinstatement of cable trenches will follow the same process of reinstating stored subsoil followed by topsoil but may also require reinstatement of the paved surface, such as laying of asphalt, tarmac or other paving material, to the specification agreed with the relevant authority or asset owner.

2.3.4.3.14 Third Party Asset Crossings

214. Where third party assets are to be crossed for duct installation works or the haul road, construction works will be undertaken in accordance with industry standard practice and safety guidance. The crossing methodology will be confirmed at detailed design post-consent and agreed with the relevant asset owner / operator to ensure their protection and continued operation.

2.3.4.3.15 Jointing Bay and Link Box Construction

215. In parallel to the duct installation works, jointing bays and associated link boxes will be constructed at locations along the onshore ECC where jointing of cable sections will occur.
216. Construction activities will likely involve:
- Topsoil stripping;
 - Subsoil excavation;
 - Dewatering of the excavation using pumps (if required);
 - Installation of the reinforced concrete slab base for the jointing bay (and if required, installation of reinforced concrete walls and roof structure following cable pull-in and jointing operations); and
 - Installation of the reinforced concrete enclosure for an underground link box or a kiosk overlying a concrete pad for an above-ground link box and bollards, fences or similar (if required) in proximity to the jointing bay.

2.3.4.3.16 Cable Pull-In and Jointing

217. Following the completion of duct installation works and construction of jointing bays and link boxes, onshore export cable sections will be pulled into the pre-installed ducts from jointing bay locations, therefore, cable trenches will not require re-excavation. Access to and from jointing bays via construction accesses off the public highway or the haul road will be required during this phase of works.
218. Prior to cable pull-in operations, a cable drum will typically be delivered to designated jointing bay locations, with the cable tethered to a winch cable from the adjacent jointing bay. The onshore export cable will then be winched off the cable drum from one jointing bay to another through the pre-installed ducts. Once cable sections from both directions have been installed within each jointing bay, cable jointing will be undertaken. Cable testing will be undertaken for each section of installed onshore export cables along the entire length of the onshore ECC.

2.3.4.3.17 Reinstatement and Site Demobilisation

219. Construction within the onshore ECC will be undertaken concurrently at multiple corridor sections. However, works within each section will be considerably shorter in duration than the total onshore export cable construction programme. This allows for rolling reinstatement whereby land within the temporary construction corridor between jointing bay locations will be reinstated, where practicable, as soon as construction within each section is completed.

220. Reinstatement of the cable trenches are outlined in **Section 2.3.4.3.9**, as they can be undertaken following duct installation works. Following cable pull-in and jointing operations, the jointing bays will be backfilled with cement bound sand and excavated subsoil, and topsoil will be reinstated above the jointing bay.
221. Upon completion of all onshore export cable works, construction plant and equipment will be demobilised. Temporary construction compounds, construction accesses, haul road and other temporary infrastructure along the length of the onshore ECC will be removed, and topsoil will be reinstated within these areas.
222. All areas within the temporary construction corridor will be reinstated to pre-construction conditions as practicable. Reinstatement works will also include as appropriate:
- Reinstating any land drainage removed or altered;
 - Reinstating any watercourse, minor road, PRow or third party asset temporarily diverted or disturbed; and
 - Replanting / replacement planting of hedgerows and trees removed (or relocation of trees to a suitable location if planting restrictions over the installed cables prevent replanting at the original location).

2.3.5 Onshore Converter Station Zone

223. The OCS zone contains all the electrical transmission infrastructure required to stabilise and convert electricity generated by the Project into a suitable voltage for grid connection and auxiliary energy storage and balancing equipment.
224. Within the PEIR assessment, the Onshore Development Area includes two broad zones (OCS Zones 4 and 8) of approximately 50ha and 60ha respectively, which will accommodate the construction and permanent footprint of the OCS and ESBI, including any ancillary works such as drainage, access and parking, welfare facilities, lighting, fencing, landscaping and environmental mitigation / enhancement. Both zones remain under consideration (see **PEIR Volume 1, Chapter 5 Site Selection and Consideration of Alternatives** within the PEIR), but only one zone will be taken forward to development.
225. At this stage, layout configurations of infrastructure within both OCS zones are still under consideration, and both zones are therefore considered. The OCS zones will be further refined through site selection, considering stakeholder feedback and further engineering and environmental information and confirmed in the ES and RIAA for the DCO application.

226. The Project Design Envelope with respect to the OCS and ESBI has been defined based on the maximum land and infrastructure requirements from the range of design and technology options under consideration. This is to provide a realistic worst-case assessment of their environmental impacts (e.g. spatial footprint and building massing) within the PEIR. The final layout of the OCS and ESBI will vary within the selected zone and optimised to meet technical and operational requirements, and the final design and technology specification will be determined post-consent following detailed design and procurement decisions.

2.3.5.1 Description of Onshore Converter Station

227. The OCS will comprise a fenced compound to house electrical equipment for converting the electricity generated by the Project from HVDC to 400kV HVAC, as required to meet the UK Grid Code for connection into the National Grid electricity transmission network. **Plate 2-20** provides an illustration of an example OCS.



Plate 2-20 Example Onshore Converter Station (Source: Dogger Bank C)

228. The OCS is likely to include the following key components:
- A valve hall to house DC to AC converter equipment;
 - A service building to support operation and maintenance activities;
 - A storage building;
 - A DC and AC yard containing switch gear and harmonic filters to connect the OCS to the HVDC and HVAC onshore export cables respectively;

- An outdoor transformer area containing transformers to control the voltage level with concrete fire walls between each transformer;
- An outdoor reactor yard containing current limiting, voltage control, harmonic filtering, smoothing current and reactive power compensation equipment;
- A cooling fan assembly to ensure all heat generated by electrical equipment is safely dissipated;
- Lightning protection masts; and
- Emergency diesel generators and associated storage / bunkering (as required).

229. **Table 2-27** and **Table 2-28** provide the key design parameters for the OCS.

Table 2-27 Project Design Envelope – Onshore Converter Station and Energy Storage and Balancing Infrastructure Parameters

Parameter	Value
OCS	
Maximum number of OCS	1
Indicative number of OCS buildings	3 (excluding smaller shed structures)
Maximum OCS building height (m)	25
Maximum OCS outdoor electrical equipment height (m)	30
Indicative number of OCS temporary construction compound	1
ESBI	
Indicative number of battery block and composition	50 (each block with up to 24 battery units and 2 PCS units)
Indicative battery unit dimensions (m) (length-width-height)	20 x 5 x 4
Indicative PCS unit dimensions (m) (length-width-height)	6.1 x 2.5 x 4
Indicative number of ESBI buildings	6 (excluding smaller shed structures)
Maximum ESBI building height (m)	20
Maximum ESBI outdoor electrical equipment height (m)	25
Indicative number of ESBI temporary construction compound	1

Parameter	Value
Combined (OCS and ESBI)	
Indicative access road width (m) (including site access road from the public highway and internal tracks within the site)	7.3
Indicative quantity of topsoil excavated during combined construction works (m³)	100,000
Indicative quantity of topsoil removed off-site during combined construction works (m³)	50,000

Table 2-28 Project Design Envelope – Onshore Converter Station and Energy Storage and Balancing Infrastructure Areas

Parameter	Value
Maximum OCS platform footprint (ha)	5.5
Maximum permanent OCS area (ha)	9.5*
Maximum ESBI platform footprint (ha)	8.5
Maximum permanent ESBI area (ha)	11*
Total permanent area (ha)	20.5*
Indicative OCS temporary construction compound area (ha)	2.5
Indicative ESBI temporary construction compound area (ha)	2
Total temporary area (ha)	4.5
Maximum developable area for OCS and ESBI (ha)	25*

*Note: These areas include, but not limited to, the platform footprint, landscaping, access, drainage and attenuation but exclude areas for ecological mitigation / enhancement.

230. The largest building within the OCS will be the valve hall. The converter equipment within the valve hall requires a controlled environment for safe operation, requiring the valve hall building to be designed to be weathertight and meet airtightness standards. Operational working clearance requirements around the converter equipment within the valve hall will determine the footprint and height of the building. The tallest height of any outdoor electrical equipment within the OCS will be the lightning protection masts.

2.3.5.2 Description of Energy Storage and Balancing Infrastructure

231. The ESBI will comprise a fenced compound(s) co-located with the OCS to provide a storage solution for energy generated from the wind farm and allow flexibility during intermittent wind generation output. The ESBI will discharge energy to the electricity transmission system during times of system need, including provision of low carbon balancing, peaking and ancillary services, thus enhancing the resilience of the Project's power supply.
232. The ESBI will be connected to the OCS via electrical cabling and/or to the National Grid electricity transmission network via HVAC onshore export cables which will run to Birkhill Wood Substation.
233. The ESBI is likely to include the following key components:
- Battery blocks, each containing:
 - Battery units;
 - Power conversion system (PCS) units to convert electricity between AC and DC during electricity import and export processes;
 - Heating, ventilation and air conditioning (HVAC) system;
 - Battery management system
 - Fire suppression system;
 - Energy management system;
 - Other monitoring and control systems;
 - An outdoor substation containing transformers, busbars, switchgear and concrete fire walls;
 - Harmonic filters;
 - A service building to support operation and maintenance activities;
 - Storage buildings;
 - Switch rooms and auxiliary transformers;
 - Lightning protection masts; and
 - Firefighting water tanks and pumps
234. The largest buildings within the ESBI will be the switch room buildings. The electrical equipment within the switch room buildings will collect and distribute the power to and from the battery units. The tallest outdoor electrical equipment associated with the ESBI will be the lightning protection masts. Battery blocks are typically provided in containerised solutions and arranged in rows with appropriate separation retained between individual battery units to ensure operational working clearances.

235. In ensuring the safety of the ESBI during both construction and operation, a number of measures will be considered through the design and development process. Indicative safety measures for the ESBI are provided below, which will be confirmed in the Outline Battery Safety Management Plan developed at the ES stage:

- Selection of battery units which promote safety in design through:
 - Battery chemistry;
 - Alarms and monitoring;
 - Fire alarms – monitoring battery 'failure state' and smoke detectors;
 - Temperature;
 - Humidity compliance with relevant engineering standards;
 - Fire rating and firewalls;
 - Ventilation and cooling systems;
 - Deflagration panels;
- Implementation of separation distances both between individual battery blocks (indicatively 3.1m) and between groups of battery blocks to provide a fire break (indicatively 6.1m); and
- Provision of appropriate firefighting water reserves and other containment measures.

236. **Table 2-27** and **Table 2-28** provide the key design parameters for the ESBI.

2.3.5.3 Onshore Converter Station and Energy Storage and Balancing Infrastructure Construction Activities

237. The main construction works within the OCS zone are likely to include:
- Pre-construction activities and surveys;
 - Topsoil stripping;
 - Construction of temporary construction compounds;
 - Construction of access roads to enable site access and movement of plant and equipment and personnel within the zone;
 - Land forming and earthworks, including cut and fill (if required);
 - Excavation of trenches and installation of underground electrical cabling, utilities and drainage, including termination of HVDC and HVAC onshore export cables within the zone;
 - Formation of foundations for buildings and outdoor equipment;

- Construction of building superstructures;
- Installation of electrical and auxiliary equipment;
- Equipment testing and commissioning; and
- Landscaping and site demobilisation.

238. Prior to the commencement of construction, pre-construction surveys, such as ground investigations, geophysical, UXO, utility, drainage, topographical and environmental surveys, will be undertaken to inform the detailed design and construction methodology of OCS and ESBI construction works and ensure required mitigation works are in place. Pre-construction activities will also be undertaken to secure and prepare the site for construction works. Further details of pre-construction surveys and activities are provided in the **Outline Code of Construction Practice** (document reference 8.9) provided with the PEIR.

239. General construction practices, including construction drainage, fencing and signage, lighting, vegetation clearance and soil handling, for the OCS and ESBI construction works are expected to be similar to those undertaken for onshore export cable works, which are presented in **Section 2.3.4.3.4** to **Section 2.3.4.3.8**.

240. It is assumed that site establishment and enabling works will be undertaken on a site-wide basis. Construction and installation of the OCS and ESBI will likely be undertaken in parallel, but staggering of works may be required. Based on the indicative construction programme (see **Section 2.4**), the duration of combined OCS and ESBI construction works is anticipated to be approximately five years.

2.3.5.3.1 Temporary Construction Compounds

241. Two temporary construction compounds will be required to serve the OCS and ESBI construction works. These compounds are likely to include laydown areas for construction materials and plant and equipment, storage areas for construction waste, bunded storage areas, vehicle parking areas, welfare facilities, wheel washing facilities, workshops and offices.

242. Where there is no existing hardstanding, temporary construction compounds will be constructed by stripping and storing the topsoil for reinstatement, laying a geotextile membrane or similar directly on top of the subsoil and spreading crushed stone or other aggregates to create a suitable hardstanding area.

243. Both compounds will be established within the footprint of the OCS zone and will be in place for the duration of OCS and ESBI construction works. The final location and layout of the OCS and ESBI temporary construction compounds will be determined during detailed design post-consent.

2.3.5.3.2 Construction Accesses

244. Construction accesses to the OCS zone will be established to allow construction traffic to access and egress from the public highway onto the site. The temporary construction accesses will be used for the duration of OCS and ESBI construction works and may remain as the permanent O&M accesses to the site.

245. Construction of the access roads will involve topsoil stripping, laying of a geotextile membrane and reinforcing geogrid onto the subsoil and installation of suitable graded aggregates and paving material to form hardstanding. The material specification and design of the access roads will be determined during detailed design post-consent following ground investigations.

246. The final location of the construction access points, outline access design and details on the modification works required will be confirmed for the DCO application and presented in the ES, with detailed access design to be determined post-consent.

2.3.5.3.3 Enabling Works

247. The construction site will be subject to topsoil strip, and the ground graded to the required levels, which will be determined during detailed design post-consent. The existing ground may be excavated from areas where the ground level needs to be lowered and relocated to areas that require elevation. This is known as cut and fill earthworks.

248. Where the ground does not have the required strength to support the proposed infrastructure, additional imported material may be used. Any excess material will be used on-site where practicable for earthworks, bunding and landscaping, with unsuitable material being removed from site for suitable recycling or disposal.

2.3.5.3.4 Formation of Foundations

249. After grading throughout the site is complete, subsoil excavations will be undertaken to facilitate the laying of foundations, trenches for internal underground electrical cabling, termination of the HVDC and HVAC onshore export cables, third party utility connections and site drainage. Where groundwater levels are high, dewatering of excavations may be required.

250. At this stage, it is not known whether the foundations would be shallow or piled, and therefore both options are included in the Project Design Envelope. As the worst-case scenario, it is assumed that piling may be required during construction of the foundations. Formation of foundations will typically require construction activities such as formwork, aggregate laying and concrete pouring. The foundation requirements will be dependent on the ground conditions and the electrical, mechanical and structural design requirements of the OCS and ESBI, which will be determined during detailed design post-consent.

2.3.5.3.5 Building and Equipment Installation Works

251. Upon completion of the foundation works, building superstructures will be constructed. The building superstructures associated with the OCS and ESBI will be predominantly composed of steel frame with cladding materials, although brick or block-built structures may be considered. The structural steelwork will likely be fabricated off-site and delivered to site for installation. The steelwork will be erected with the use of cranes, and cladding will be fitted once the formwork is in place.
252. Electrical equipment associated with the OCS and ESBI will be delivered to site. Due to their size and weight of components such as the transformers and battery blocks, specialist delivery methods will be employed, and components will be offloaded at site and positioned onto foundations with the use of cranes. Installation of other electrical and auxiliary equipment will require the use of mobile plant and equipment and lifting apparatus. Other activities include internal fit-outs of buildings and installation of other ancillary infrastructure such as site fencing, lighting and access roads and parking.

2.3.5.3.6 Finishing Works and Site Demobilisation

253. As part of finishing works, landscaping and bunding measures will be established within the permanent footprint of the OCS and ESBI to provide mitigation against environmental effects such as noise or landscape and visual effects, as identified through the EIA process. An outline design of soft and hard landscaping measures at the OCS zone will be presented in the Outline LMP which will be developed at the ES stage, with detailed landscaping design to be determined post-consent.
254. The Project is also exploring opportunities to deliver a minimum of 10% Biodiversity Net Gain (BNG), noting that the delivery of terrestrial BNG is expected to become mandatory from November 2025 onwards based on the requirements of the Environment Act 2021 for Nationally Significant Infrastructure Projects. Ecological mitigation / enhancement areas will also be established within the permanent footprint of the OCS and ESBI, and where practicable, this will be incorporated as part of the landscaping design. Further details of BNG measures will be provided in the Outline BNG Strategy which will be developed at the ES stage.
255. Upon completion of all construction works, construction plant and equipment will be demobilised, and temporary construction compounds and other temporary infrastructure will be removed. Any temporary works area within the construction site will be reinstated using the stored topsoil to pre-construction conditions as far as practicable.

2.3.5.4 Grid Connection into Birkhill Wood Substation

256. Birkhill Wood Substation is not part of the Project and therefore does not fall within the scope of the DCO application. National Grid Electricity Transmission (NGET) will seek a separate planning permission under the Town and Country Planning Act 1990 to develop the new substation.
257. The Onshore Development Area within the PEIR includes land around Birkhill Wood Substation for grid connection works. These works are likely to involve the installation of HVAC onshore export cables up to the boundary of Birkhill Wood Substation and termination of cables at user bays located close to or within the substation footprint.

2.3.5.5 Onshore Operation and Maintenance

258. The O&M phase of the Project's onshore infrastructure is anticipated to be 35 years long. The sections below provide an indicative description of likely O&M activities for onshore infrastructure.

2.3.5.5.1 Onshore Export Cables

259. An operational easement of approximately 20m width for the HVDC export cables and 25m width for the HVAC export cables will be in place along the onshore ECC throughout the Project's operational lifetime to restrict ground-penetrating activities that would affect the installed export cables. It is expected that normal agricultural activities would be able to continue. The width of the operational easement at specific locations will be determined at detailed design stage post-consent and may widen at trenchless crossing locations depending on the installation depth. In addition to the bollards, fencing or similar equipment around the link boxes (see **Section 2.3.4.2**), small marker posts of approximately 1m to 1.2m height will be installed along the operational easement to demark the location of the installed onshore export cables. Marker posts will, at a minimum, be required at field boundaries, on either side of obstacle crossings such as roads and watercourses and where there are significant directional changes in the cable route.
260. Onshore export cables will be remotely monitored to ensure good performance and determine the requirements for corrective maintenance. Routine non-intrusive inspection works is anticipated to consist of a visit to each jointing bay and associated link box location every six months for cable joint inspection and monitoring. Periodic testing of onshore export cables is likely to be required every six months, which would be undertaken at defined inspection points along the onshore ECC.

- 261. Personnel access would be undertaken either from the manhole cover installed on top of underground link boxes or via the installed kiosk for above-ground link boxes. As the haul road will not be in place during operation, access to the relevant sections of the onshore export cables and jointing bay locations will be gained using existing field accesses or other suitable accesses from the public highway.
- 262. Maintenance of the onshore export cables during operation is expected to be minimal. Unplanned emergency maintenance works to address faults would be undertaken as required, and depending on the nature of the repair, may involve intrusive works such as the excavation of two adjacent jointing bays, removal of the faulty cables and installation of replacement spare cables into the cable ducts. Alternatively, the length of faulty cables may be excavated and replaced with spare cables, and two new jointing bays installed within the affected area.
- 263. No modifications to the public highway are anticipated to enable O&M access for routine inspection works and non-intrusive maintenance works.
- 264. No long-term operational lighting will be required within the onshore ECC. Routine inspection and non-intrusive maintenance activities will typically be undertaken during daylight hours, but temporary directional task lighting may be required where night time or continuous working is proposed or in low light conditions during normal working hours.

2.3.5.5.2 Onshore Converter Station and Energy Storage and Balancing Infrastructure

- 265. The OCS and ESBI will be unmanned with no permanent on-site personnel presence and will be capable of operating 24 hours a day and year-round. Monitoring of the OCS and ESBI will be undertaken using remote monitoring equipment to ensure good performance and determine the requirements for corrective maintenance. Site security will be provided using perimeter fencing and CCTV technology.
- 266. Routine inspections of the OCS and ESBI during operation is anticipated to consist of a monthly visit to the OCS and ESBI for a duration of a few days.
- 267. Routine non-outage maintenance works of the OCS and ESBI are anticipated to consist of four annual visits to the OCS and ESBI for a duration of one week, with outage maintenance works scheduled once every third year. End of life replacement of components associated with the OCS and ESBI will be undertaken as required, the frequency of which will vary depending on the design life of each component.
- 268. Unplanned emergency maintenance works to address faults or redundancy loss will be undertaken as and when necessary, and depending on the nature of the repair, may involve deinstallation of faulty electrical equipment and installation of replacement spare parts.

- 269. Where practicable, O&M accesses to the OCS zone will be via the same access roads installed during construction, however, construction of new permanent access roads may also be required. O&M accesses will remain in place for the duration of the Project's O&M phase.
- 270. Operational lighting (with the exception of low-level, motion-sensored security lighting) at the OCS zone will only operate when required for operation and maintenance activities during low light conditions. Further details on operational lighting requirements for the OCS and ESBI will be provided in the ES, with detailed lighting design determined post-consent.
- 271. Routine inspection and maintenance activities will be typically undertaken during daylight hours, but temporary directional task lighting may be required where night time or continuous working is proposed or in low light conditions during normal working hours.
- 272. An operational surface water drainage system will be installed for the OCS and ESBI and will be designed to meet the technical requirements outlined in the National Planning Policy Framework (NPPF). This will include the use of Sustainable Drainage System (SuDS) whereby attenuation and infiltration techniques will be used before a controlled discharge. Further details on the operational surface water drainage strategy for the OCS and ESBI will be presented in the Outline Drainage Strategy to be developed at the ES stage.
- 273. Foul drainage will be collected through either a mains connection discharged to the existing local authority sewer system if available or a septic tank located within the OCS and ESBI. The specific approach will be determined during detailed design post-consent.

2.3.5.6 Onshore Decommissioning

- 274. The final decommissioning strategy of the Project's onshore export cable infrastructure, OCS and ESBI has not yet been decided. The final decommissioning methodology will adhere to regulatory requirements and industry best practice at the time of decommissioning and outlined in an Onshore Decommissioning Plan, which will be submitted and agreed with the relevant authorities prior to the commencement of onshore decommissioning works. The sections below provide a description of potential decommissioning activities for onshore infrastructure.

2.3.5.6.1 Onshore Export Cables

275. Where appropriate, onshore export cables and other buried infrastructure along the onshore ECC, such as jointing bays, underground link boxes and cable ducts, will be decommissioned and left in-situ. If considered unsuitable to be left in-situ at the time of decommissioning, these components will be excavated and removed from the ground, and the land above will be reinstated. Above ground link boxes will be removed during decommissioning. Where practicable, materials and components would be recovered and recycled.

2.3.5.6.2 Onshore Converter Station and Energy Storage and Balancing Infrastructure

276. Decommissioning works are likely to be undertaken in reverse to the sequence of construction works and involve similar levels of vehicles and plant and equipment and duration of works. Decommissioning activities for the OCS and ESBI are expected to include the deinstallation and removal of electrical equipment, removal of foundations, cables and other underground services, deinstallation of buildings and other above-ground structures and landscaping and site reinstatement. Where practicable, materials and components would be recovered and recycled. The site would be reinstated to its pre-construction conditions as practicable or made suitable for an alternative use.

2.4 Construction Programme

277. An indicative construction programme for the Project is presented in **Plate 2-21**. The programme includes offshore, landfall and onshore construction activities, including the commissioning works. The programme illustrates the anticipated duration of the key construction activities, with an estimated total construction duration of five years. Should the DCO be granted in 2028, the earliest construction start year is anticipated to be 2029, with first power scheduled for 2032 and the Project becoming fully operational in 2033.
278. The construction programme is dependent on several factors that may be subject to change such as the grid connection timeline agreed with National Grid, consenting timeframe, funding mechanisms, the lead-in times associated with detailed design and procurement activities, and site and weather conditions during construction. Therefore, details within the construction programme are indicative at this stage and provided as a reasonable basis to inform the EIA.
279. Construction working hours for offshore activities (including any activities in the intertidal zone) are assumed to be 24 hours a day and seven days a week. However, a seasonal restriction is proposed so far as feasible in relation to vessel movements within the Greater Wash SPA to avoid potentially significant impacts to red-throated divers.

280. Core construction working hours for onshore activities are 07:00 to 19:00 hours Monday to Saturday. Vehicle movements on the public highway network and employees' arrival and departure to / from site may occur outside of the core working hours. Onshore construction activities will not take place on Sunday, bank holidays or outside core working hours, except in the following circumstances:

- Where extended and continuous periods (up to 24 hours a day, seven days a week) of working are required such as trenchless installation works, concrete pouring and cable pull-in and jointing operations;
- Deliveries of abnormal indivisible loads that may otherwise cause congestions on the public highway network;
- Testing and commissioning of installed onshore electrical infrastructure;
- Daily start-ups and shut-downs, limited to site inspections, housekeeping and safety checks;
- Emergency works; and
- Works as otherwise agreed in writing with the relevant local authority.

281. Further details of onshore construction timings are provided in the **Outline Code of Construction Practice** (document reference 8.9) provided with the PEIR.

Plate 2-21 Indicative Project Construction Programme



2.5 Site Selection

282. Site selection is an iterative process with selection and refinement of the Project Area ongoing throughout the EIA and HRA process. The Applicant has sought to develop a boundary which gives consideration to key constraints known at this time, particularly those related to designated sites. However, the Project Area has also been developed to provide sufficient flexibility to accommodate further refinement of onshore and offshore infrastructure.

2.5.1 Development of Scenarios

283. The site and route selection scenarios for the onshore converter station, ESBI, and onshore and offshore cable corridors are constrained by the initiating point at the Array Area and the terminating point at the grid connection point at the National Grid substation (Birkhill Wood).

2.5.1.1 Array Area

284. As described in **Section 1.1** the Applicant identified the option to maximise the capacity of the third phase of the Dogger Bank Wind Farm, namely DBC, such that additional capacity of up to 1.5GW of renewable energy could potentially be consented and constructed in the eastern part of the original DBC site. Therefore the new development phase in the eastern section of DBC provided the Array Area, which is the initiating point of the Project and the site selection process.

2.5.1.2 Grid Connection Point

285. Due to the network capacity required to connect large-scale generation infrastructure, offshore wind farms such as DBD need to be connected to a high voltage electricity transmission system. The national electricity transmission network in England (and Wales) is owned and maintained by the National Grid Electricity Transmission (NGET), while National Energy System Operator (NESO) – formerly known as National Grid Electricity System Operator (NGESO) – is responsible for the planning and operations of Great Britain's energy system. The Project's interface with the electricity transmission system is linked to the grid connection point identified by NESO through strategic network planning at the national level.

286. The historical approach to connecting offshore wind farms to the electricity transmission system involves individual radial connections developed on a project-by-project basis. The UK Government's announcement to deliver 50GW of offshore wind power by 2030 highlighted the need to reinforce existing offshore-onshore transmission infrastructure and build new infrastructure to accommodate the increasing generation capacity and electricity demand. However, within the NPS for energy infrastructure (EN-5, paragraph 2.13.5 to 2.13.8), the UK Government notes that a more coordinated approach to delivering offshore wind farms and transmission infrastructure is needed to reduce infrastructure costs and cumulative impacts on the environment and communities.
287. Therefore, the Offshore Transmission Network Review (OTNR) was initiated by the UK Government in 2020, which resulted in a strategic review of the UK's framework to delivering its future energy system. One of the core outputs of the OTNR was the Holistic Network Design (HND) exercise undertaken by NESO.
288. The HND sought to optimise the design of new onshore and offshore transmission infrastructure associated with offshore wind farms based on the criteria of economic cost, deliverability and operability, environmental and community impacts. Key outcomes of the HND were recommendations of grid connection points for new offshore wind farms and whether a coordinated connection design would be considered preferable to the counterfactual radial connection design (i.e. direct point-to-point connection between an offshore wind farm and the UK electricity transmission network).
289. The Project was included in the first HND exercise, which involved a comparative evaluation of grid connection options by regional zones. The Project formed part of the East Coast region due to its spatial and temporal proximity with other Round 4 offshore wind projects, and the outcomes of this HND exercise were published in the "Pathway to 2030" report in 2022.
290. In early 2024, NESO published the "South Cluster HND Impact Assessment", which revised the original HND design recommended to offshore wind projects off the east coast of England (including DBD). A radial connection to a new substation to be built in proximity to the existing Creyke Beck Substation in East Riding of Yorkshire (known as "Birkhill Wood Substation") was confirmed as the revised and optimal design for the Project.
291. The site selection exercise undertaken by the Applicant has been progressed based on an indicative location of the Birkhill Wood Substation provided by NESO and therefore aligns with outcomes of strategic network planning at the national level.

292. The Birkhill Wood Substation will be developed by NGET as part of “The Great Grid Upgrade” initiative and therefore does not form part of the Project or the DCO application. The precise location and layout of Birkhill Wood Substation will be determined by NGET and therefore does not fall within the scope of this Project’s site selection exercise.

2.5.2 Project Alternatives Considered at Site Selection Phase

2.5.2.1 Wind Turbines and Offshore Platforms

293. A number of project-level alternatives with respect to design and technology have been considered as part of the site selection and project development process. Specifically relevant to the RIAA were:

- Turbine foundation types – given gravity base foundations result in a significantly greater footprint (and thus habitat loss), the Project has only considered mono-pile and suction bucket jacketed options for the wind turbine foundations;
- Alternative landfall construction methodologies - compared to open cut trenching at landfall, trenchless installation techniques (Commitment ID CO23 in **PEIR Volume 2, Appendix 6.3 Commitments Register**) would result in significant reductions in environmental impacts by minimising the excavation footprint and avoiding sensitive receptors on the coast, as well as avoiding prolonged periods of disturbance along the foreshore; and
- HVAC versus HVDC transmission design - due to distance from shore, several offshore compensation platforms would have been required within the offshore ECC for an HVAC transmission design. Selection of an HVDC transmission design significantly reduces the Project’s offshore environmental impacts by reducing the level of infrastructure required that would otherwise directly impact the seabed.

2.5.2.2 Offshore Export Cable Corridor

2.5.2.2.1 Defining the Offshore Export Cable Corridor Area of Search

294. The most important factor in determining the offshore ECC Area of Search (AoS) was to ensure that the area provided flexibility to capture the most feasible routes from the Array Area to landfall. The southern extent of the offshore ECC AoS was established from the southern edge of the refined landfall AoS to the south-eastern corner of the Dogger Bank SAC within UK territorial waters. The southern AoS extent ran slightly setback from the southern edge of the Dogger Bank SAC to allow potential offshore ECCs to exit the Dogger Bank SAC from the south and then travel west to the landfall.

295. The northern extent of the offshore ECC AoS was defined as from the northern edge of the refined landfall AoS to the south-eastern corner of the Swallow Sand MCZ, then parallel to the northern boundary of the Dogger Bank SAC to the boundary between the German EEZ. A significant buffer was established between the northern edge of the Dogger Bank SAC and the offshore ECC AoS due to a potential Dogger Bank SAC extension.

296. At the time of site selection it is understood that the Department for Environment, Food and Rural Affairs (Defra) is looking to identify potential areas for new Marine Protected Area (MPA) designations, or extensions to existing designations, to provide compensation for loss for impacts to benthic habitats. There is uncertainty at this stage of the Project about whether Dogger Bank SAC will be identified as a potential site for extension. In the event that the Dogger Bank SAC is selected there is further uncertainty on the extent and direction where any extension may occur. Based on available information it is considered that if an extension to the Dogger Bank SAC is taken forwards, an extension would most likely be to the north of the existing site. This is based upon the Dogger Bank Selection Assessment Document (JNCC, 2011) which identified the sandbank extended further to the north of the SAC boundary, as well as and further recommendation in RWE (2024). Furthermore, the assumption has also been based on the identified macrofaunal and infaunal communities from historic benthic surveys (Wieking and Kröncke, 2003; and RWE, 2024), which provided the best available indication of the extent of the sandbank feature. The Applicant therefore included a significant buffer to the north of the existing Dogger Bank SAC to provide flexibility in the event of a future extension.

2.5.2.2.2 Site Selection Principles and Engineering Assumptions

297. A full description of the site selection principles and engineering assumptions in relation to the offshore ECC are presented in **Section 5.9.2 in PEIR Volume 1, Site Selection and Consideration of Alternatives** provided in the PEIR.
298. The offshore ECC options were originally identified as 3km wide corridors from the Array Area. The primary objective of the offshore ECC routeing exercise was to minimise both the total route length from the Array Area to the landfall options as well as any environmental and engineering limitations on those routes. A key principle was to “*avoid, but where not possible minimise, direct impacts to sites designated for nature conservation (SACs, SPAs and MCZs), recognising that it is not possible to completely avoid this on account of the location of the Project within the Dogger Bank SAC*”.

2.5.2.2.3 Identification of Offshore Export Cable Corridor Options

299. A series of assessments were carried out incorporating a range of engineering assumptions and site selection principles, commencing with the identification of long list options, the identification of short list options, and finally the identification and refinement of the preferred offshore ECC option(s).

300. The key influence on the offshore ECC selection process relative to National Site Network sites and features was minimising the length of the offshore ECC that is present within the Dogger Bank SAC (or any NSN site), as well as fewer potential cable crossings. In particular, in relation to the Dogger Bank SAC this resulted in all southern options being discarded as they were further in length through the SAC, and thus raised a greater risk and scale of potential impacts on the SAC and its features in comparison to northern route options. Whilst a preference is for the shortest route out of and outside of the Dogger Bank SAC, the Project has retained optionality through the identification of the Characterisation Area in the event of extension of the SAC or a Marine Protected Area designation. Within the context of assessment the worst-case scenarios are therefore considering the effects of cable routes along the southern and northernmost extent of the offshore Export Cable Corridor (and Characterisation Area). The route options being taken forward to PEIR are shown in **Figure 2-2**.

2.5.2.3 Onshore Export Cable Corridor

2.5.2.3.1 Defining the Onshore Export Cable Corridor Area of Search

301. The onshore ECC AoS included land between the northern and southern boundaries of the refined landfall AoS and the OCS zone AoS. The boundaries of the onshore ECC AoS were defined to align with identifiable boundaries of physical and environmental constraints, including urban settlements, industrial areas, designated ecological and heritage sites, roads and the Hull-Scarborough railway line.
302. In addition, flexibility to route the onshore export cables into the OCS zone AoS from both the west and east was considered when defining the onshore ECC AoS. It was not feasible to route onshore export cables from the north or south of the OCS zone AoS due to the presence of Beverley, Cottingham and Hull.

2.5.2.3.2 Site Selection Principles and Engineering Assumptions

303. A full description of the site selection principles and engineering assumptions in relation to the offshore ECC are presented in **Section 5.10.2 in PEIR Volume 1, Site Selection and Consideration of Alternatives** provided in the PEIR.
304. The onshore ECC from the landfall to the OCS zone AoS was identified to site the High Voltage Direct Current (HVDC) onshore export cables. Broad 500m wide corridors were initially identified based on the maximum corridor width required to accommodate both the temporary construction and permanent infrastructure footprint, which allowed flexibility for refinement at a later stage. A key factor for onshore export cable routeing was to determine the most direct route to the OCS zone AoS as practicable whilst minimising interactions with environmental and engineering constraints”.

305. A key engineering principle was to keep the onshore ECC as straight and short as practicable, avoiding tight bends and minimising directional changes. Moreover, pinch points around concentrations of constraints at crossing points and limitations on physical space availability were reviewed to ensure technical feasibility of the onshore ECC options identified.

2.5.2.3.3 Identification of Onshore Export Cable Corridor Options

306. A series of assessments were carried out incorporating a range of engineering assumptions and site selection principles, commencing with the identification of long list options, the identification of short list options, and finally the identification and refinement of the preferred onshore ECC option(s).
307. The key influence on the onshore ECC selection process was the very limited options available for routing to the OCS zone. Given the indirect nature of potential effects on European site features, no specific consideration was made over and above avoidance of locally designated wildlife sites. However, refinement and selection included consultation with stakeholders (including Natural England) at a Site Selection ETG meeting held on the 7th August 2024, which fed into the option selection process. The route options being taken forward to PEIR are shown in

308. Figure 2-3.

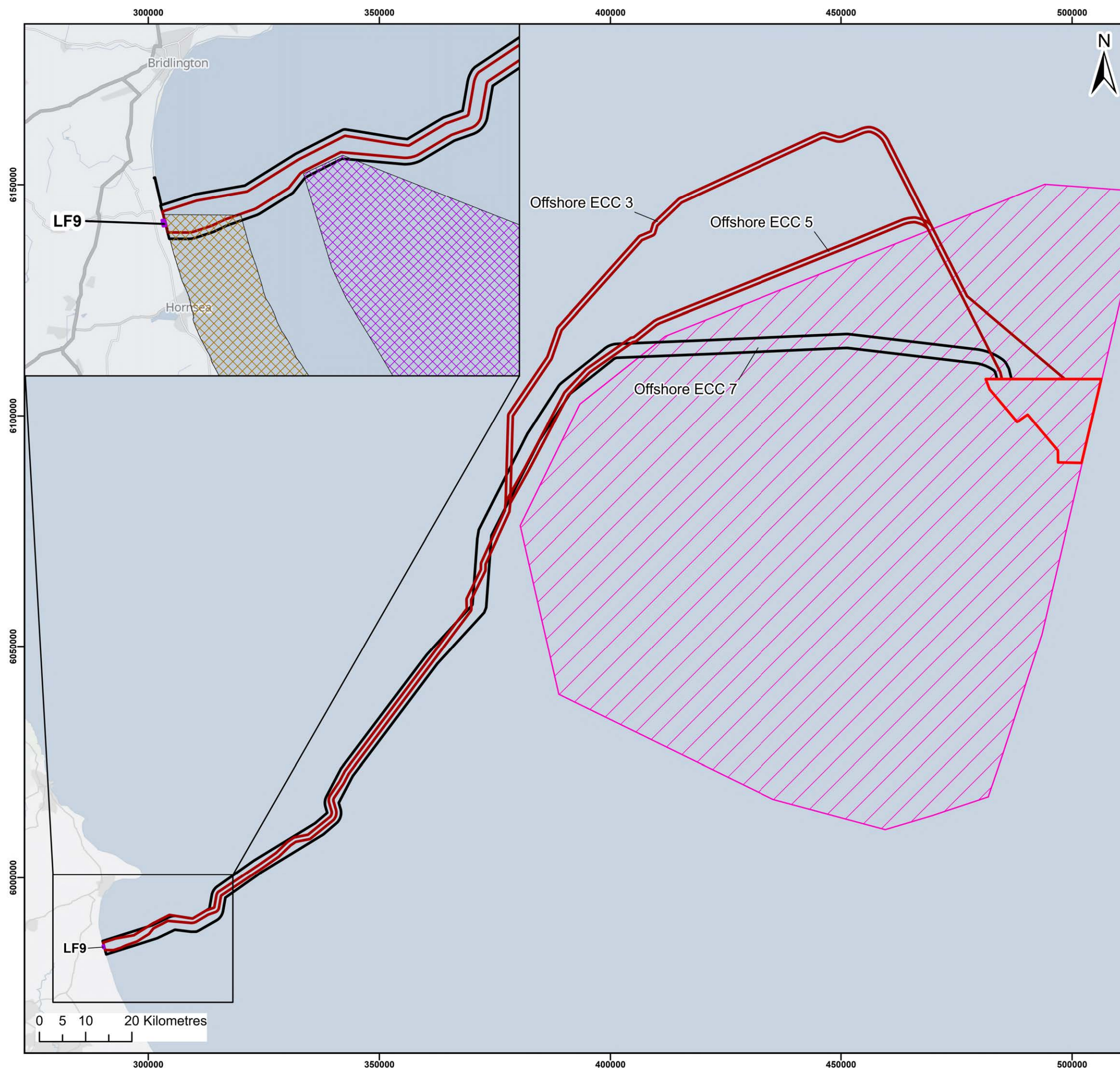
2.5.2.4 Onshore Converter Station

2.5.2.4.1 Defining the Onshore Converter Station Zone Area of Search

100. Using the indicative location of Birkhill Wood Substation provided by NESO, the OCS zone AoS was defined as a 3km search radius around the grid connection point. This 3km radius was set to minimise the length of High Voltage Alternating Current (HVAC) onshore export cables required to connect into the electricity transmission network and maximise the power transfer. In addition to compliance with the Grid Code required for connection into the UK transmission network, minimising this distance was considered appropriate to reduce the quantity of reactive compensation equipment required, mitigate transmission losses and minimise adverse effects on economic efficiency.

2.5.2.4.2 Site Selection Principles and Engineering Assumptions

101. The OCS zone was identified to co-locate the OCS and ESBI with a key factor being the availability of physical space to accommodate the permanent infrastructure and associated construction activities. Broad zones were identified based on a range of the minimum and maximum area required to site the platforms for permanent infrastructure, two temporary construction compounds and additional space for landscaping, drainage, access and environmental mitigation and enhancement.



- Legend:**
- Dogger Bank D Array Area
 - Landfall Preferred Option
 - Offshore Export Cable Corridor Options Taken Forward at PEIR Refinement Stage
 - Offshore Export Cable Corridor Options Excluded at PEIR Refinement Stage
- Key Constraints**
- Dogger Bank Special Area of Conservation

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Project:	DOGGER BANK WIND FARM
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Title:

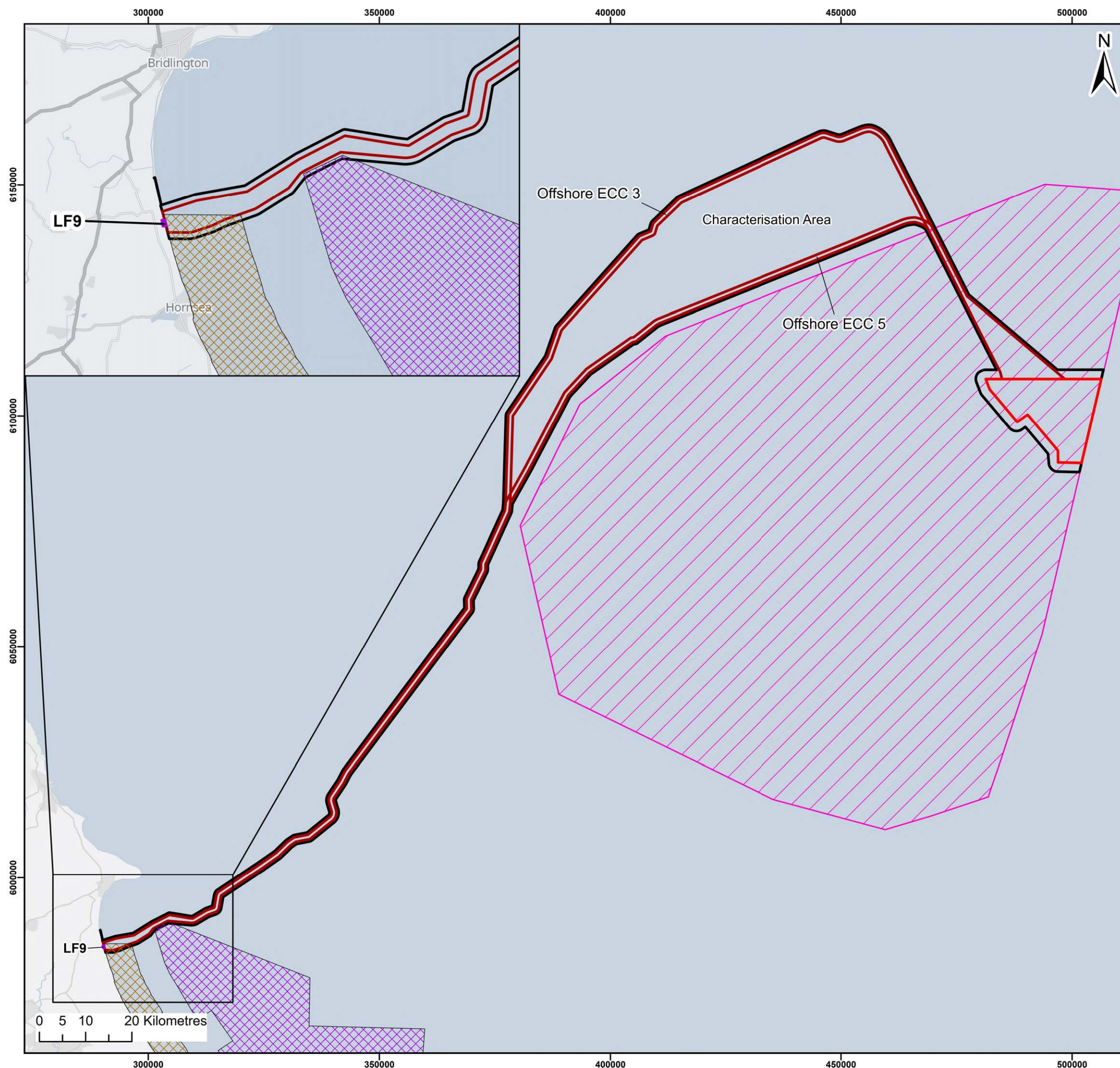
Preferred Offshore Cable Corridor Options
- Sheet 1 of 2

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Figure: 2-2		Drawing No: PC6250-RHD-XX-OF-DR-GS-0603			
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Co-ordinate system: WGS 1984 UTM Zone 31N





- Legend:**
- Dogger Bank D Array Area
 - Landfall Preferred Option
 - Offshore Export Cable Corridor Preferred Options
 - Offshore Development Area for PEIR
- Key Constraints**
- Dogger Bank Special Area of Conservation
 - Holderness Inshore Marine Conservation Zone
 - Holderness Offshore Marine Conservation Zone

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Project:	DOGGER BANK WIND FARM
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Title:

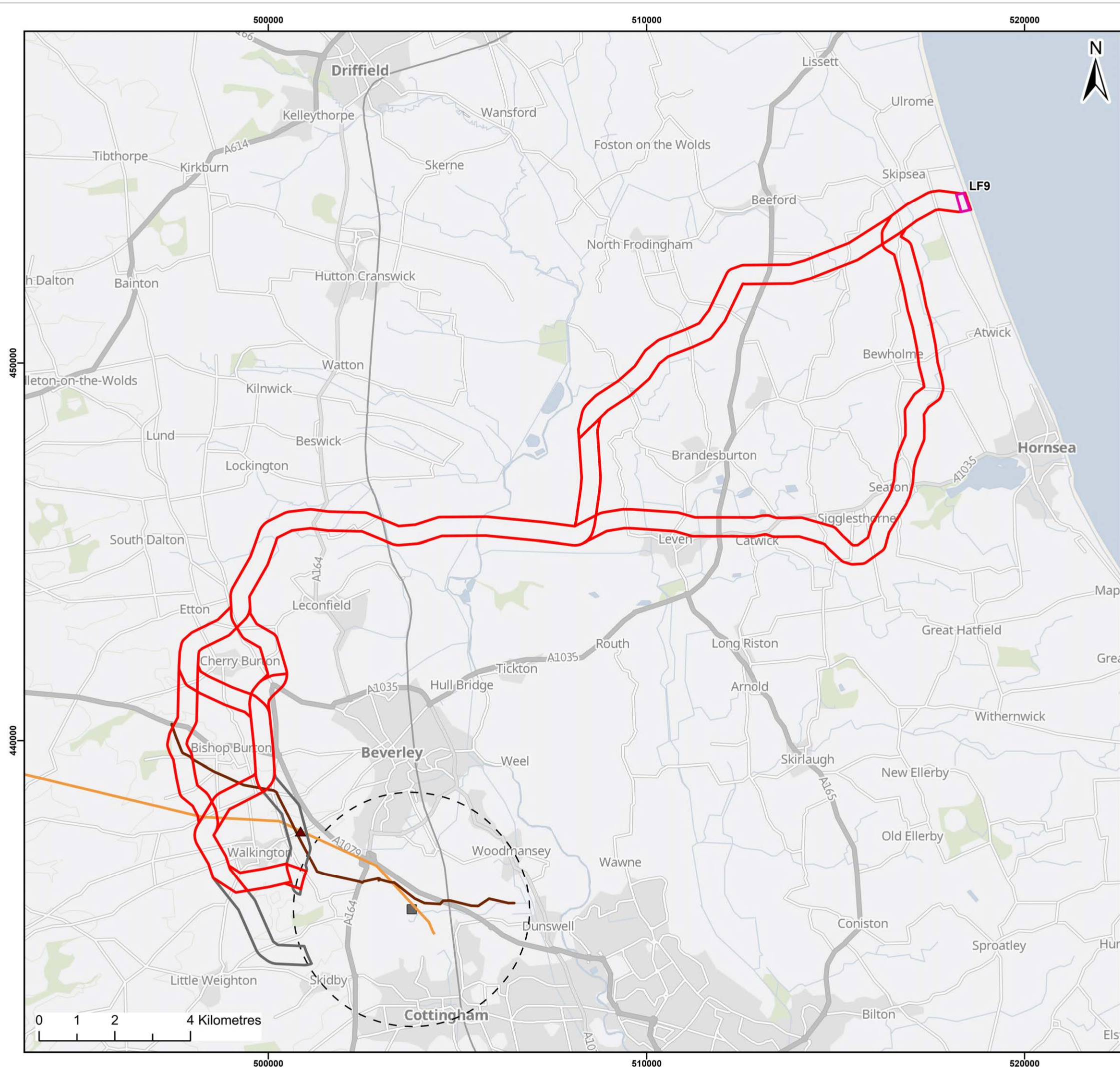
Preferred Offshore Cable Corridor Options
- Sheet 2 of 2

Figure:	2-2	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0603		
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01	13/05/2025	JH	AB	A3	1:825,000

Co-ordinate system: WGS 1984 UTM Zone 31N





Legend:

- Onshore Export Cable Corridor Options Taken Forward to Non Statutory Consultation Stage
- Onshore Export Cable Corridor Options Excluded at Non Statutory Consultation Stage
- Landfall Preferred Option
- Onshore Converter Station Zone Area of Search (3km Buffer)
- Grid Connection Point - Indicative Birkhill Wood Substation Location

Pinch Points

- ▲ Broadgate Pinch Point

Key Constraints

- National Grid Overhead Lines
- INEOS/SABIC ethylene pipeline

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Project:

Dogger Bank D
Offshore Wind Farm

Title:

Preferred Onshore Cable Corridor Options
- Sheet 1 of 4

Figure:	2-3	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0604								
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Co-ordinate system: British National Grid



Legend:

- Onshore Export Cable Corridor Options Taken Forward to Non Statutory Consultation Stage
- Landfall Preferred Option
- Modifications for Non Statutory Consultation Stage
- Onshore Converter Station Zone Area of Search (3km Buffer)
- Grid Connection Point - Indicative Birkhill Wood Substation Location

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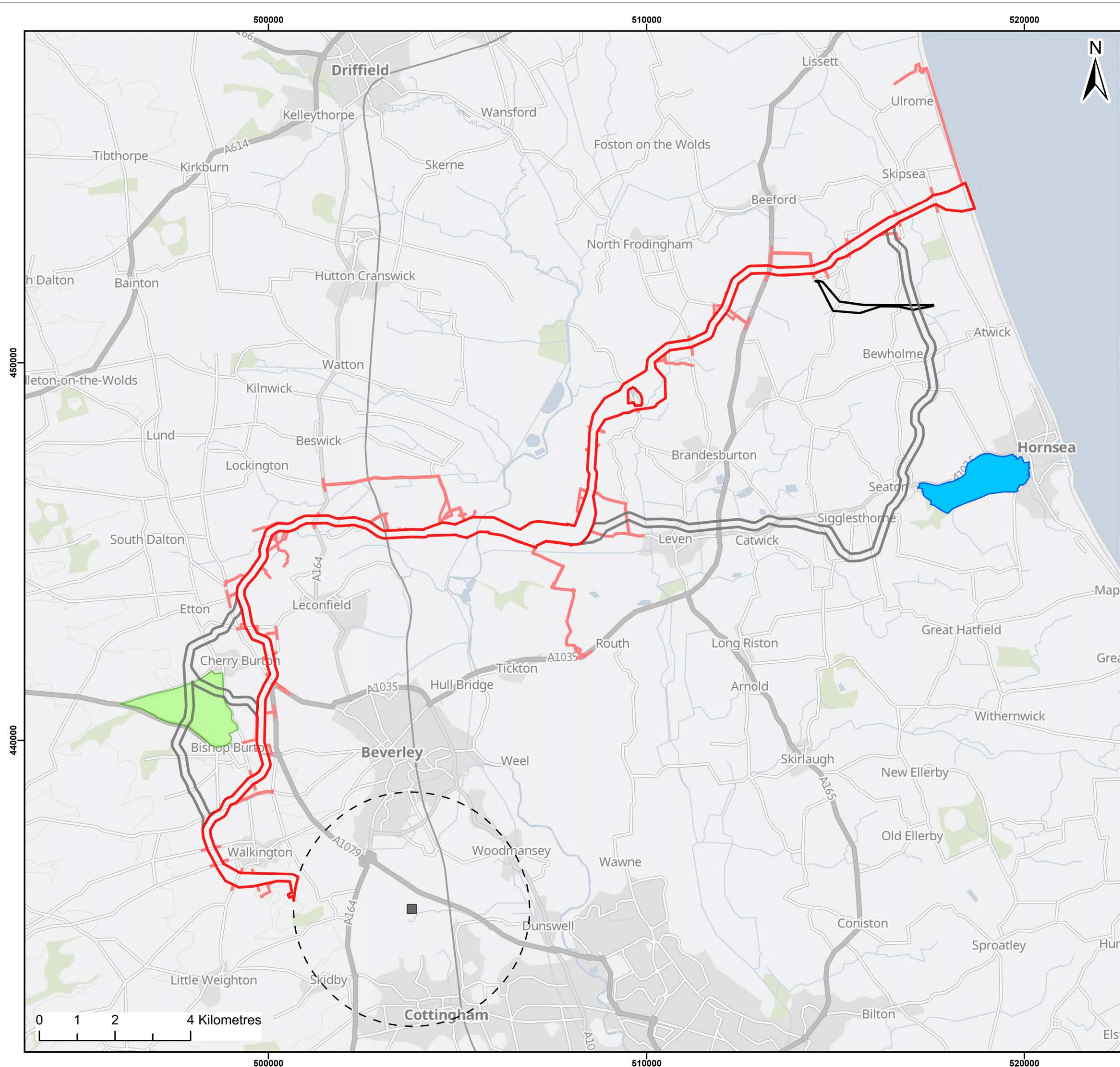
Project:	
Dogger Bank D Offshore Wind Farm	DOGGER BANK WIND FARM

Title:

Preferred Onshore Cable Corridor Options
- Sheet 2 of 4

Figure:	2-3	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0604			
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Co-ordinate system: British National Grid



Legend:

- Onshore Export Cable Corridor Options Taken Forward to Non Statutory Consultation Stage
- Modifications During PEIR Refinement Stage
- Onshore Export Cable Corridor Options excluded at Non Statutory Consultation Stage
- Onshore Converter Station Zone Area of Search (3km Buffer)
- Grid Connection Point - Indicative Birkhill Wood Substation Location

Key Constraints

- Hornsea Mere Special Protection Area / Site of Special Scientific Interest / Important Bird Area
- National Grid gas pipelines
- Bishop Burton College of Agricultural Land

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Project:

Dogger Bank D Offshore Wind Farm

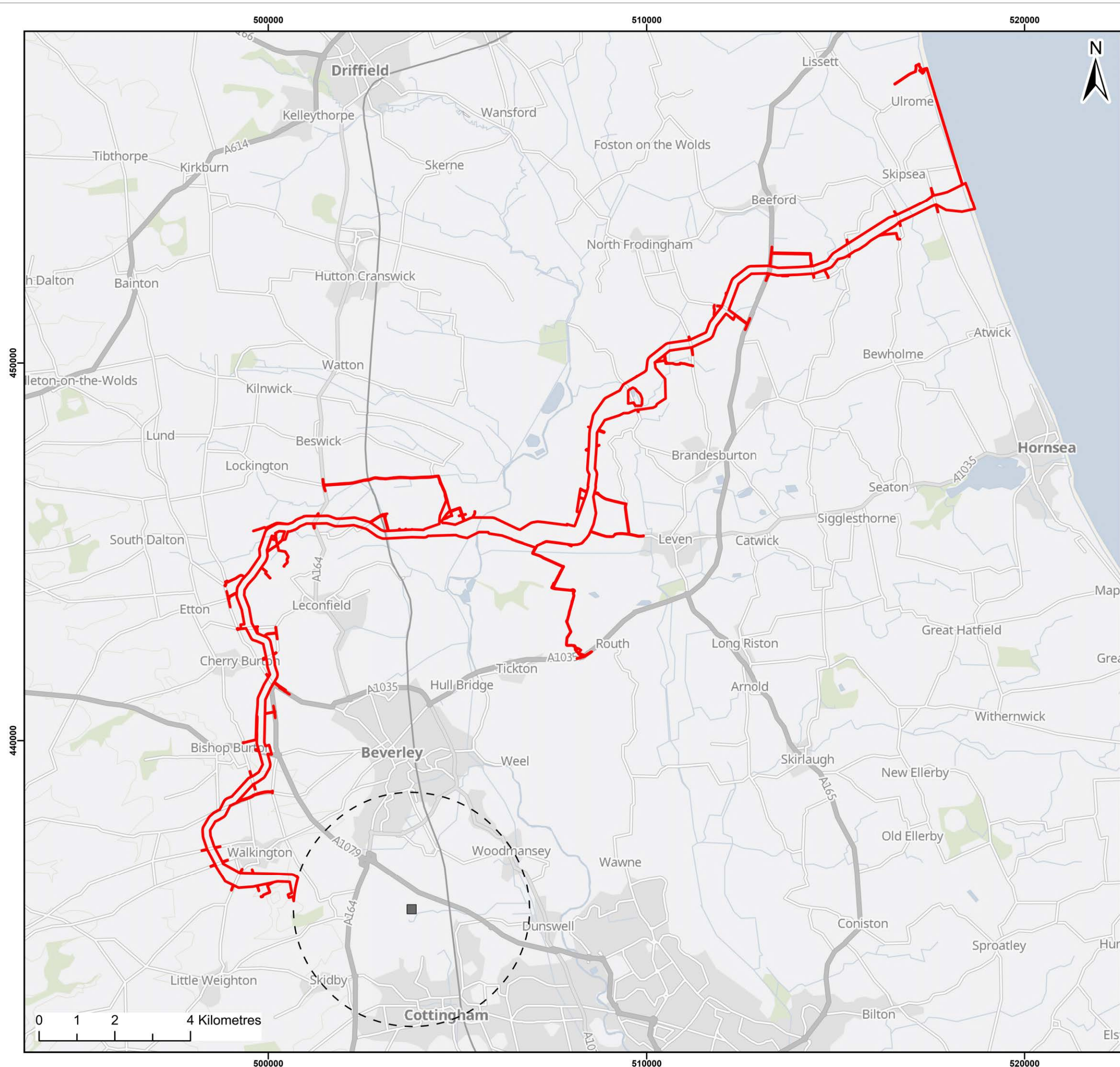
DOGGER BANK WIND FARM

Title:

Preferred Onshore Cable Corridor Options - Sheet 3 of 4

Figure:	2-3	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0604			
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Co-ordinate system: British National Grid



Legend:

- Onshore Development Area
- Onshore Converter Station Zone Area of Search (3km Buffer)
- Grid Connection Point - Indicative Birkhill Wood Substation Location

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

Title:

Preferred Onshore Cable Corridor Options
- Sheet 4 of 4

Figure:	2-3	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0604			
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Co-ordinate system: British National Grid

102. The size of the OCS zone allowed flexibility for refinement at a later stage in the site selection process and provided contingencies for micro-siting to overcome unknown constraints that may arise during detailed site investigation and design.
103. Another key engineering principle was to consider connectivity to the onshore ECC identified for the HVDC and HVAC onshore export cables and their entry and exit points into the OCS zone to provide a holistic evaluation of the onshore transmission infrastructure.

2.5.2.4.3 Identification of Onshore Converter Station Zone Options

309. A series of assessments were carried out incorporating a range of engineering assumptions and site selection principles, commencing with the identification of 9 long list options, the identification of 2 short list options, and finally the identification and refinement of the preferred OCS options. The two short-listed options have been taken forward as preferred for flexibility.
310. The 7 other options were discounted on the basis of feasibility for the requirements, difficulty in onward connection to the Birkhill Wood Substation, and also other significant potential environmental constraints or impacts. The OCS options being taken forward to PEIR are shown in **Figure 2-4**.

2.5.3 Proposed Consideration of Alternatives post-PEIR

311. The following sub-sections briefly describe alternative design and construction elements that are and will be considered after the PEIR and this RIAA consultation round, to determine whether changes can be implemented in advance of the ES and DCO application in order to further prevent or minimise impacts on the NSN sites and their features.

2.5.3.1 Wind Turbines and Array Area

312. At the PEIR stage a range of turbine types has been considered. The worst-case scenario assessed in this RIAA is based on the largest number of the smaller turbine model currently being considered, along with a standardised air gap.
313. Currently a worst-case scenario of two Offshore Platforms has been considered. Further work will be undertaken up to the ES and DCO application to determine whether this can be reduced to avoid the footprint impact. However, this will be subject to design and feasibility constraints.

314. Inter-array cables have been assessed on a worst-case basis within this RIAA. Further refinement of the inter-array cable extents will be undertaken for the ES and DCO application (and associated RIAA), and it is expected that the scale of effect will reduce. However, the scenario will remain a worst-case scenario as the detailed design will not be undertaken prior to submission.

315. Currently there is an estimation (worst-case) extent of cable protection or cable crossings for the inter-array cables within the Array Area. This is due to ongoing development and collection of information. Unfortunately not all information can be obtained prior to submission. However, refinement of potential cable protection extent will be undertaken in the Cable Burial Risk Assessment being updated prior to submission, and this will inform the updated RIAA. It is expected that the scale of the impact will reduce, however, the scenario will remain a worst-case scenario as the detailed design will not be undertaken prior to submission and often during construction.

2.5.3.2 Offshore Export Cable

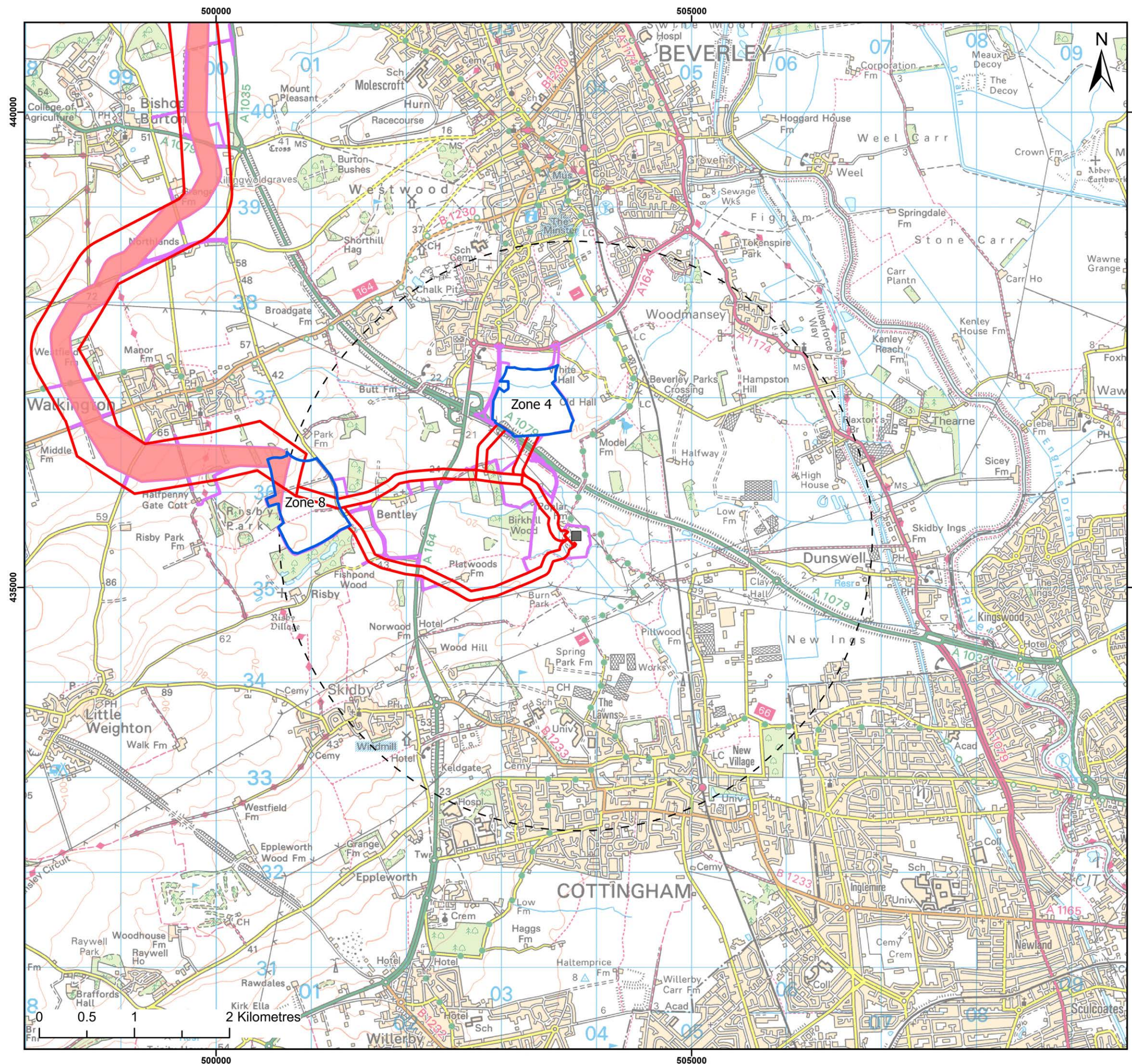
316. Currently there is an estimation (worst-case) extent of cable protection for the extent of the export cable within the Array Area and the Dogger Bank SAC. This is due to ongoing development and collection of information. Unfortunately not all information can be obtained prior to submission. However, refinement of potential cable protection extent will be undertaken in the Cable Burial Risk Assessment being updated prior to submission, and this will inform the updated RIAA. It is expected that the scale of the impact will reduce, however, the scenario will remain a worst-case scenario as the detailed design will not be undertaken prior to submission and often during construction.

2.5.3.3 Landfall

317. There are limited opportunities for the landfall design to be altered further to minimise potential for disturbance activities, given the approach to trenchless design results in the avoidance of disturbance from land based plant within the intertidal zone. Proposals for monitoring and actions to avoid impacting significant numbers of waterbirds have been incorporated as embedded mitigation. However, further review will be undertaken following comments on this RIAA.

2.5.3.4 Onshore Export Cable

318. Given numerous limitations around the available route to the OCS from the landfall, significant route alterations are not feasible in relation to potential Functionally Linked Land (FLL) (see **Section 6.1**). However, further assessment prior to the ES and DCO application will enable the RIAA to be updated to identify whether there would be a need for micro-siting as an option or whether seasonal restriction may be a necessary mitigation to avoid impacts on the Humber Estuary SPA features using the FLL.



- Legend:
- Onshore Export Cable Corridor Preferred Options
 - Onshore Converter Station Zone Preferred Options
 - Modifications for Non Statutory Consultation Stage
 - Modifications During PEIR Refinement Stage
 - Onshore Converter Station Zone Area of Search (3km Buffer)
 - Grid Connection Point - Indicative Birkhill Wood Substation Location

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Project:

Dogger Bank D
Offshore Wind Farm

**DOGGER BANK
WIND FARM**

Title:

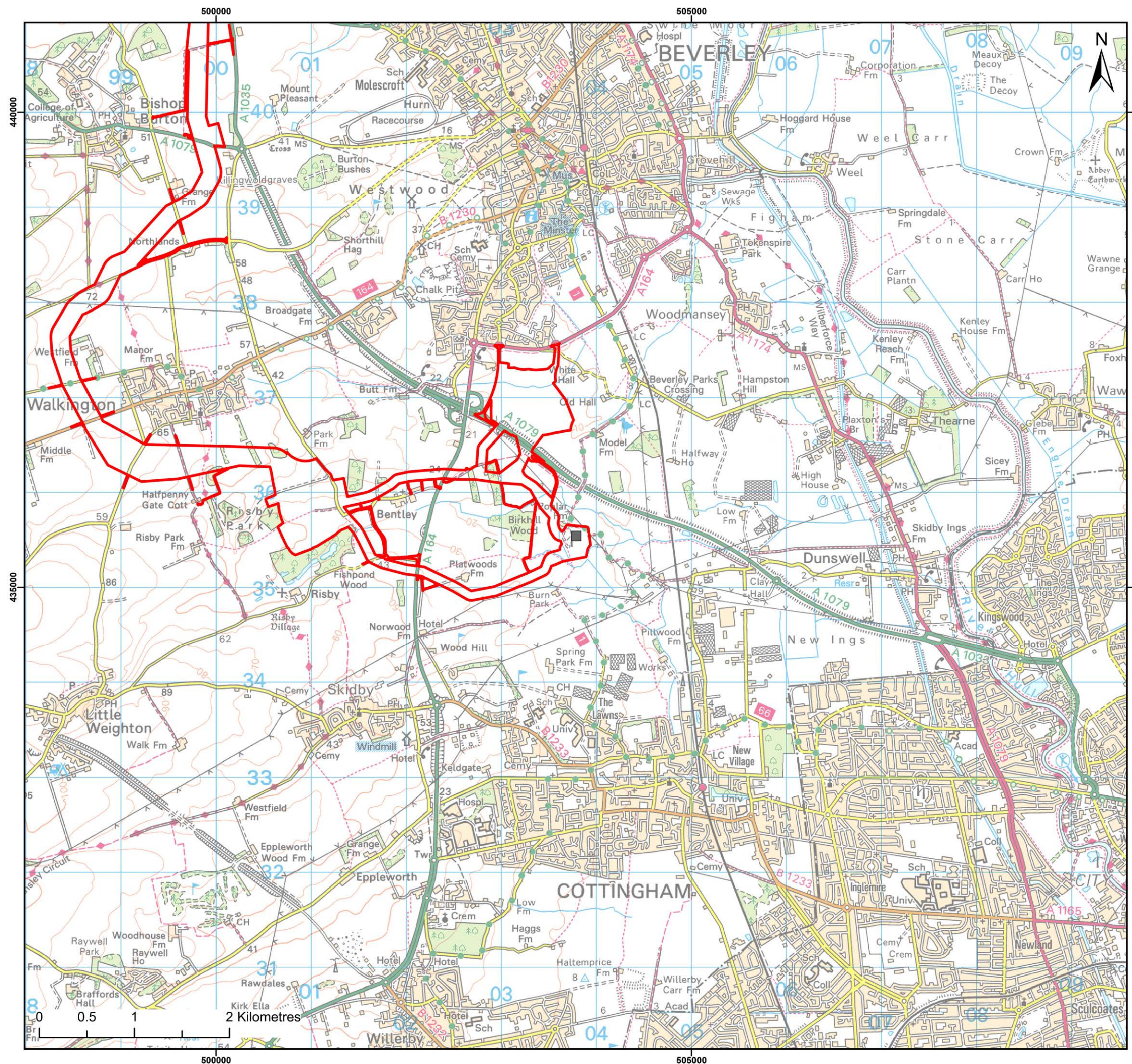
Preferred Onshore Converter Station Zone Options
- Sheet 1 of 2

Figure: 2-4 Drawing No: PC6250-RHD-XX-OF-DR-GS-0605

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	13/05/2025	JH	AB	A3	1:40,000

Co-ordinate system: British National Grid





- Legend:
- Onshore Development Area for PEIR
 - Grid Connection Point - Indicative Birkhill Wood Substation Location

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

Title:

Preferred Onshore Converter Station Zone Options
- Sheet 2 of 2

Figure: 2-4 Drawing No: PC6250-RHD-XX-OF-DR-GS-0605

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	13/05/2025	JH	AB	A3	1:40,000

Co-ordinate system: British National Grid



2.5.3.5 Onshore Converter Station

319. Due to the constraints of siting and available land for the OCS there would be significant restriction on design alteration if there is evidence of FLL being present and the loss or disturbance resulting in a potential AEOL.

3 Habitats Regulations Process

3.1 Legislative Context

320. In England and Wales, the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and elements of Council Directive 2009/147/EC on the conservation of wild birds (the Birds Directive) are implemented under (i) the Conservation of Habitats and Species Regulations 2017 (as amended by The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019) (the 'Habitats Regulations') onshore and up to 12 nautical miles (nm) offshore and (ii) the Conservation of Offshore Marine Habitats and Species Regulations 2017 between 12 and 200nm offshore.
321. The Habitats Regulations (as they are collectively known) require the Secretary of State to consider whether a plan or project has the potential to have an adverse effect on the integrity and features of a National Site Network site (e.g. SPA, SAC), known as HRA.

3.1.1 European Legislation

3.1.1.1 The Birds Directive

322. The Birds Directive provides a framework for the conservation and management of wild birds in Europe. The relevant provisions of the Directive are the identification and classification of SPAs for rare or vulnerable species listed in Annex I of the Directive and for all regularly occurring migratory species (required by Article 4). The Directive requires national Governments to establish SPAs and to have in place mechanisms to protect and manage them. The SPA protection procedures originally set out in Article 4 of the Birds Directive have been replaced by the Article 6 provisions of the Habitats Directive.

3.1.1.2 The Habitats Directive

323. The Habitats Directive provides a framework for the conservation and management of natural habitats, wild fauna (except birds) and flora in Europe. Its aim is to maintain or restore natural habitats and wild species at a favourable conservation status. The relevant provisions of the Directive are the identification and classification of Special Areas of Conservation (SAC) (Article 4) and procedures for the protection of SACs and SPAs (Article 6). SACs are identified based on the presence of natural habitat types listed in Annex I and populations of the species listed in Annex II. The Directive requires national Governments to establish SACs and to have in place mechanisms to protect and manage them.

3.1.1.3 The Ramsar Convention

324. The Convention on Wetlands of International Importance especially as Waterfowl Habitat, as amended in 1982 and 1987 (the 'Ramsar Convention') is an international treaty for the conservation and sustainable use of wetlands of international importance. Ramsar site selection has had an emphasis on wetlands of importance to waterbirds, however non-bird features are increasingly considered, both in the selection of new sites and when reviewing existing sites. The UK government and the devolved administrations have issued policy statements relating to Ramsar sites which extend to them the same protection at a policy level as SACs and SPAs. Ramsar sites are therefore included in the HRA process.

3.1.2 UK National Legislation

325. The Conservation of Habitats and Species Regulations 2017, the Conservation of Offshore Marine Habitats and Species Regulations 2017, and the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019.
326. These regulations (hereafter the 'Habitats Regulations') together with the Wildlife and Countryside Act 1981 transpose the Habitats and Birds Directives into UK legislation covering terrestrial areas out to and including the UK Offshore Marine Area with the exception of within Scottish territorial waters, where The Conservation (Natural Habitats, &c.) Regulations 1994 continue to apply.
327. The Conservation of Habitats and Species Regulations 2019 make changes to the 2017 Habitats Regulations so that they continue to work (are operable) following the UK's exit from the EU on 31st January 2020. While the basic legal framework for HRA is maintained, the EU Exit Regulations transfer functions previously undertaken by the European Commission (EC) to UK Ministers.
328. The Habitats Regulations place an obligation on 'competent authorities' to carry out an appropriate assessment of any proposal likely to significantly affect a designated site, to seek advice from Natural England and not to approve an application that would have an adverse effect on a designated site unless certain conditions are met (where there are no alternative solutions, the plan or project can only proceed if there are imperative reasons of over-riding public interest and if the necessary compensatory measures can be secured). The competent authority in the case of the proposed Project is the Planning Inspectorate.

3.1.2.1 National Site Network Sites (Post EU Exit)

329. Where the Habitats Regulations continue to use the term European sites, those sites (i.e. SACs and SPAs) now form part of a "National Site Network" and not the European "Natura 2000" site network. However, when considering transboundary effects this considers the Natura 2000 sites.

3.2 Policy and Guidance

330. In addition to the legislation outlined above, this RIAA considers all relevant guidance and policies issued by a number of Governmental, statutory and industry bodies.

3.2.1 Government Guidance

331. Guidance from Government bodies considered in the preparation of this RIAA includes:

- Department for Environment, Food & Rural Affairs: Guidance on Habitats regulations assessments: protecting a European site; how a competent authority must decide if a plan or project proposal that affects a European site can go ahead;
- European Commission: Assessment of Plans and Projects Affecting Natura 2000 Sites;
- European Commission: EU Guidance on wind energy development in accordance with EU nature legislation;
- Department of Communities and Local Government: Guidance on ‘Planning for the Protection of European Sites: Appropriate Assessment’;
- The Planning Inspectorate Advice Note Nine: Using the Rochdale Envelope;
- The Planning Inspectorate Advice Note Ten: Habitats Regulations Assessment relevant to nationally significant infrastructure projects;
- The Planning Inspectorate Advice Note Seventeen: Cumulative Effects Assessment; and
- Department of Energy and Climate Change: Guidelines on the Assessment of Transboundary Impacts of Energy Developments on Natura 2000 Sites outside the UK.

3.2.2 Statutory Nature Conservation Bodies Guidance

332. Key guidance from Statutory Nature Conservation Bodies (SNCBs) considered in the preparation of this HRA includes:

- English Nature: Habitats Regulations Guidance Note (HRGN) 1: The Appropriate Assessment (Regulation 48) The Conservation (Natural Habitats &c) Regulations, 1994;
- English Nature: Habitats Regulations Guidance Note (HRGN) 3: The Determination of Likely Significant Effect under the Conservation (Natural Habitats &c) Regulations, 1994;
- English Nature: Habitats Regulations Guidance Note (HRGN) 4: Alone or in-combination;

- Natural England and JNCC: Interim advice on HRA screening for seabirds in the non-breeding season;
- Natural England and JNCC: Advice on HRA screening for seabirds in the breeding season; and
- Natural England and JNCC: Interim Advice Note – Presenting information to inform assessment of the potential magnitude and consequences of displacement of seabirds in relation to Offshore Windfarm Developments.

333. Details of any further topic specific guidance used are provided in **Section 5** to **Section Error! Reference source not found.**

3.2.3 Industry Guidance

334. Industry guidance considered in the preparation of this HRA includes:

- Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers (King *et al.*, 2009); and
- Cumulative Impact Assessment Guidelines – Guiding Principles for Cumulative Impacts Assessment in Offshore Wind Farms (RenewableUK, 2013).

3.3 The HRA Process

335. HRA can be described as a three-stage process as outlined in Planning Inspectorate Advice Note 10 (The Planning Inspectorate, 2022):

3.3.1 Stage 1 – Screening

336. Stage 1. Screening is the process which initially identifies whether a proposal is likely to have a significant effect on the National Site Network site(s)’s conservation objectives, both alone or in combination with other plans or projects. If a conclusion of no likely significant effect (LSE) is reached for all National Site Network sites and their qualifying features considered, it is not necessary to proceed to the next stages of HRA. If the conclusion is for LSE to occur or the effect is not known, this would trigger the need for an appropriate assessment.

3.3.2 Stage 2 – Appropriate Assessment

337. Stage 2. Appropriate assessment involves the detailed assessment of the implications of the proposal for the qualifying features of the National Site Network site(s), in view of the site(s)'s conservation objectives, and identify ways to avoid or minimise any effects, i.e. through the identification and description of mitigation measures. This is to determine whether there is objective evidence that adverse effects on the integrity (AEol) of the site can be excluded. These mitigation measures will follow a hierarchy whereby measures to avoid impacts should be considered first, then measures to minimise the effects through changes in design or construction and/or operational methodology. Under the Habitats Regulations the cost of such measures is not a supportive argument, though health and safety and technical feasibility are. These would be further tested in Stage 3.

3.3.3 Stage 3 – Derogation

338. Stage 3. The derogation stage considers if proposals that would have an AEol of a National Site Network site(s) qualify for an exemption. There are three tests to this stage to be followed in order: consider alternative solutions; consider imperative reasons of overriding public interest (IROPI); and secure compensatory measures. Each test must be passed in sequence for a derogation to be granted.
339. In the event that no feasible alternative solutions are available, and the tests of alternative solutions and IROPI case are passed, compensatory measures will need to be developed and provided. Compensation measures will need to offset the effects to the site(s) and the specific feature(s). The compensation measures must also be effective, whereby there is certainty in their achievement of offsetting the specific effects. The measures should usually be in place before the effects on the site(s) and feature(s) occur.

4 Stage 1 Screening Conclusions

340. The Applicant issued a HRA Screening Report for comment on 19 December 2023 to Natural England, the Marine Management Organisation (MMO); Joint Nature Conservation Committee (JNCC), Centre for Environment, Fisheries and Aquaculture (Cefas) and the Royal Society for the Protection of Birds (RSPB). Sites screened in for further assessment are detailed in the HRA Screening Report. A ‘Screening Opinion’ was subsequently received detailing responses on the HRA Screening Report from relevant stakeholders who wished to provide comment.
341. The Applicant issued a subsequent HRA Screening Addendum for comment on 21 August 2024 to Natural England and the MMO. This updated the HRA Screening Report from December 2023, incorporating changes to the sites/features screened into the HRA, in response to key Project changes, and stakeholder comments received in response to the HRA Screening Report.
342. **Section 4.1 to Section 4.5** summarise the progression in relation to European site(s) features screened both in and out throughout these two reports.

4.1 Sites Designated for Annex I Marine Habitats

4.1.1 Sites and Features Screened In to the RIAA

343. A summary of the Annex I Marine Habitats considered in this RIAA are provided in **Table 4-1**.

Table 4-1 Summary of European Sites Designated for Annex I Marine Habitats Screened in for the Project as of HRA Addendum

European Site	Distance to Array (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
Annex I Marine Habitats			
Dogger Bank SAC (Site Code: UK0030352)	0	0	Sandbanks which are slightly covered by seawater all the time.

4.1.2 Sites and Features Screened Out in the HRA Screening/Addendum Reports

344. The HRA Screening Report concluded that the following designated sites should be screened in for further consideration:
- Humber Estuary Ramsar;
 - Humber Estuary SAC; and
 - Dogger Bank SAC.
345. However, the HRA Addendum subsequently screened additional sites out of assessment. A summary of the Annex I Marine Habitats screened out in the HRA Addendum Report, and therefore not considered in this RIAA are provided in **Table 4-2**.

Table 4-2 Summary of European Sites Designated for Annex I Marine Habitats Screened out for the Project as of HRA Addendum

European Site	Distance to Array (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened Out
Annex I Marine Habitats			
Humber Estuary SAC (Site code: UK00300170)	235	7	All features
Humber Estuary Ramsar (Site code: UK11031; RSIS code: 663)	233	7	All features

4.1.3 Potential Effects Screened In

346. The HRA Screening Addendum considered potential for effects (given the change in the Project Design Envelope and spatial changes to the Project Area) and concluded the following potential effect previously screened out of further consideration should be screened in (see **Section 5** in **Appendix A.2 Dogger Bank D HRA Screening and HRA Addendum Reports**):
- Introduction of marine INNS from vessel traffic – all phases.
347. All other screening decisions made during the HRA Screening exercise (**Appendix A.2 Dogger Bank D HRA Screening and HRA Addendum Reports**) remained unchanged.

348. A summary of potential effects assessed in this RIAA are provided in **Table 4-3** for the Construction (C), Operation and Maintenance (O&M), and Decommissioning (D) phases of the Project.

Table 4-3 Summary of Potential Effects Identified for Annex I Marine Habitats

Potential Effect	Potential pressure as described in JNCC (JNCC, 2022b)	C	O&M	D
Temporary physical disturbance / Physical disturbance	Abrasion / disturbance of the substrate on the surface of the seabed	✓	✓	✓
	Penetration and / or disturbance of the substrate below the surface of the seabed, including abrasion	✓	✓	✓
Long term habitat loss	Habitat structure changes – removal of substratum (extraction)	✓	✓	✓
	Physical change (to another seabed type)	x	✓	x
Increased suspended sediment concentrations (SSC)	Physical change (to another sediment type)	x	✓	x
	Changes in suspended solids (water clarity)	✓	✓	✓
Remobilisation of contaminated sediments	Smothering and siltation rate changes (heavy)	✓	✓	✓
	Smothering and siltation rate changes (light)	✓	✓	✓
Pollution events resulting from the accidental release of pollutants	Hydrocarbon & Polyaromatic Hydrocarbon (PAH) contamination	✓	✓	✓
	Transition elements & organo-metal (e.g. TBT) contamination	✓	x	✓
Underwater noise and vibration	Hydrocarbon & PAH contamination	✓	x	✓
	Transition elements & organo-metal (e.g. TBT) contamination	✓	x	✓
Interactions of Electromagnetic Field (EMF) (including potential cumulative EMF effects)	Synthetic compound contamination	x	✓	x
	Underwater noise changes/Vibration	✓	✓	✓
	Electromagnetic changes	x	✓	x

Potential Effect	Potential pressure as described in JNCC (JNCC, 2022b)	C	O&M	D
Introduction of marine INNS from vessel traffic	Introduction or spread of INNS	✓	✓	✓
Colonisation of introduced substrate	Introduction or spread of INNS	x	✓	x
In-combination effects	N / A	✓	✓	✓
Transboundary effects	N / A	✓	✓	✓

4.1.4 Potential Effects Screened Out in the HRA Screening / Addendum Reports

349. A summary of potential effects on Annex I Marine Habitats screened out in the HRA Screening and HRA Addendum Reports on the basis of the change in the Project Design Envelope and spatial extent of the Project Area (see **Section 5 in Appendix A.2 Dogger Bank D HRA Screening and HRA Addendum Reports**), and therefore not considered in this RIAA are provided in **Table 4-4**. Most of the effects were screened out due to the removal of the HPF, and also additional sediment quality results received post the HRA Screening stage.

Table 4-4 Summary of Potential Effects Screened Out for Offshore Annex I Habitats

Potential Effect	C	O&M	D
Long term habitat loss – Barrier to species movement	x	x	x
Pollution events resulting from the accidental release of pollutants - Introduction of other substances (solid, liquid or gas)	x	x	x
Salinity increase (Hydrogen and hybrid opportunities only)	x	x	x
Temperature increase (Hydrogen and hybrid opportunities only)	x	x	x
Changes to longshore sediment processes - Water flow (tidal current) changes, including sediment transport considerations	x	x	x

4.2 Sites Designated for Annex II Terrestrial Ecology and Ornithology

350. The HRA Screening Report concluded that the following designated sites should be screened in for further consideration:
- Greater Wash SPA;
 - Hornsea Mere SPA;
 - Humber Estuary SAC;
 - Humber Estuary Ramsar; and
 - Humber Estuary SPA.
351. The HRA Screening Addendum screening exercise considered potential for effects given the change in the Project Design Envelope and spatial extent of the Project Area.
352. The HRA Screening Addendum screening outcome concluded the following potential effects previously screened in for further consideration should be screened out on the basis of the change in project design and location of the HRA screening area:
- Direct effects on European sites; and
 - Long term and temporary loss of designated Annex I habitats.
353. The HRA Screening Addendum screening outcome concluded the following qualifying features previously screened in for further consideration should be screened out on the basis of the change in the Project Design Envelope and spatial extent of the Project Area:
- Avocet (breeding) feature of Humber Estuary SPA; and
 - Little tern (breeding) feature of Humber Estuary SPA.
354. All other screening decisions made during the HRA Screening exercise remained unchanged.
355. Sites screened out from Appropriate Assessment at the outcome of the HRA Screening Addendum are listed in **Section 4.2.2**.
356. Due to Project developments since the HRA Screening Addendum submission date of August 2024, Hornsea Mere SPA is now located 6.5km to the south of landfall. This now falls outside the Zol for Likely Significant Effects, caused by changes in air quality, from the Project and is therefore also screened out of the appropriate assessment stage below.

4.2.1 Sites and Features Screened In to the RIAA

357. A summary of the Annex I and II Terrestrial Ecology and Ornithology Sites and Species considered in this RIAA are provided in **Table 4-5**.

Table 4-5 Summary of European Sites and Annex II Terrestrial Ecology and Ornithology Species Screened in for the Project

European Site	Designated Feature Screened In
Terrestrial Ecology and Ornithology	
Humber Estuary Ramsar (Site code: UK11031; RSIS code: 663)	Species: <ul style="list-style-type: none">• Bar-tailed godwit, wintering• Black-tailed godwit, passage• Black-tailed godwit, wintering• Dunlin, passage• Dunlin, wintering• Golden plover, passage• Golden plover, wintering• Knot, passage• Knot, wintering• Redshank, passage• Redshank, wintering• Shelduck, wintering• Waterbird assemblage, wintering Habitats: <ul style="list-style-type: none">• Estuarine habitats
	<ul style="list-style-type: none">• Avocet, non-breeding• Bar-tailed godwit, non-breeding• Black-tailed godwit, non-breeding• Dunlin, non-breeding• Golden plover, non-breeding• Hen harrier, non-breeding• Knot, non-breeding• Marsh harrier, breeding

European Site	Designated Feature Screened In
	<ul style="list-style-type: none">Redshank, non-breedingRuff, non-breedingShelduck, non-breedingWaterbird assemblage
Humber Estuary Special Area of Conservation (SAC) (Site code: UK0030170)	<p>Primary qualifying features for designation:</p> <ul style="list-style-type: none">EstuariesMudflats and sand flats not covered by seawater at low tide <p>Other qualifying features, but not a primary reason for designation:</p> <ul style="list-style-type: none">Atlantic salt meadows
The Greater Wash SPA (Site code: UK9020329)	<ul style="list-style-type: none">Little tern, breedingCommon tern, breedingSandwich tern, breedingLittle gull, breeding and non-breedingCommon scoter, non-breedingRed-throated diver, non-breeding

4.2.2 Sites and Features Screened Out in the HRA Screening / Addendum Reports

358. A summary of the Annex I and II Terrestrial Ecology and Ornithology screened out, in the HRA Screening Report and the HRA Screening Addendum Report, and therefore not considered in this RIAA are provided in **Table 4-6**.

Table 4-6 Summary of European Sites and Annex II Terrestrial Ecology and Ornithology Species Screened out for the Project

European Site	Designated Feature Screened Out
Humber Estuary SPA (Site code: UK9006111)	<ul style="list-style-type: none">Avocet, breedingBittern, breedingBittern, non-breedingLittle tern, breeding

European Site	Designated Feature Screened Out
Humber Estuary Special Area of Conservation (SAC) (Site code: UK0030170)	<ul style="list-style-type: none">Other qualifying features, but not a primary reason for designation:Sandbanks which are slightly covered by sea water all the timeCoastal lagoonsSalicornia and other annuals colonizing mud and sandEmbryonic shifting dunes“Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes)”“Fixed coastal dunes with herbaceous vegetation (grey dunes)”Dunes with <i>Hippopha rhamnoides</i>
Humber Estuary Ramsar	<ul style="list-style-type: none">Breeding colony of grey seals <i>Halichoerus grypus</i>
Hornsea Mere SPA (Site code: UK9006171)	<ul style="list-style-type: none">GadwallMute Swan

4.2.3 Potential Effects Screened In the RIAA

359. The potential effects on Annex I and II Terrestrial Ecology and Ornithology features during the construction, operation and maintenance, and decommissioning phases are shown in **Table 4-7**.

Table 4-7 Summary of Potential Effects Identified for Annex I and II Terrestrial Ecology and Ornithology

Potential Effect	C	O&M	D
Disturbance / displacement	✓	✓	✓
Long term and temporary loss of functionally linked land	✓	✓	✓
Indirect impacts through effects on supporting habitats and prey species	✓	✓	✓
Indirect habitat degradation through changes in air quality	✓	x	x

4.2.4 Potential Effects Screened Out in the HRA Screening / Addendum Reports

360. A summary of potential effects on Annex I and II Terrestrial Ecology and Ornithology Effects screened out in the HRA Screening Report and the HRA Screening Addendum Report, and therefore not considered in this RIAA are provided in **Table 4-8**.

Table 4-8 Summary of Potential Effects Screened Out for Annex I and II Terrestrial Ecology and Ornithology

Potential Effect	C	O&M	D
Direct Effects on European Sites	x	x	x
Long term and temporary loss of designated Annex I Habitats	x	x	x

4.3 Sites Designated for Annex II Marine Ornithological Features

4.3.1 Potential Effects Screened In

Table 4-9 Summary of Potential Effects Identified for Offshore and Intertidal Ornithology

Potential Effect	Type of Ornithology Receptor	C	O&M	D
Direct disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall.	Intertidal and offshore	✓	✓	✓
Displacement due to presence of wind turbines and other offshore infrastructure	Offshore ornithology receptors only (red-throated diver, gannet (<i>Morus bassanus</i>), auks)	✓	✓	✓
Barrier effect due to presence of wind turbines and other offshore infrastructure	Offshore and intertidal ornithology receptors (including migratory waterbirds)	x	✓	x
Indirect Effects via Habitats or Prey Availability	Offshore and intertidal receptors	✓	✓	✓
Collision risk with wind turbine blades	Offshore ornithology receptors (gulls, skuas, gannet) and intertidal ornithology receptors (including migratory waterbirds)	x	✓	x

4.3.2 Sites and Features Considered in the RIAA

Table 4-10 Summary of European Sites and Species Screened in for the Project as of HRA Addendum

European Site	Distance to DBD Array Area (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
Marine Ornithological Features			
The Greater Wash SPA (Site code: UK9020329)	215	0	<ul style="list-style-type: none">Little tern, breedingCommon tern, breedingSandwich tern, breedingCommon scoter, non-breedingRed-throated diver, non-breeding
Humber Estuary SPA (Site codes: UK9006111)	235	25	<ul style="list-style-type: none">Little tern, breeding
Flamborough and Filey Coast (FFC) SPA (Site code: UK9006101)	209	7	<ul style="list-style-type: none">Gannet, breedingGuillemot (<i>Uria aalge</i>), breedingKittiwake (<i>Rissa tridactyla</i>), breedingRazorbill (<i>Alca torda</i>), breedingSeabird assemblage, breedingPuffin (<i>Fratercula arctica</i>)Herring gull (<i>Larus argentatus</i>)Shag (<i>Phalacrocorax aristotelis</i>)Cormorant (<i>Phalacrocorax carbo</i>)
Teesmouth and Cleveland Coast SPA (Site codes: UK9006061)	245	84	<ul style="list-style-type: none">Common tern, breeding
Northumbria Coast SPA (Site codes: UK9006131)	257	118	<ul style="list-style-type: none">Arctic tern (<i>Sterna paradisaea</i>), breeding

European Site	Distance to DBD Array Area (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
Coquet Island SPA (Site code: UK9006031)	271	170	<ul style="list-style-type: none">• Arctic tern, breeding• Common tern, breeding• Roseate tern (<i>Sterna dougallii</i>), breeding• Sandwich tern, breeding• Seabird assemblage, breeding• Puffin• Herring gull• Lesser black-backed gull (<i>Larus fuscus</i>)• Kittiwake
Farne Islands SPA (Site code: UK9006021)	279	182	<ul style="list-style-type: none">• Arctic tern, breeding• Common tern, breeding• Guillemot, breeding• Roseate tern, breeding• Sandwich tern, breeding• Seabird assemblage, breeding• Kittiwake• Shag• Cormorant• Puffin
Lindisfarne SPA (Site codes: UK9006011)	287	190	<ul style="list-style-type: none">• Roseate tern, breeding

European Site	Distance to DBD Array Area (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
Forth Islands SPA (Site code: UK9004171)	348	259	<ul style="list-style-type: none">• Arctic tern, breeding• Common tern, breeding• Gannet, breeding• Lesser black-backed gull, breeding• Puffin, breeding• Roseate tern, breeding• Sandwich tern, breeding
Imperial Dock Lock, Leith SPA (Site codes: UK9004451)	383	289	<ul style="list-style-type: none">• Common tern, breeding
Fowlsheugh SPA (Site code: UK9002271)	362	283	<ul style="list-style-type: none">• Guillemot, breeding• Kittiwake, breeding
Ythan Estuary, Sands of Forvie and Meikle Loch (extension) SPA and Ramsar (Site codes: UK9002221 and UK13061)	373	295	<ul style="list-style-type: none">• Common tern, breeding• Sandwich tern, breeding
Loch of Strathbeg SPA (Site codes: UK9002211)	395	321	<ul style="list-style-type: none">• Sandwich tern, breeding
Troup, Pennan and Lion's Heads SPA (Site code: UK9002471)	414	340	<ul style="list-style-type: none">• Guillemot, breeding
Inner Moray Firth SPA (Site codes: UK9001624)	494	414	<ul style="list-style-type: none">• Common tern, breeding
Cromarty Firth SPA (Site codes: UK9001623)	504	426	<ul style="list-style-type: none">• Common tern, breeding

European Site	Distance to DBD Array Area (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
East Caithness Cliffs SPA (Site code: UK9001182)	505	431	<ul style="list-style-type: none">Guillemot, breedingHerring gull, breedingKittiwake, breedingRazorbill, breeding
North Caithness Cliffs SPA (Site code: UK9001181)	519	447	<ul style="list-style-type: none">Guillemot, breeding
Pentland Firth Islands SPA (Site code: UK9001131)	524	453	<ul style="list-style-type: none">Arctic tern, breeding
Auskerry SPA (Site code: UK9002381)	540	471	<ul style="list-style-type: none">Arctic tern, breeding
Hoy SPA (Site code: UK9002141)	544	472	<ul style="list-style-type: none">Great skua (<i>Stercorarius skua</i>), breeding
Fair Isle SPA (Site code: UK9002091)	550	486	<ul style="list-style-type: none">Arctic tern, breedingGuillemot, breeding
Rousay SPA (Site code: UK9002371)	565	496	<ul style="list-style-type: none">Arctic tern, breeding
Marwick Head SPA (Site code: UK9002121)	574	504	<ul style="list-style-type: none">Guillemot, breeding
West Westray SPA (Site code: UK9002101)	575	506	<ul style="list-style-type: none">Arctic tern, breedingGuillemot, breeding
Sumburgh Head SPA (Site code: UK9002511)	575	512	<ul style="list-style-type: none">Arctic tern, breeding
Papa Westray (North Hill and Holm) SPA (Site code: UK9002111)	578	510	<ul style="list-style-type: none">Arctic skua, breedingArctic tern, breeding
Mousa SPA (Site code: UK9002361)	590	527	<ul style="list-style-type: none">Arctic tern, breeding

European Site	Distance to DBD Array Area (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
Noss SPA (Site code: UK9002081)	598	535	<ul style="list-style-type: none">Gannet, breedingGreat skua, breedingGuillemot, breeding
Foula SPA (Site code: UK9002061)	621	557	<ul style="list-style-type: none">Arctic tern, breedingGreat skua, breedingGuillemot, breedingPuffin, breeding
Papa Stour SPA (Site code: UK9002051)	636	573	<ul style="list-style-type: none">Arctic tern, breeding
Fetlar SPA (Site code: UK9002031)	638	576	<ul style="list-style-type: none">Arctic tern, breedingGreat skua, breeding
Ronas Hill – North Roe and Tingon SPA (Site codes: UK9002041)	648	586	<ul style="list-style-type: none">Great skua, breeding
Hermaness, Saxa Vord and Valla Field SPA (Site code: UK9002011)	660	598	<ul style="list-style-type: none">Gannet, breedingGreat skua, breedingPuffin, breeding

4.4 Sites Designated for Annex II Migratory Fish

4.4.1 Sites and Features Screened In To the RIAA

361. A summary of the Annex II Migratory Fish Sites and Species considered in this RIAA are provided in **Table 4-11**.

Table 4-11 Summary of European Sites and their Annex II Migratory Fish Species Screened in for the Project as of HRA Addendum

European Site	Distance to Array (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
River Derwent SAC (Site code: UK0030253)	246	38	<ul style="list-style-type: none">Indirect effects on Annex II species that are a primary reason for selection of this site:<ul style="list-style-type: none">River lamprey.Annex II species present as a qualifying feature, but not a primary reason for site selection:<ul style="list-style-type: none">Sea lamprey.
Humber Estuary SAC (Site code: UK0030170)	235	7	<ul style="list-style-type: none">Indirect effects on Annex II species present as a qualifying feature, but not a primary reason for site selection:<ul style="list-style-type: none">Sea lamprey; andRiver lamprey.
Humber Estuary Ramsar (Site code: UK11031; RSIS code: 663)	233	7	<ul style="list-style-type: none">Indirect effects on river lamprey and sea lamprey.

4.4.2 Sites and Features Screened Out in the HRA Screening/Addendum Reports

362. The HRA Screening Report concluded that the following designated sites should be screened in for further consideration:

- River Derwent SAC;
- Humber Estuary SAC; and

- Humber Estuary Ramsar.

363. However, the HRA Addendum subsequently screened additional sites out of assessment. A summary of the Annex I Marine Habitats screened out in the HRA Addendum Report, and therefore not considered in this RIAA are provided in **Table 4-12**.

Table 4-12 Summary of European Sites and Annex II Migratory Fish Species Screened out for the Project as of HRA Addendum

European Site	Distance to Array (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened Out
Humber Estuary SAC (Site code: UK00300170)	235	7	Onshore Project Area
Humber Estuary Ramsar (Site code: UK11031; RSIS code: 663)	233	7	Onshore Project Area

4.4.3 Potential Effects Screened In

364. The HRA Screening Addendum considered potential for additional effects (given the change in project design and location of the HRA screening area) and concluded no change from the HRA Screening Report.

365. A summary of potential effects assessed in this RIAA are provided in **Table 4-13** for the Construction (C), Operation and Maintenance (O&M), and Decommissioning (D) phases of the Project.

Table 4-13: Summary of Potential Effects Screened in for Annex II Migratory Fish

Potential Effect	C	O&M	D
Underwater Noise (UXO clearance only)	✓	x	x

4.4.4 Potential Effects Screened Out in the HRA Screening/Addendum Reports

366. A summary of potential effects on Annex I Marine Habitats screened out in the HRA Screening and HRA Addendum Reports on the basis of the change in project design and location of the HRA screening area, and therefore not considered in this RIAA are provided in **Table 4-14**.

Table 4-14: Summary of Potential Effects Screened Out for Offshore Annex II Migratory Fish

Potential Effect	C	O&M	D
Direct Effects on European Sites	x	x	x
Introduction of other substances (such as pollutants or sediments)	x	x	x
Introduction or spread of INNS	x	x	x

4.5 Sites Designated for Annex II Marine Mammals

4.5.1 Sites and Features to Be Considered in the RIAA

367. A summary of the Annex II Marine Mammals sites considered in this RIAA are provided in **Table 4.15**, further detail on why these sites have been considered is within the **HRA Screening Report** (see **Annex A.2**).

Table 4.15 Summary of European Sites and Species Screened in for the Project as of HRA Addendum

European Site	Distance to Array (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
Annex II Marine Mammals			
Doggersbank SAC (Site code: NL2008001)	0	0	Harbour Seal Grey Seal Harbour Porpoise
Southern North Sea SAC (Site code: UK0030395)	39	0	Harbour porpoise
Humber Estuary SAC (Site code: UK0030170)	235	25	Grey Seal
Ridens et dunes hydrauliques du 80etroit du Pas-de-Calais SAC (Site code: FR3102004)	457	65	Grey Seal
Klaverbank SAC (Site code: NL2008002)	74	72	Grey Seal Harbour Seal Harbour Porpoise

European Site	Distance to Array (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
The Wash and North Norfolk Coast SAC (Site code: UK0017075)	244	99	Harbour seal
Berwickshire and North Northumberland Coast SAC (Site code: UK0017072)	267	167	Grey Seal
Sylter Außenriff SCI (Site code: DE1209301)	207	208	Grey Seal
Noordzeekustzone SAC (Site code: NL9802001)	218	216	Grey Seal
Duinen Terschelling SAC (Site code: NL2003059)	224	223	Grey Seal
Waddenzee SAC (Site code: NL1000001)	225	224	Grey Seal
Duinen Vlieland SAC (Site code: NL2003061)	225	225	Grey Seal
Duinen en Lage Land Texel SAC (Site code: NL2003060)	231	229	Grey Seal
Duinen Ameland SAC (Site code: NL3009005)	237	236	Grey Seal
Sydlig Nordsø SAC (Site code: DK00VA347)	243	242	Grey Seal
Isle of May SAC (Site code: UK0030172)	350	260	Grey Seal
SPA Ostliche Deutsche Bucht SPA (Site code: DE1011401)	262	262	Grey Seal
National park Niedersachsisches Wattenmeer SAC (Site code: DE2306301)	267	266	Grey Seal

European Site	Distance to Array (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
NTP S-H Wattenmeer und angrenzende Küstengebiete SAC (Site code: DE0916391)	311	310	Grey Seal
Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde SAC (Site code: DK00AY176)	314	313	Grey Seal
Vlaamse Banken SAC (Site code: BEMNZ0001)	383	320	Grey Seal
Helgoland mit Helgolander Felssockel SAC (Site code: DE1813391)	320	320	Grey Seal
Bancs des Flandres SAC (Site code: FR3102002)	407	328	Grey Seal
Steingrund SAC (Site code: DE1714391)	328	328	Grey Seal
Doggerbank SCI (Site code: DE1003301)	67	332	Harbour Porpoise Harbour Seal
Voordelta SAC and SPA (Site code: NL4000017)	334	332	Grey Seal
Dünenlandschaft Süd-Sylt SAC (Site code: DE1115391)	333	333	Grey Seal
Küsten- und Dünenlandschaften Amrums SAC (Site code: DE1315391)	337	336	Grey Seal
Vlakte van de Raan SCI (Site code: BEMNZ0005)	377	344	Grey Seal
Vlakte van de Raan SAC (Site code: NL2008003)	377	345	Grey Seal

European Site	Distance to Array (nearest km)	Distance to ECC (nearest km)	Designated Feature Screened In
Duinen Goeree & Kwade Hoek SAC (Site code: NL9801079)	351	349	Grey Seal
Recifs Gris-Nez Blanc-Nez SAC (Site code: FR3102003)	450	350	Grey Seal
Grevelingen SAC (Site code: NL4000021)	356	351	Grey Seal
Hamburgisches Wattenmeer SAC (Site code: DE2016301)	353	353	Grey Seal
Oosterschelde SPA and SAC (Site code: NL3009016)	366	355	Grey Seal
Westerschelde & Saeftinghe SAC (Site code: NL9803061)	382	356	Grey Seal
Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC (Site code: FR3100478)	458	362	Grey Seal
Baie de Canche et couloir des trois estuaires SAC (Site code: FR3102005)	495	392	Grey Seal
Moray Firth SAC (Site code: UK0019808)	469	392	Bottlenose dolphin
Estuaires et littoral picards (baies de Somme et d’Authie) SAC (Site code: FR2200346)	517	414	Grey Seal

4.5.2 Sites and Features Screened Out in the HRA Screening/Addendum Reports

368. Due to potential connectivity, many designated sites were considered in the HRA Screening Report, the full list of designated sites screened out of the HRA is presented in **Table 4-14** in the **HRA Screening Report** (see **Annex A.2**).

4.5.3 Potential Effects Screened In

369. The HRA Screening Addendum considered potential for additional effects (given the change in project design and therefore location of the HRA screening area) and concluded no change from the HRA Screening Report (see **Annex A.2**).
370. The potential effects on Annex II Marine Mammal features during the construction, operation and maintenance (O&M) and decommissioning phases are shown in **Table 4.16**.

Table 4.16 Summary of Potential Effects Identified for Annex II Marine Mammals (C = construction, O&M = operation and maintenance, D = decommissioning)

Potential Effect	C	O&M	D
Underwater Noise: Physical and Auditory Injury (permanent threshold shift (PTS)) Resulting from Impact Piling During Construction	✓	×	×
Underwater Noise: Behavioural Impacts Resulting from Impact Piling During Construction	✓	×	×
Underwater Noise: Physical and Auditory Injury (PTS) Resulting from Operational Wind Turbine Noise	×	✓	×
Underwater noise: behavioral impacts resulting from operational wind turbine noise	×	✓	×
Underwater Noise: Physical and Auditory Injury (PTS) Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise	✓	✓	✓
Underwater noise: behavioral impacts resulting from other construction and maintenance activities (such as dredging and rock placement), and vessel noise (including disturbance to foraging areas)	✓	✓	✓
Underwater noise: barrier effects	✓	✓	✓
Disturbance at seal haul-out sites	✓	✓	✓
Vessel interaction (increase in risk of collision)	✓	✓	✓

Potential Effect	C	O&M	D
Changes to prey resource	✓	✓	✓
Changes to water quality	✓	×	✓
Barrier effects from the physical presence of the wind farm during operation	×	✓	×
In-combination effects	✓	✓	✓
Transboundary effects	✓	✓	✓

4.5.4 Potential Effects Screened Out in the HRA Screening/Addendum Reports

371. The HRA Addendum screening outcome concluded the following potential effects previously screened in for further consideration should be screened out on the basis of the change in project design and location of the HRA screening area:
- Although the Offshore Development Area has changed, this has not resulted in any alterations to the designated sites for marine mammals originally assessed in 2023. The only change comes as a result of HPF removal, and therefore any LSE on water quality during O&M are now screened out.
372. A summary of potential effects on Annex II Marine Mammals screened out in the HRA Screening and HRA Addendum Reports on the basis of the change in project design and location of the HRA screening area, and therefore not considered in this RIAA are provided in **Table 4.17**.

Table 4.17 Summary of Potential Effects Screened Out for Offshore Annex II Marine Mammals

Potential Effect	C	O&M	D
Changes to water quality	✓	×	✓
Effects from EMF during operation	×	×	×

5 Stage 2 Assessment of Sites Designated for Annex I Marine Habitats

5.1 Approach to Assessment

373. The approach to this RIAA for Annex I marine habitats is to identify the relevant qualifying features of the Dogger Bank SAC, examine the individual impacts previously screened in from the Stage 1 assessment (see **Section 4.1**), and consider the potential adverse effect on the integrity of the Dogger Bank SAC during construction, operation and maintenance, and decommissioning. Following this, an in-combination assessment has been provided, assessing the potential for AEoI of the Dogger Bank SAC alongside other relevant developments and projects.

5.2 Consultation

374. The key elements of consultation to date have included the HRA Screening Report (**Appendix A.2 Dogger Bank D HRA Screening and HRA Addendum Reports**), the HRA Screening Addendum (**Appendix A.2 Dogger Bank D HRA Screening and HRA Addendum Reports**) and the ongoing consultation with stakeholders participating in the Seabed Expert Topic Group (for further information see **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology**). Consultation responses relevant to the RIAA which have been received to date are detailed in **Appendix A.1 Dogger Bank D HRA Consultation Responses**. Specific meetings held regarding the benthic ecology aspects relating to the RIAA are listed in **Table 5-1** along with stakeholders present and the key purposes of those meetings.

375. The Project has a separate ETG for benthic compensation, ongoing engagement in this forum is summarised in **Appendix A.1 Dogger Bank D HRA Consultation Responses** and detailed in the following compensation roadmap documents:

- **Benthic HRA Derogation and Compensation – Roadmap & Evidence** (document reference 5.4.1).

Table 5-1 Meetings as part of the Evidence Plan Process undertaken to date for the topic of Benthic Ecology (informing the Annex I Habitat assessment)

Meeting	Stakeholder(s)	Date(s) of Meeting	Purpose of Meeting
ETG Meetings			
ETG1 (Marine Physical Processes, Fish and Benthic)	<ul style="list-style-type: none">• Natural England• MMO• Environment Agency• Cefas• Inshore Fisheries and Conservation Authority (IFCA)	13/09/2023	<ul style="list-style-type: none">• Discussion and feedback on approach to EIA with agreements requested for:• Study area chosen;• Approach to data collection; and• Impacts scoped in.
	<ul style="list-style-type: none">• Natural England• MMO• Environment Agency• Cefas	30/10/2024	
ETG1 (Marine Physical Processes)	<ul style="list-style-type: none">• Natural England• MMO• Cefas	22/07/2024	

5.3 Assessment of Potential Effects

5.3.1 Embedded and Standard Mitigation Measures

376. This section outlines the embedded mitigation relevant to the Annex I Marine habitats assessment, which has been incorporated into the design of the Project (**Table 5-2**).

5.3.2 Worst-Case Scenario

377. **Table 5-3** outlines the worst-case scenario for effects which are of relevance to this Stage 2 assessment.

Table 5-2 Embedded Mitigation Measures incorporated into the Project design to date relevant to Annex I Marine Habitats

Parameter	ID	Commitments	How the Commitment Will be Secured
Micrositing / Long term habitat loss	CO24	<p>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.</p> <p>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.</p>	DML Condition - Cable Specification and Installation Plan
Pollution events resulting from the accidental release of pollutants	CO25	<p>A Project Environmental Management Plan (PEMP) will be provided in accordance with the Outline PEMP and will include:</p> <ul style="list-style-type: none"> • A Marine Pollution Contingency Plan (MPCP), which will include plans to address the risks, methods and procedures to deal with any spills and collision incidents in relation to all activities carried out below Mean High Water Springs (MHWS) to safeguard the marine environment; • Best practice measures for the storage, use and disposal of lubricant and chemicals will be undertaken throughout the construction phase; • A Chemical Risk Assessment (CRA) to ensure any chemicals, substances and materials to be used will be suitable for use in the marine environment and in accordance with the Health and Safety Executive and the Environment Agency Pollution Prevention Control Guidelines or latest relevant available guidelines; • A marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised; and • Details of waste management and disposal arrangements. 	DML Condition - Project Environmental Management Plan
All parameters	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
All parameters	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 operation and maintenance (O&M) phases.	DML Condition - In Principle Monitoring Plan

Table 5-3 Worst-Case Scenario for potential effects on Annex I Marine Habitats

Impact	Worst-case scenario	Notes and rationale
Construction phase		
Temporary physical disturbance / Physical Disturbance	<p>Array Area:</p> <ul style="list-style-type: none"> Maximum scour protection area per foundation including structure footprint for suction buckets of 14,314m² x 113 wind turbine generators (WTG)) = 1,617,482m². Two Offshore Platforms (OPs) with monopile foundations (25,000m² per monopile foundation x 2 OPs) = 50,000m². Inter-array cable seabed sand wave levelling and installation including seabed preparation activities (35m width x 400km length of inter-array cables) = 14,000,000m². Vessel jack up assuming 5 jack up locations per WTG / OP (400m² per jack up leg x 6 legs x 5 jack up operations per WTG x 113 WTG and 2 x OPs) = 1,380,000m². Anchoring during WTG and OP installation (based on 16 anchors x 100m² footprint x 113 WTG and 34 anchors x 100m² footprint for the 2 OPs) = 187,600m². Anchoring during inter-array cable installation (based on 6 anchors x 100m² x 11.5 anchoring events x 2 vessels) = 13,560m². Worst case scenario total disturbance footprint in the Array Area = 17,248,642m². <p>Export cable:</p> <ul style="list-style-type: none"> Maximum temporary disturbance for seabed preparation within the offshore ECC = 16,608,000m²; 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 pre-sweeping on 28.8% of cable route; Disturbance from pre-sweeping (35m width x 230.4km (28.8% of the 800km export cable) = 8,064,000m²; and Disturbance from installation (15m trench width x 569.6km (71.2% of the 800km export cable) = 8,544,000m². Anchoring during offshore export cable installation (based on 6 anchors x 100m² x 24 anchoring events) = 14,400m². Landfall (trenchless exit pits) <ul style="list-style-type: none"> 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 = 7,500m². Anchoring during landfall exit pits installation (based on 6 anchors x 100m² x 12 anchoring events) = 7,200m². Worst-case scenario total disturbance footprint in the offshore ECC – 16,637,100m². <p>Total disturbance footprint – 33,885,742m²</p> <p>Of the above works, the array area construction would take place within the Dogger Bank SAC (as calculated above, the worst-case scenario total disturbance footprint in the Array Area is 17,248,642m²).</p> <p>Additionally, the following offshore ECC construction could be within the SAC:</p> <ul style="list-style-type: none"> Maximum total export cable trench length of 88km = 22% of overall Offshore ECC. Maximum width of temporary disturbance is approximately 35m. Anchor placement (22% of 14,400m²) = 3,168m². 	<p>Temporary habitat loss / physical disturbance relates to seabed preparation and installation activities.</p> <p>The persistent / permanent footprint of infrastructure is assessed as an operation phase impact.</p> <p>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.</p> <p>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.</p> <p>The sand wave levelling width and/or the installation width also include the following activities:</p> <ul style="list-style-type: none"> Boulder clearance; Route clearance pre-lay grapnel run (PLGR); Crossing preparation; and Archaeological surveys / investigation / relocation.

REPORT TO INFORM APPROPRIATE ASSESSMENT

Impact	Worst-case scenario	Notes and rationale
	<ul style="list-style-type: none"> Total disturbance footprint (88km export cable trench length x 35m width sand wave levelling) = 3,080,000m² + vessel anchoring 3,168m² = 3,083,168m². <p>Total disturbance footprint in the Dogger Bank SAC – 20,331,810m².</p>	
Increased suspended sediment concentrations (SSC)	<p>Array Area:</p> <ul style="list-style-type: none"> Seabed preparation volume for a single turbine foundation (suction bucket foundation plus scour protection footprint 14,314m² x 2.5m levelling depth) = 35,785m³. Seabed preparation volume for 113 turbine foundations = 4,043,705m³. Seabed preparation volume for two offshore platform foundations (monopile foundation plus scour protection footprint 25,000m² x 2 platforms x 4m levelling depth = 200,000m³. Inter-array cable sand wave levelling (35m width x 400km length of inter-array cables x 4m maximum burial depth) = 56,000,000m³. Inter-array cable installation (5m width x 400km length of inter-array cable x 3.5m depth) = 7,000,000m³. Worst-case scenario volume for Array Area = 67,243,705m³. <p>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 seabed levelling for suction bucket described above.</p> <ul style="list-style-type: none"> Drill arisings at 50% of WTGs (60m average drill depth x 254.5m² drill area (18m drill diameter) x 57 WTGs (rounded up 50%)) = 870,390m³. Drill arisings from OPs (100m average drill depth x 176.7m² drill area (15m drill diameter). Based on maximum 12 piles, 50% requiring drilling) = 106,020m³. Total drill arisings = 976,410m³. <p>Export cable (includes portion within the Array Area and Landfall):</p> <ul style="list-style-type: none"> Displaced sediment volume during sand wave levelling for Offshore Export Cable installation (length 230,400m) = 32,256,000m³ (230,400m length x 4m depth x 35m width). Displaced sediment volume during trenching for Offshore Export Cable installation = 14,000,000m³ (800,000m length x 3.5m depth x 5m width). Landfall (trenchless exit pits) <ul style="list-style-type: none"> 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 – 26,250m³. Worst-case scenario volume for export cables (sand wave levelling + trenching for offshore export cable installation + landfall trenchless exit) = 46,282,250m³. <p>Overall Total:</p> <p>Worst-case total for Project = 113,525,955m³.</p> <p>Of the above works, the Array Area construction would take place within the Dogger Bank SAC (as calculated above, the worst-case total SSC in the Array Area is 67,243,705m³).</p> <p>Additionally, the following offshore ECC construction could be within the Dogger Bank SAC:</p> <ul style="list-style-type: none"> Export cable seabed preparation (44km x 2 cables x 35m width x 4m depth) = 12,320,000m³. Export cable installation (length of 88km x 5m width x 3.5m depth) = 1,540,000m³. 	<p>Seabed preparation (dredging using a trailing suction hopper dredger and installation of a bedding and levelling layer) may be required to a depth of 4m. 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.</p> <p>Sandwave levelling may be required prior to offshore cable installation. Any excavated sediment due to sandwave levelling would be disposed of within the offshore project area, meaning there will be no net loss of sediment from the site.</p> <p>The offshore HDD exit location will be subtidal in 1m to 8m water depth. Sediment displacement is included in the totals for the export cable.</p>

Impact	Worst-case scenario	Notes and rationale
	<ul style="list-style-type: none">Worst-case scenario volume for export cables within the Dogger Bank SAC = 13,860,000m³.Worst-case scenario volume for SSC in the Dogger Bank SAC = 81,103,705m³.	
Remobilisation of contaminated sediments	Maximum suspension of sediments as described above. No contaminated sediments were recorded exceeding any Action Levels (ALs) within the offshore project area. See Section 9.6.1.1 in PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality for more detail.	
Underwater noise and vibration	Maximum hammer energy: <ul style="list-style-type: none">5,000kJ (pin-piles); and8,000kJ (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 phase		
Temporary physical disturbance / Physical disturbance	<p>Array Area:</p> <ul style="list-style-type: none">Seabed disturbance from jacking-up activities over the Project's lifetime (7 visits for WTG over lifetime x (400m² per jack up leg x 6 legs x 5 jack up operations per WTG) = 84,000m².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) = 225,000m².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) = 1,050,000m².Anchoring during inter-array cable repairs/reburial (based on 6 anchors x 100m² x 35 anchoring events) = 21,000m².Total disturbance in Array Area (sum of above) = 1,380,000m². <p>Offshore ECC:</p> <ul style="list-style-type: none">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) = 525,000m².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) = 1,050,000m².Anchoring during export cable repairs/reburial (based on 6 anchors x 100m² x 35 anchoring events) = 21,000m².Total disturbance in offshore ECC (sum of above) = 1,596,000m². Note that all Export Cable maintenance has been assumed to occur within the Dogger Bank SAC for this RIAA, therefore a highly conservative scenario. <p>Total disturbance footprint = 2,976,000m²</p>	The worst-case scenario assumes all of the export cable repairs could be within the Dogger Bank SAC.

REPORT TO INFORM APPROPRIATE ASSESSMENT

Impact	Worst-case scenario	Notes and rationale
Long term habitat loss	<p>Array Area:</p> <ul style="list-style-type: none"> Total worst case turbine footprint with scour protection (14,314m² maximum scour protection area per foundation including structure footprint (135m diameter / 14,314m²) x 113 WTGs) = 1,617,482m². Total worst-case scour protection for two OPs with monopile foundations (25,000m² per monopile foundation including scour protection x 2 OPs) = 50,000m². Inter-array cable rock / remedial protection (10m width of rock berm protection x 40km length of exposed inter-array cables requiring remedial protection) = 400,000m². Inter-array cable crossings (5 assumed at 1,000m² each) = 5,000m². Total Array Area (sum of the above) = 2,072,482m². <p>Offshore ECC (within the Dogger Bank SAC):</p> <ul style="list-style-type: none"> Total export cable protection (20% of cable requiring protection in the Dogger Bank SAC (17.6km) x 10m width of rock berm protection) = 176,000m². Overall total (2,072,482m² + 176,000m²) = 2,248,482m² <p>Of the above works, all the array area works would be within the Dogger Bank SAC, but only the offshore ECC calculations have been based proportionally on the length within the SAC.</p>	<p>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.</p> <p>88km of the offshore export cables would be located in the Doger Bank SAC, with a maximum of 20% (17.6km) requiring protection.</p> <p>Total scour protection per turbine includes structure footprint area.</p> <p>Predicted number of export cable crossings for Project, though none within the Dogger Bank SAC:</p> <ul style="list-style-type: none"> 16 cable crossings per cable; and 3 pipeline crossings per cable.
Increased suspended sediment concentrations (SSC)	<ul style="list-style-type: none"> 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) = 787,500m³. 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) = 3,675,000m³. Anchoring during inter-array cable repairs/reburial (based on 6 anchors x 100m² x 50 anchoring events x 6.1m depth) = 183,000m³. 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) = 1,837,500m³. 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) = 3,675,000m³. <p>Total increased SSCs (sum of above) = 10,158,000m³.</p>	<p>The volume of sediment that could be suspended is expected to be much smaller proportion compared with the quantity generated by construction and decommissioning activities.</p>
Remobilisation of contaminated sediments	No contaminated sediments were recorded exceeding any ALs within the offshore project area. See Section 9.6.1.1 in PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality for more detail.	
Underwater noise and vibration	Underwater noise parameters in PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report . Operational life of the Project = 35 years.	
Interactions of Electromagnetic Field (EMF) (including potential cumulative EMF effects)	<p>Minimum target burial depth – 0.2m.</p> <p><i>Note</i> - 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.</p>	

Impact	Worst-case scenario	Notes and rationale
Colonisation of introduced substrate	<p>Vessels:</p> <ul style="list-style-type: none">Maximum number of operation & maintenance (O&M) vessels on site at any one time – 16.(See habitat loss / alteration row for infrastructure that could be colonised).	<p>The risk of introducing INNS during construction is primarily related to vessel activities should vessels come from other marine bioregions.</p> <p>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.</p>
Decommissioning		
Temporary physical disturbance / Physical disturbance	<p>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 PEIR Volume 1, Chapter 4 Project Description.</p> <p>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 Commitment ID CO21 in PEIR Volume 2, Appendix 6.3 Commitments Register), which will be submitted and agreed with the relevant authorities prior to the commencement of offshore decommissioning works.</p> <p>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.</p>	
Increased suspended sediment concentrations (SSC)		
Remobilisation of contaminated sediments		
Underwater noise and vibration		

5.4 Dogger Bank SAC

5.4.1 Site Description

5.4.1.1 Qualifying Features

378. Dogger Bank SAC has been designated for Annex I habitat: ‘Sandbanks which are slightly covered by seawater all the time’. The SAC is 12,331km² and the entirety of the designated site is covered by Annex I habitat. The sediment is characterised predominantly by gravelly sand and sand and possesses no vegetation. The SAC, at its crest, sits 20m below the surface and gradually extends in to deeper water (Diesing *et al.*, 2009; JNCC, 2011).

379. Characteristic communities of the SAC are not explicitly defined by JNCC (2022). However, key macrofaunal communities and fish have been identified. In terms of macrofaunal communities, evidence from surveys in 2008 and 2014 (Diesing *et al.*, 2009; Eggleton *et al.*, 2017) supported the existence of the four related biological communities previously identified by Wieking and Kröncke (2003):

- the “Bank” community was the predominant community and straddled across the bank from north to southeast. It is characterised by a *Bathyporeia Tellina* community of amphipods and small clams;
- the “North-Eastern” community had lower densities but the highest number of species. The tube-inhabiting velvet anemone *Cerianthus lloydii* and the small sea urchin *Echinocyamus pusillus* occurred at high densities in the shallower part. The brittlestar *Amphiura filiformis*, the clam *Abra prismatica* and the polychaete *Scoloplos armiger* were more common in the deeper part;
- the “South-West Patch” community was a sub-group of the Bank community in the shallow western side. The amphipod *Bathyporeia elegans* is the most abundant species with the clam *Donax vittatus* and the polychaete *Nephtys cirrosa* at their highest abundances in this sub area of the Bank community; and
- the “Southern Amphiura” community in the deeper southern part of the bank. The polychaete *Spiophanes bombyx* was abundant, but here the brittlestar *Amphiura filiformis* and its commensal bivalve *Kurtiella bidentata* dominated in numbers.

5.4.1.2 Conservation Objectives

380. The conservation objectives set for ‘Sandbanks which are slightly covered by sea water all the time’ of Dogger Bank SAC are (JNCC, 2022):

- For the feature to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of Annex I Sandbanks which are slightly covered by seawater all the time.

381. This contribution would be achieved by maintaining or restoring, subject to natural change:

- The extent and distribution of the qualifying habitat in the site;
- The structure and function of the qualifying habitat in the site; and
- The supporting processes on which the qualifying habitat relies.

5.4.1.3 Condition Assessment

382. The most recent condition assessment determined that the Annex I sandbank feature of the Dogger Bank SAC is currently in unfavourable condition (JNCC, 2022). A restore objective is advised for two of the above conservation objective attributes:

- The extent and distribution of the qualifying habitat in the site; and
- The structure and function of the qualifying habitat in the site.

5.4.1.3.1 Extent, distribution and structure

383. With regard to ‘physical change to another seabed/sediment type’, the restore objective for ‘Attribute: Extent and Distribution’ in the Supplementary Advice on Conservation Objectives (SACO) for Dogger Bank Special Area of Conservation (JNCC, 2022) states that: “JNCC understands that the site continues to be subjected to activities that have resulted in a change to the extent and distribution of the feature within the site, noting bottom trawling no longer occurs within the site. Installation and/or removal of infrastructure will have a continuing effect on extent and distribution. As such, JNCC continues to advise a restore objective which is based on expert judgement; specifically, our understanding of the feature’s sensitivity to pressures which can be exerted by ongoing activities i.e. offshore wind farms, cabling and oil and gas industry activities....

...These industries [offshore wind farms, cabling and oil and gas industry] have placed infrastructure i.e. gas platforms, pipelines, wind turbines, cables and protective materials (e.g. rock dump and mattresses), in or on the seabed throughout the site; although it is not possible to quantify the amount of material introduced.... Whilst JNCC does not consider it likely that the human activities taking place within the site have the potential to permanently impact on the large scale topography of the sandbank feature, JNCC continues to advise that the extent of the sandbank feature in terms of its sedimentary composition and biological assemblages has been reduced and it continues to be reduced by ongoing activities; albeit by an unquantifiable amount.”

384. The restore objective for ‘Attribute: Structure and Function’ (JNCC, 2022) states that: *“JNCC understands that the site continues to be subjected to some activities that have resulted in a change to the finer topography, sediment composition and distribution, and characteristic communities of the feature within the site, noting bottom trawling no longer occurs within the site....As such, JNCC continues to advise a restore objective, which is based on expert judgement; specifically, our understanding of the feature’s sensitivity to pressures which can be exerted by ongoing activities i.e. offshore wind farms, cabling and oil and gas industry activities.”*
385. JNCC (2022) states that with regard to the physical structure the restore objectives relates to finer scale topography and sediment composition and distribution. With regard to biological structure the restore objective relates to the key and influential species and characteristic communities present.
386. Additionally, JNCC state that it is not possible to quantify the amount of material introduced (and does not quantify the extent of historic fishing activity) and therefore by extension it is also not possible from the above statements to understand at what magnitude/footprint the effects on Extent and Distribution and Structure and Function led to unfavourable condition. It should be noted though that, referring to the original draft conservation objectives for the candidate SAC (JNCC, 2012 cited in DECC, 2015) the sandbank feature was already considered to be in unfavourable condition (i.e. previous to any offshore wind farm development).
387. The Dogger Bank SAC (Specified Area) Bottom Towed Fishing Gear Byelaw 2022 is in place came into force on the 13th June 2022. This byelaw was enacted to protect the entirety of the Dogger Bank SAC from the impacts of bottom-towed fishing gear. Even more recently, in January 2024 Defra announced that the UK government had decided to prohibit the fishing of sandeels within English waters of ICES Area 4 (North Sea) effective from March 2024 (Defra, 2024). This includes the Dogger Bank SAC. These measures will aid in the recovery of the extent, distribution and structure of the Dogger Bank SAC.

5.4.1.3.2 Function

388. The SACO (JNCC, 2002) list three ecosystem services which “may be provided by the sandbank feature”, namely;
- Nutrition – the site provides a feeding ground where prey is made available for a variety of species of commercial importance;
 - Bird and whale watching – the site provides some supporting function provision for wider marine bird and mammal populations; and
 - Climate regulation – the range of sedimentary habitats and associated communities in the site perform ecological processes common to sandbanks such as deposition and burial of carbon in seabed sediments through bioturbation, living biomass and calcification of benthic organisms.

389. The SACO states: *“...there is evidence to indicate that the biological communities within the site would continue to be impacted by activities associated with the oil and gas industry, cabling and historic bottom trawling and historic aggregate dredging. Effects from historic activities, including aggregates and bottom trawling, may continue to impact the carbon storage function of Dogger Bank through their disturbances to subsurface peat (Diesing et al., 2009). The significance of any impact on the health of the sandbank feature and/or its provision of ecosystem services to the wider marine environment is unclear, but it is likely impacted. A restore objective continues to be advised for function within the site based on impacts to the characterising communities and peat deposits from ongoing and historical activities i.e., wind farm, demersal fishing, aggregates, cabling and oil and gas industry activities.”*
390. Practical advice from the SACO (JNCC, 2022) is that: *“Activities must look to minimise, as far as is practicable, disturbance and changes to the biological communities and the abiotic component of the Dogger Bank to conserve the functions that it provides to the wider marine environment.”*
391. The Applicant notes that although peat deposits are discussed in the SACO (JNCC, 2022) in relation to climate regulation, such deposits are geological (not ecological) features and do not feature within the SAC selection documentation (JNCC, 2011). The geology underlying sandbanks is not considered within the Interpretation Manual of European Union Habitats (EC, 2013).

5.4.2 Assessment of Potential Effects of the Project Alone

5.4.2.1 Temporary Physical Disturbance / Physical Disturbance

5.4.2.1.1 Construction

392. During construction there will be disturbance within the offshore development area due to cable laying operations, jack up operations, construction works for foundations and UXO clearance. This will cause temporary physical disturbance/physical disturbance to the seabed.
393. Where disturbed sediments (e.g. preparation areas for foundations) are subsequently covered with infrastructure, they are no longer assessed as temporary physical disturbance but as long term habitat loss due to the change in seabed/sediment type. As such, long term habitat loss has been assessed as an operational impact in **Section 5.4.2.2.2**, and is not considered further here.
394. The impact of temporary physical disturbance has been defined using the following pressures identified by JNCC’s AoO for Dogger Bank SAC:
- Abrasion / disturbance of the substrate on the surface of the seabed;

- Penetration and / or disturbance of the substrate below the surface of the seabed, including abrasion; and
 - Habitat structure changes – removal of substratum (extraction) (JNCC, 2022b).
395. **Table 5-3** presents the worst-case scenario of temporary physical disturbance on the Annex I habitat within the Dogger Bank SAC. The worst-case area of seabed within the Dogger Bank SAC which could be disturbed during construction would be 20,331,810m². This equates to 0.165% of the SAC area.
396. Findings from the **PEIR Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report** identified the following biotopes to be the most prevalent within the offshore development area:
- *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in Atlantic infralittoral compacted fine muddy sand (MB5236). Assigned to 21 stations;
 - *Amphiura brachiata* with *Astropecten irregularis* and other echinoderms in circalittoral muddy sand (MC5215). Assigned to 16 stations (as an epibiotic biotope overlaying MB5236);
 - *Echinocyamus pusillus*, *Ophelia borealis* and *Abra prismatica* in circalittoral fine sand (MC5211). Assigned to 20 stations;
 - *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212). Assigned to 15 stations;
 - Faunal communities in Atlantic offshore circalittoral sand (MD521). Assigned to 16 stations; and
 - Atlantic circalittoral sand (MC52). Assigned to 11 stations.
397. The biotopes identified within the offshore development area 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) (Last *et al.*, 2020). The tolerance, recoverability and sensitivity of the identified biotopes have been discussed further in **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology** of the PEIR. However, the exceptions are ‘Piddocks with a sparse associated fauna in Atlantic circalittoral very soft chalk or clay’, ‘Ocean quahog (*Artica islandica*)’ and “Seapens and burrowing megafauna in Atlantic circalittoral fine mud”. Due to their increased sensitivity to temporary physical disturbance, biotopes have been considered to have medium sensitivity to this impact. This has been discussed further in **Section 10.7.1.1 in PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology**.
398. The effects on sandbank feature function are also considered in terms the physical effects based on advice that “activities must look to minimise, as far as is practicable, disturbance and changes to the biological communities and the abiotic component of the Dogger Bank to conserve the functions that it provides” in the SACO (JNCC, 2022). This methodology is applied to all effects throughout this assessment.
399. There is limited information available to evidence the recovery of seabed habitats from temporary physical disturbance in the Dogger Bank SAC. As such, Dogger Bank South commissioned a geophysical survey to investigate the potential for seabed recovery following the installation and removal of two met masts (monopiles on 15m diameter suction caissons) located within the Dogger Bank Wind Farm zone between 2013 and 2017 (Dogger Bank South, 2024). The study found that between pre-installation and post-removal there were no significant changes to the seabed features resulting from the presence of met masts within the four years. It also found that trawl marks and localised depressions present pre-installation had infilled over the 10 year period from installation of the met masts in March / September 2013. This analysis provides robust evidence to suggest the seabed habitats within the Dogger Bank SAC would recover from temporary physical disturbance.
400. Given the low to medium sensitivity of biotopes within the SAC (in particular due to their high recoverability), the relatively small footprint and the episodic nature of the effect it is considered that temporary physical disturbance for the Project alone would not significantly affect:
- The extent of the sandbank feature in terms of its sedimentary composition or biological assemblages;
 - The physical structure and function in terms of finer scale topography and sediment composition and distribution;
 - The biological structure and function in terms of the key and influential species and characteristic communities present; and
 - The function of the feature within the site.
401. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to temporary physical disturbance of the seabed during construction from the Project alone.
- 5.4.2.1.2 Operation and Maintenance
402. Temporary physical disturbance will occur during the operational phase of the Project through activities such as cable repairs and reburial, turbine repairs, and potentially the deployment of jack up vessels or vessel anchors. The areas disturbed would be extremely small in comparison to during construction.

403. Each operation and maintenance activity would be relatively short term, and it is likely that the requirements for maintenance would be spread out over the life of the Project, with recovery commencing once the activity is complete. In the unlikely event that the effects of all operation and maintenance activities occur within the Dogger Bank SAC, the estimated area of seabed disturbance is 2,976,000m² (0.024% of the Dogger Bank SAC). In reality, the extent of operation and maintenance phase temporary physical disturbance would be intermittent over the Project life (and assumes all export cable maintenance would occur within the SAC), and it is therefore very likely that habitats will commence recovery once the activity is complete.
404. As evidenced above in **Section 5.4.2.1.1**, the seabed habitats in the Dogger Bank Offshore Wind Farm zone have high likelihood for recoverability from the effects of temporary physical disturbance (Dogger Bank South, 2024).
405. Given the low to medium sensitivity of biotopes within the Dogger Bank SAC (in particular due to their high recoverability), the relatively small footprint and the episodic nature of the effect it is considered that temporary physical disturbance for the Project alone would not significantly affect:
- The extent of the sandbank feature in terms of its sedimentary composition or biological assemblages;
 - The physical structure and function in terms of finer scale topography and sediment composition and distribution;
 - The biological structure and function in terms of the key and influential species and characteristic communities present; and
 - The function of the feature within the site.
406. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to temporary physical disturbance of the seabed during operation and maintenance from the Project alone.
- 5.4.2.1.3 Decommissioning
407. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with the best industry practice. The decommissioning methodology and programme would need to be finalised nearer to the end of the lifetime of the Project to ensure it is in line with the most recent guidance, policy and legislation.
408. Temporary physical disturbance/physical disturbance effects on the features of the Dogger Bank SAC would be no greater than, and are expected to be less than, those of the construction phase (**Section 5.4.2.1.1**). Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to temporary physical disturbance of the seabed during decommissioning from the Project alone.

5.4.2.2 Long Term Habitat Loss

5.4.2.2.1 Construction

409. The effects of long term habitat loss on features of the Dogger Bank SAC have been screened out of assessment during the construction phase (see **Table 4-4**) and are considered in the operation and maintenance phase assessment below.

5.4.2.2.2 Operation and Maintenance

410. Long term habitat loss within the Dogger Bank SAC 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. All of the array area works would be within the Dogger Bank SAC, but only 88km of the offshore ECC overlaps the SAC.
411. The impact of long term habitat loss has been defined using the following pressures identified by JNCC's AoO for the Dogger Bank SAC:
- Physical change (to another seabed type); and
 - Physical change (to another sediment type).
412. The total worst-case scenario for habitat loss within the Dogger Bank SAC is 2,248,482m² (see **Table 5-3**). This area represents 0.018% of the Dogger Bank SACs overall extent of 12,331km². This is a conservative worst-case scenario, assuming a maximum of 20% of the export cable (17.6km) and 10% (40km) of the inter-array cable would require scour protection. The assessed worst-case long-term habitat loss from the ECC is 176,000m². The final area of habitat loss within the SAC is likely to be much lower than estimated in the worst-case assessment as the Applicant will seek to minimise the use of scour protection for the turbine foundations and OSP foundations; and external cable protection for any stretches of unburied cables and cable crossings. This will be secured through the Cable Specification and Installation Plan that will be submitted for approval post consent (as further detailed in **Table 5-2**). Subsequently, the extent, distribution and structure of Annex I sandbank would be largely maintained across the Dogger Bank SAC.
413. The most prevalent biotopes in the offshore development area (**Section 5.4.2.1.1**) identified in the **PEIR Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report** are predominantly sandy habitats. The installation of infrastructure on sediment habitats will potentially result in localised mortality of associated biological communities and their replacement, over time, by a community of different species composition and with different key structural and influential species. See **Section 5.4.2.9**.

414. The change of seabed / sediment type to the Annex I habitat would have implications on the three conservation objectives for Dogger Bank SAC. A change seabed/sediment type could affect the *extent and distribution, structure and function, and supporting processes* of the Annex I sandbanks. The sedimentary composition and biological assemblages within the SAC would have low resistance and resilience to long term habitat loss.
415. Given that the restore objectives were set at the commencement of the Dogger Bank SAC designation (before offshore wind farms were present in the designated area) and that the SACO (JNCC, 2022) details the high sensitivity to changes to seabed/sediment type and the subsequent effect this has on all conservation objectives for the site. It can be concluded that any long term habitat loss would be considered to hinder the restore objectives.
416. It is considered that long term habitat loss resulting in a physical change to seabed / sediment type could significantly affect:
- The extent of the sandbank feature in terms of its sedimentary composition or biological assemblages;
 - The physical structure and function in terms of finer scale topography and sediment composition and distribution;
 - The biological structure and function in terms of the key and influential species and characteristic communities present; and
 - The function of the feature within the site.
417. Therefore, an AEoI of the Dogger Bank SAC from long term habitat loss from the Project alone cannot be ruled out.
418. The Secretary of State for the Department for Energy Security & Net Zero has concluded that “*removing Dogger Bank D is not a viable alternative and that all projects within the [Crown Estate’s] CIP [Capacity Increases Programme] are necessary in order to meet the significant need for new offshore wind infrastructure and to combat climate change*”³. This statement is subject to various conditions on DBD as well as other projects and subject to successful development of compensation measures, which will be developed throughout the ES process and submitted with the DCO Application. Further details with respect to the proposed compensation measures with regard to the Dogger Bank SAC are provided in the **PEIR Benthic HRA Derogation and Compensation – Roadmap & Evidence** (document reference 5.4.1).

5.4.2.2.3 Decommissioning

419. The effects of long term habitat loss on features of the Dogger Bank SAC have been screened out of assessment during the decommissioning phase (see **Table 4-4**). During the decommissioning phase, there is potential for wind turbine foundation and cable removal activities to cause effects that would be comparable to the operational phase. Long term habitat loss sits in this category. The effect of long term of habitat loss on the Dogger Bank SAC would be comparable to that of the operational phase (**Section 5.4.2.2.2**). As no decision has been made regarding the final decommissioning strategy for the offshore infrastructure, the effect of long term habitat loss on the Dogger Bank SAC cannot be assessed until an Offshore Decommissioning Plan has been prepared and agreed with the relevant authorities. For this reason, the effects of long term habitat loss have not been assessed for decommissioning at this stage.

5.4.2.3 Increased Suspended Sediment Concentration

5.4.2.3.1 Construction

420. Increased suspended sediment concentrations (SSC) and subsequent deposition will occur as a result of seabed preparation for the installation of infrastructure in the Array Area and offshore ECC.
421. Increased SSC have the potential to affect benthic ecology receptors by causing physical damage or injury, blocking feeding apparatus and by smothering sessile species upon redeposition.
422. **PEIR Volume 1, Chapter 8 Marine Physical Processes** of the PEIR provides details of increased SSC and subsequent sediment deposition, and changes to bedload sediment transport as a result of the Project. The model runs are carried out for one cable run at a time (such as sand wave clearance and trenching for installation) for the export cable, a worse case of 50% of the wind turbines requiring drilling for installation, and a single OP installation (drilling run). The results are then interpolated to account for the additional export cable and OP. It is also noted that the Inter-Array Cable layout was not available for model runs at the time of PEIR, and it is a majority of the overall sediment discharge. This will be modelled for the ES stage.
423. Based on the worst-case scenario (**Table 5-3**), the maximum volume of SSC in the Dogger Bank SAC over the entire construction phase is calculated as 81,103,705m³. This will predominantly be made up of finer sand as this comprises the majority of the Array Area and easterly extremes of the Offshore ECC.

3. ³ [1746699745-cip-hra-decision-letter.pdf](#).

424. The impact of increased SSC has been defined using the following pressures identified by JNCC's AoO for the Dogger Bank SAC:
- Changes in suspended solids (water clarity);
 - Smothering and siltation rate changes (heavy); and
 - Smothering and siltation rate changes (light).
425. **PEIR Volume 1, Chapter 8 Marine Physical Processes** describes the expected movement of sediment suspended during the construction phase for the above activities. To investigate suspended sediment dispersion, a model was run using the 3D model MIKE3-MT.
426. The worst-case activity causing increased SSC is drilling for wind turbine and OSP foundations. The results show that the drilling process would cause local increases in suspended sediment concentrations at the point of discharge of the sediment at each of the 57 wind turbine locations and offshore platform foundation. The predicted suspended sediment concentrations are highest closest to the points of release with maximums of 1mg/l in the surface layer increasing to 2mg/l in the bottom layer. The worst-case thickness of sediment deposited from the plume would not exceed 1mm (see **Figure 8-24 in PEIR Volume 1, Chapter 8 Marine Physical Processes**). 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. The outputs of the model are discussed further in **PEIR Volume 1, Chapter 8 Marine Physical Process** and **PEIR Volume 2, Appendix 8.3 Marine Physical Process Modelling Report** of the PEIR.
427. Given the local favourable conditions that enable sandwave development in the study area, the sediment would be naturally transported back into any levelled areas within a short period of time. Levelled areas will naturally act as a sink for sediment in transport and will be replenished in the order of a few days to a year (see **Section 8.7.2 in PEIR Volume 1, Chapter 8 Marine Physical Processes**). Furthermore, UXO crater monitoring surveys at DBB have shown that the seabed craters from high-order UXO clearances infilled by >50% within three months of the detonations (Dogger Bank B, 2023).
428. As detailed within **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology**, the biotopes found within the offshore development area within the Dogger Bank SAC have low sensitivity to changes in suspended sediment. JNCC and Natural England (2013) note that communities associated with sandbank habitats are adapted to high levels of sediment disturbance, owing to these habitats high-energy nature. Dynamic sand communities experience strong tidal currents and consequently there is high sediment mobility. In turn, infaunal communities are adapted to suspended sediment and deposition, for example, by rapidly re-burying themselves following disturbance.
429. Given the low sensitivity of the biotopes within the SAC (in particular due to their high recoverability and the episodic nature of the effect) it is considered that increased SSC and subsequent deposition would not significantly affect:
- The extent of the sandbank feature in terms of its biological assemblages;
 - The biological structure and function in terms of the key and influential species and characteristic communities present; and
 - The function of the feature within the site.
430. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to changes to increased SSC and subsequent deposition from the Project alone.
- 5.4.2.3.2 Operation and Maintenance
431. 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.
432. Each operation and maintenance activity would be relatively short term and it is likely that the requirements for maintenance would be spread over the Project life, with suspended sediments becoming rapidly deposited.
433. Significant effects of increased suspended sediment concentrations have been assessed in **PEIR Volume 1, Chapter 8 Marine Physical Processes** of the PEIR. The assessment found that the worst-case volumes of sediment released following operation activities are considerably less than in the construction phase.
434. Based on the low sensitivity of benthic communities (see **Section 5.4.2.3.1**) and the effects from SSC causing indistinguishable change to background levels, it can be concluded that there is no potential for an AEoI of this attribute due to increased SSC and subsequent deposition during the operation and maintenance phase.

5.4.2.3.3 Decommissioning

435. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with the best industry practice. The decommissioning methodology and programme would need to be finalised nearer to the end of the lifetime of the Project to ensure it is in line with the most recent guidance, policy and legislation.
436. Increased SSC effects on the features of the Dogger Bank SAC would be no greater than, and are expected to be less than, those of the construction phase (**Section 5.4.2.3**). Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to increased SSC during decommissioning from the Project alone.

5.4.2.4 Remobilisation of Contaminated Sediments

5.4.2.4.1 Construction

437. Sediment disturbance during construction could lead to the remobilisation of contaminated sediments which may have an effect on benthic biological communities associated with the Annex I sandbank feature of the SAC.
438. To inform the baseline for sediment quality, a benthic survey of the offshore development area was undertaken in July-August 2023 (Array Area) and September 2024 (ECC) where grab sampling was undertaken and samples analysed for trace metals, organotins, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) (see **Volume 2, Appendix 9.2 Sediment Quality Analysis Report** of the PEIR).
439. Chemical analysis was undertaken in line with the MMO accreditation scheme regarding sediment sampling for disposal at sea licensing.
440. The context of contaminants found within sediments is established through the use of recognised guidelines and action levels. Sediment contaminant concentration data is compared to the Cefas Action Levels (AL), sediment guidelines developed by Cefas to determine the potential risk of contaminated sediments to the marine environment (see **PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality**). Whilst the majority of sediments assessed using these levels arise from dredging activities, however in the absence of other guidelines, it has become commonplace to use these action levels to provide an indication of risk to marine water quality). If contaminant concentrations do not exceed the lower threshold value, then contamination is not considered to be of significant concern and is low risk in terms of potential impacts on the marine environment.

441. Sediment contamination concentrations within the Array Area were found to be below the lower threshold value and as such the potential for remobilisation of contaminated sediments to cause significant effects in the Array Area was scoped out of the impact assessment. This is set out in **PEIR Volume 2, Appendix 6.2 Impacts and Effects Register**, along with supporting justification, in line with the Scoping Opinion (responses presented in **Appendix A.1 Dogger Bank D HRA Consultation Responses**). The sediment analysis results from the 2024 ECC survey also show sediment contaminant concentrations along the ECC were below the lower threshold value. As such the potential effect of the remobilisation of contaminated sediments to cause significant adverse effects along the ECC was determined to be not significant in EIA terms in **PEIR Volume 1, Chapter 9 Marine Water and Sediment**.

442. Based on the absence of contaminants at levels of concern recorded within the offshore development area, it can be concluded that there is no potential for an AEoI of the Dogger Bank SAC due to re-mobilisation of contaminated sediments during construction from the Project alone.

5.4.2.4.2 Operation and Maintenance

443. As discussed in **Section 5.4.2.4.1**, sediment analysis carried out identified contaminants were not present at levels of concern in the offshore development area. As such there is no potential for an AEoI of the Dogger Bank SAC due to re-mobilisation of contaminated sediments during operation and maintenance. This effect was assessed to be not significant in EIA terms for the ECC in **Chapter 9 Marine Water and Sediment Quality** of the PEIR. It is also noted that this potential effect in relation to the Array Area was scoped out of the impact assessment in line with the Scoping Opinion responses presented in **Appendix A.1 Dogger Bank D HRA Consultation Responses**).

5.4.2.4.3 Decommissioning

444. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with the best industry practice. The decommissioning methodology and programme would need to be finalised nearer to the end of the lifetime of the Project to ensure it is in line with the most recent guidance, policy and legislation.
445. However, remobilisation of contaminated sediment effects on the features of the Dogger Bank SAC would be no greater than, and are expected to be less than, those of the construction phase (**Section 5.4.2.4**). It is therefore concluded that there is no potential for an AEoI of the Dogger Bank SAC due to re-mobilisation of contaminated sediments during the decommissioning phase from the Project alone. This effect was assessed to be not significant in EIA terms for the ECC in **PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality** of the PEIR. It is also noted that this potential effect was scoped out of the impact assessment in line with the Scoping Opinion (responses presented in **Appendix A.1 Dogger Bank D HRA Consultation Responses**)).

5.4.2.5 Pollution Events Resulting from the Accidental Release of Pollutants

5.4.2.5.1 Construction

446. During construction if a pollution event occurs as a result of the accidental release of pollutants, there could be an increase in contaminants in the water column and subsequently settle on seabed within the Dogger Bank SAC.
447. The risk of accidental release of pollutants during construction will be mitigated through the embedded mitigation measures outlined in **Table 5-2** and provided below.
448. An outline Project Environmental Management Plan (PEMP) or similar will also be put in place for all project phases to ensure all works are undertaken in line with best practice for working in the marine environment (and reducing collision risk) and inclusive of a Marine Pollution Contingency Plan (MPCP), which will include emergency plans and mitigation for a range of potential marine pollution incidents and outline procedures to protect personnel working and to safeguard the marine environment.
449. The PEMP will identify all potential sources and types of accidental pollution for all project phases and set out the proposed mitigation measures to be developed in consultation with key stakeholders for approval by the Marine Management Organisation (MMO). Also, best practice measures for the storage, use and disposal of lubricant and chemicals will be undertaken throughout the construction phase.
450. With the mitigation measures in place, it is considered that accidental release of pollutants would not significantly affect:
- The extent of the sandbank feature in terms of its biological assemblages;
 - The biological structure and function in terms of the key and influential species and characteristic communities present; and
 - The function of the feature within the site.
451. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to the accidental release of pollutants from the Project alone.

5.4.2.5.2 Operation and Maintenance

452. Operation and maintenance activities may lead to the release of synthetic compounds within the Dogger Bank SAC, resulting in an adverse effect on the existing communities.
453. There exists the potential for routine maintenance of the paint covering of the wind turbines and foundations to result in ‘flakes’ of synthetic paint material to enter the water column. It is likely that any emissions would be episodic over the Project’s lifetime and any flakes dispersed by physical processes.

454. Synthetic pollutants may enter the water column from wind turbines during operation and maintenance. The majority of these particles will enter the water column and be distributed by currents across a wide area. Given that these particles will be of low density (see **PEIR Volume 1, Chapter 8 Marine Physical Processes** for discussion of fine particulates) it is unlikely they would fall out of suspension in proximity to the wind turbines and build up over time in the array area. In addition, flakes would not be released as a plume (as per SSC increases from construction or maintenance activities), instead being released episodically over the lifetimes of the Project.
455. In addition, the Applicants are committed to ensuring any paint utilised for the Project would be approved for use in the marine environment by the relevant bodies as set out in the PEMP.
456. Given the limited and episodic nature of any release of synthetic compounds, mitigation committed to by the Applicants in the PEMP and lack of evidence indicating any potential effects, it is considered that contamination from synthetic compound contaminants would not significantly affect:
- The extent of the sandbank feature in terms of its biological assemblages;
 - The biological structure and function in terms of the key and influential species and characteristic communities present; and
 - The function of the feature within the site.
457. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to contamination from synthetic compound contaminants from the Project alone.

5.4.2.5.3 Decommissioning

458. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with the best industry practice. The decommissioning methodology and programme would need to be finalised nearer to the end of the lifetime of the Project to ensure it is in line with the most recent guidance, policy and legislation.
459. Pollution events resulting from the accidental release of pollutants effects on the features of the Dogger Bank SAC would be no greater than, and are expected to be less than, those of the construction phase (**Section 5.4.2.5**). Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to contamination from during the decommissioning phase from the Project alone.

5.4.2.6 Underwater Noise and Vibration

5.4.2.6.1 Construction

460. Underwater noise and vibration will occur, primarily as a result of foundation installation, cable installation and UXO clearance. Construction works will occur within the Dogger Bank SAC offshore development area and so have the potential to effect benthic ecology receptors.
461. The impact of underwater noise and vibration has been defined using the following pressures identified by JNCC's AoO for the Dogger Bank SAC (JNCC, 2021):
- Underwater noise changes; and
 - Vibration.
462. There is evidence to suggest benthic species respond to increased levels of underwater noise and vibration. The effects have been assessed further in **Section 10.7.1.4 of PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology**. Continued research into the effects of underwater noise and vibration is being conducted on a range of benthic species, however further understanding into the effects is required.
463. Underwater noise and vibration have the potential to affect benthic communities through disturbance to the habitat. Research into the effects of underwater noise and vibration have been carried out on a number of species of crustacea. It has been found that various, common benthic species exhibit a response to changes in underwater noise and adapt their behaviours accordingly. Studies have been focused on the response of crustaceans and the results of these studies are inconclusive as many found conflicting results. However, evidence of behaviour changes include research into the effects of vibration on common benthic species was carried out by Roberts *et al.*, 2016. Common hermit crabs *Pagurus bernhardus* exhibited behaviours associated with shell rapping as a consequence of vibrations within the sediment. At high amplitudes, individuals lifted their shells, and some left their shell completely. (see **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology**).
464. However, as detailed within **Section 10.7.1.4 of PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology** of the PEIR and within the JNCC AoO (2021), the biotopes (see **Section 5.4.2.1.1**) identified and associated with the features of the SAC have no direct interaction with underwater noise and vibration.

465. In line with existing guidance, it is considered that underwater noise and vibration would not significantly affect the biotopes present within the Dogger Bank SAC:

- The extent of the sandbank feature in terms of its biological assemblages;
- The biological structure and function in terms of the key and influential species and characteristic communities present; and
- The function of the feature within the site.

466. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to underwater noise and vibration from the Project alone.

5.4.2.6.2 Operation and Maintenance

467. Underwater noise and vibration may occur during the operation and maintenance phase. 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.
468. As discussed in **Section 5.4.2.6.1** there are a number of studies in the effects of underwater noise and vibration on various crustaceans. Evidence suggest that benthic crustacean species exhibit behavioural responses to change in underwater noise and vibration.
469. However, the level of underwater noise and vibration from wind farm operation is much lower than during construction where levels are increased for activities such as piling and UXO clearance.
470. As the biotopes associated with the features of the Dogger Bank SAC have no direct interaction with underwater noise and vibration, there is no potential for an AEoI of the SAC in relation to underwater noise and vibration from the Project alone.

5.4.2.6.3 Decommissioning

471. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with the best industry practice. The decommissioning methodology and programme would need to be finalised nearer to the end of the lifetime of the Project to ensure it is in line with the most recent guidance, policy and legislation.
472. Underwater noise and vibration effects on the features of the Dogger Bank SAC would be no greater than, and are expected to be less than, those of the construction phase (**Section 6.4.2.4**). Therefore, there is no potential for an AEoI of the SAC in relation to underwater noise and vibration from the Project alone.

5.4.2.7 Interactions of Electromagnetic Fields

5.4.2.7.1 Construction

473. The effects of electromagnetic fields on features of the Dogger Bank SAC have been screened out of assessment during the construction phase (see **Table 4-4**). It is therefore concluded that there is no potential for an AEol of the Dogger Bank SAC in relation to electromagnetic changes from the Project alone during the construction phase.

5.4.2.7.2 Operation and Maintenance

474. There is potential for inter-array cables and offshore export cables to produce electromagnetic fields (EMFs) that interfere with the behaviour of benthic species.
475. EMF comprise both the electrical (E) fields, measured in volts per metre (V/m), and the magnetic (B) fields, measured in microtesla (µT) or milliGauss (mG). It is common practice to block the direct electrical field using conductive sheathing, meaning that the only EMFs that are emitted into the marine environment are the magnetic field and the resultant induced electrical field. It is generally considered impractical to assume that cables can be buried at depths that will reduce the magnitude of the magnetic field, and hence the sediment-sea water interface induced electrical field, to below that at which these fields could be detected by certain marine organisms on or close to the seabed (Gill *et al.*, 2009; Gill *et al.*, 2010). By burying a cable, the magnetic field at the seabed is reduced due to the distance between the cable and the seabed surface as a result of field decay with distance from the cable (CSA, 2019).
476. Studies have found contrasting behaviours in benthic species towards EMF. Spiny lobster *Panulirus argus*, American lobster *Homarus americanus* and the edible crab *Cancer pagarus* have been found to exhibit behavioural responses to EMF where they favoured EMF sources (Boles and Lohmann, 2003; Hutchinson *et al.*, 2020; and Scott *et al.*, 2018). Conversely, yellow rock crabs *Metacarcinus anthonyu* and red rock crabs *Cancer productus* have been found to have no preference to EMF sources (Love *et al.*, 2015). The effects of EMF have been assessed further in **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology**.
477. As detailed within **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology**, the biotopes associated with the features of the SAC are not sensitive to the effects of EMF. In addition, the Advice on Operations for the Dogger Bank SAC (JNCC, 2021) doesn't list electromagnetic changes as a pressure.

478. The presence of increased EMF will last over the entirety of the operational phase for the Project, however, indiscernible alteration to baseline EMF levels is predicted. This is due to the cables being planned to be buried in the seabed (where conditions allow) to a target depth of 3.5m. 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.

479. Due to the low sensitivity of the biotopes associated with the features of the SAC and small footprint of effect; it is considered that electromagnetic changes would not significantly affect:

- The extent of the sandbank feature in terms of its biological assemblages;
- The biological structure and function in terms of the key and influential species and characteristic communities present; and
- The function of the feature within the site.

480. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to electromagnetic changes from the Project alone.

5.4.2.7.3 Decommissioning

481. The effects of electromagnetic fields on features of the Dogger Bank SAC have been screened out of assessment during the decommissioning phase (see **Table 4-4**). Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to electromagnetic changes from the Project alone during this phase.

5.4.2.8 Introduction of Marine Invasive Non-Native Species from Vessel Traffic

5.4.2.8.1 Construction

482. Marine invasive non-native species (INNS) may displace native organisms by preying on them or out-competing them for resources such as food, space or both. The primary pathway for the potential introduction of INNS during construction is from the use of vessels and infrastructure that have originated from regions that are distinctly different, such as from other seas or oceans.
483. It should be noted that there is an existing baseline of vessel activity within the Dogger Bank SAC and therefore the small increase in vessel traffic (for further information see **PEIR Volume 1, Chapter 15 Shipping and Navigation**) in proximity to the SAC associated with the construction of the Project will not represent a significantly increased risk of introduction of INNS.

484. The risk of spreading INNS will be mitigated through the embedded mitigation measures outlined in **Table 5-2**.

485. The impact of the introduction of marine INNS has been defined using the following pressure identified by JNCC's AoO for the Dogger Bank SAC (JNCC, 2021):

- Introduction or spread of INNS.

486. With the mitigation measures in place, it is considered that the introduction of INNS would not significantly affect:

- The extent of the sandbank feature in terms of its biological assemblages;
- The biological structure and function in terms of the key and influential species and characteristic communities present;
- The function of the feature within the site.

487. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to the introduction of INNS from the Project alone during construction.

5.4.2.8.2 Operation and Maintenance

488. Marine INNS have two pathways of introduction during the operation and maintenance phase. As discussed above in **Section 5.4.2.8.1** one pathway is through increased vessel activity through the Dogger Bank SAC and the second pathway is through the installation of hard infrastructure into the SAC. The effects of INNS colonising introduced substrate has been assessed in **Section 5.4.2.9**.

489. As discussed in **Section 5.4.2.8.1**, the risk of introduction and spread of INNS through vessel activity will be mitigated through adherence to the relevant regulations and guidance stated in **Table 5-2**. Furthermore, the occurrence of vessel activity in the operation and maintenance phase will be significantly less than in the construction and decommissioning phase.

490. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to the introduction of INNS from the Project alone during this phase.

5.4.2.8.3 Decommissioning

491. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with the best industry practice. The decommissioning methodology and programme would need to be finalised nearer to the end of the lifetime of the Project to ensure it is in line with the most recent guidance, policy and legislation.

492. The introduction of marine INNS from vessel traffic effects on the features of the Dogger Bank SAC would be no greater than, and are expected to be less than, those of the construction phase (**Section 5.4.2.8.1**). Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to the introduction of INNS from the Project alone during decommissioning.

5.4.2.9 Colonisation of Introduced Substrate

5.4.2.9.1 Construction

493. The effects of colonisation of introduced substrate on features of the Dogger Bank SAC have been screened out of assessment during the construction phase (see **Table 4-4**). Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to colonisation of introduced substrate from the Project alone during construction.

5.4.2.9.2 Operation and Maintenance

494. Hard infrastructure that has been placed in the benthic environment is likely to be colonised by native and/or INNS for the life for the Project for infrastructure that will be removed at decommissioning, or permanently for infrastructure that may be left in situ on decommissioning. The effects of marine invasive INNS are discussed in **Section 5.4.2.8**.

495. The colonisation of marine fauna on introduced hard substrate has been widely recognised across the southern North Sea. Shrieken *et al* (2013) found that new species were colonising wrecks around the Dogger Bank and Cleaver Bank regions. Twenty-nine species were identified on the wrecks that had not been previously known to reside in the Dogger Bank area.

496. The impact of colonisation of introduced substrate has been defined using the following pressure identified by JNCC's AoO for the Dogger Bank SAC (JNCC, 2021):

- Introduction or spread of INNS.

497. The impact of colonisation is closely related to that of habitat loss (**Section 5.4.2.2**) as the sediment habitat is lost and replaced with the hard artificial substrate associated with the Project infrastructure.

498. There are a number of studies into hard infrastructure and its use as a 'stepping stone' for INNS. The introduction of hard infrastructure to a predominantly sandy environment provides an opportunity for species unable to colonise in these conditions, to find suitable habitat.

499. The colonisation of marine fauna on introduced substrate has been widely recognised across the southern North Sea. Shrieken *et al* (2013) found that new species were colonising on wrecks around the Dogger Bank and Cleaver Bank regions. 29 species were identified on the wrecks that has not been previously known to reside in the entire Dogger Bank area.
500. The increasing numbers of wrecks, oil and gas rigs, and now offshore wind turbines, has led to a notable increase in the number of INNS found in the southern North Sea. Kerckhof *et al* (2011) looked at the colonisation of benthic fauna on wind turbines in the North Sea and found over a third of species to be non-indigenous. These included the oyster *Crassostrea gigas* and the limpet *Patella vulgata*. Their study provides strong evidence to suggest INNS use hard infrastructure as ‘steppingstones’ to colonise in new communities.
501. As detailed within **Section 10.7.2.7 of PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology**, the biotopes of ‘*Branchiostoma lanceolatum* in Atlantic circalittoral coarse sand with shell ravel’ and ‘*Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand’ both have a high sensitivity to INNS.
502. Due to the embedded mitigation measures outlined in **Table 5-2**, the risk of INNS during operation and maintenance will be reduced. Furthermore, the occurrence of vessel activity in the operation and maintenance phase will be significantly less than in the construction and decommissioning phase.
503. With the mitigation measures in place, it is considered that the introduction of INNS would not significantly affect:
- The extent of the sandbank feature in terms of its biological assemblages;
 - The biological structure and function in terms of the key and influential species and characteristic communities present; and
 - The function of the feature within the site.
504. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to the colonisation of introduced substrate from the Project alone during this phase.

5.4.2.9.3 Decommissioning

505. The effects of colonisation of introduced substrate on features of the Dogger Bank SAC have been screened out of assessment during the decommissioning phase (see **Table 4-4**). Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to the colonisation of introduced substrate from the Project alone during decommissioning.

5.4.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

506. The in-combination assessment considers other developments (plans or projects) in planning, construction or operation where the predicted effects on the Dogger Bank SAC may have the potential to interact with effects from the proposed construction, operation and maintenance or decommissioning of the Project.
507. Plans and projects within the 28km search area have been identified and listed below in **Table 5-4**. This distance has been used as it encompasses two tidal ellipses to encompass one tidal ellipse from the Project plus an extra tidal ellipse from the nearby project in relation to the study area as determined from the modelling conducted for the **PEIR Volume 1, Chapter 8 Marine Physical Processes** (see **Section 10.4.1 of PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology**).

5.4.3.1 In-combination effect 1: Temporary physical disturbance

508. There is potential for a temporal and spatial interaction during the construction, operation and maintenance, and decommissioning phases of the Dogger Bank A, Dogger Bank B, Dogger Bank C, Sofia, and Dogger Bank South.
509. This could result in an in-combination effect from temporary physical disturbance on the seabed. The most prevalent biotopes within the offshore development area are characteristic of highly disturbed environments, and typically have medium to high recoverability and will therefore recover rapidly from disturbance from activities.
510. Overlap in construction activities is likely with Dogger Bank South (as construction is expected to begin in 2026 subject to consent), however the worst-case for footprint activities that may result in abrasion / disturbance of the seabed will be during construction and are estimated to impact approximately 31.4km² within Dogger Bank South East and Dogger Bank South West combined (RWE, 2024). This represents 0.2% of the area of the Dogger Bank SAC and represents the worst-case scenario which encompasses a precautionary approach for assessment.
511. Due to the nature of the operation and maintenance activities of Dogger Bank A, B, C, and Sofia, we assume that as a worst-case scenario, there could be temporal or spatial overlap in the activities with the Project at any time.
512. These projects combined would disturb a minimal area of the seabed in comparison to the overall size of the Dogger Bank SAC, with effects being temporary in nature.

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Table 5-4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

Project / Plan	Development Type	Status	Tier	Construction / Operation Period	Closest distance to the SAC (km)	Included in the in-combination assessment	Rationale
East Inshore, North-east Inshore, East Offshore and North-east Offshore Marine Plans	Strategic Plans	Plan	7	-	0	No	Although there is an overlap spatially, these are plans and therefore part of the baseline.
Dogger Bank A	Offshore Wind Farm	Under construction	2	2024 - 2025	0	No	There is no spatial overlap with the offshore ECC and Array Area inside the ZOI.
Dogger Bank B			2	2024 - 2025	0	Yes	There is a spatial overlap but no temporal overlap with the offshore ECC.
Sofia			2	2024 – 2026	0	Yes	
Dogger Bank C			2	2024 - 2026	0	Yes	
Hornsea Project Four		Consented	3	2025 - 2029	32.22	Yes	There is a spatial overlap and temporal overlap with the offshore ECC.
Dogger Bank South		Pre-planning	6	2026 - 2032	0	Yes	
Ossian		Pre-planning	6	2026 – 2030	52.14	No	Although there is a temporal overlap, there is no spatial overlap with the Dogger Bank SAC.
Shearwater to Bacton Seal pipeline	Oil and Gas pipeline	Active	1	-	0	No	Although there is a spatial overlap, the pipeline is already active and therefore part of the baseline.
Esmond to Bacton		Active	1	-	0	No	
York to Easington		Active	1	-	0	No	
Breagh Platform to shore		Active	1	-	50.36	No	There is no spatial overlap with the pipeline, plus the pipeline is already active and therefore part of the baseline.
Apollo to Minerva		Active	1	-	75.29	No	
Eris to Mercury		Active	1	-	87.66	No	
Kilmar routes		Active	1	-	9.25	No	
Johnston routes		Active	1	-	47.29	No	
Langeled to Easington		Active	1	-	32.92	No	
Mercury to Neptune		Active	1	-	65.14	No	
Easington to Tolmount		Active	1	-	74.49	No	
Cleeton routes		Active	1	-	54.3	No	
Ravenspurn routes		Active	1	-	51.19	No	

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Project / Plan	Development Type	Status	Tier	Construction / Operation Period	Closest distance to the SAC (km)	Included in the in-combination assessment	Rationale
Rough routes		Active	1	-	91.2	No	
West Sole to Easington		Active	1	-	82.61	No	
Wollaston to Whittle		Active	1	-	64.25	No	
Northern Endurance CCS	CCS	In planning	4	2026 – 2029	26.09	Yes	There is a spatial overlap and temporal overlap with the offshore ECC.
Eastern Green Link (EGL 2)	Subsea cables	Under Construction	2	2023 – 2028	0	No	Although there is a spatial overlap, the construction period ends before the Project's construction period.
Eastern Green Link (EGL 3)		In planning	6	Construction expected to start in 2028	0	No	Although there is a spatial overlap with the offshore ECC, the construction period is not yet known and therefore considered to fall outside of the Project's construction period.
Eastern Green Link (EGL 4)		In planning	6	Construction expected to start in 2027	0	No	
Tata North Europe		Active	1	-	0	No	Although there is a spatial overlap with the offshore ECC and Dogger Bank SAC, the cables are in operation and therefore part of the baseline.
VSNL Northern Europe (TGN North Europe)		Active	1	-	0	No	
UK – Denmark 4		Disused / Removed	1	-	0	No	Disused and/or removed and therefore no activity. This is located outside the ZoI from the Dogger Bank SAC.
UK – Denmark 6 (Viking link)		Active	1	-	10.92	No	Although there is a spatial overlap with the offshore ECC, the cable is in operation and is outwith the Dogger Bank SAC.
Pangea North		Active	1	-	21.94	No	
Havhingsten Seg 2.1		Active	1	-	28.52	No	

513. As discussed in **Section 5.4.2.1**, due to the high resilience and recovery of biotopes within the Dogger Bank SAC, the relatively small footprint and the episodic nature of the effect, it is considered that the effects of temporary physical disturbance would not affect:

- The extent of the sandbank feature in terms of its sedimentary composition or biological assemblages;
- The physical structure and function in terms finer scale topography and sediment composition and distribution;
- The biological structure and function in terms of the key and influential species and characteristic communities present; and
- The function of the feature within the site.

514. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation to temporary physical disturbance of the seabed in combination with other plans or projects during any project phase.

5.4.3.2 In-combination effect 2: Increased SSC and deposition

515. There is potential for a temporal and spatial interaction during the construction, operation and maintenance, and decommissioning phases of the Dogger Bank A, Dogger Bank B, Dogger Bank C, Sofia and Dogger Bank South.

516. This could result in an in-combination effect from increase SSC and subsequent deposition. **PEIR Volume 2, Appendix 10.3 Benthic Ecology Baseline Characterisation Report** identified sand as the most prevalent sediment type in the offshore development area. The predicted suspended sediment concentrations are highest closest to the points of release with maximums of 1mg/l in the surface layer increasing to 2mg/l in the bottom layer. The worst-case thickness of sediment deposited from the plume would not exceed 1mm. The outputs of the model have been discussed further in **PEIR Volume 1, Chapter 8 Marine Physical Process** and **PEIR Volume 2, Appendix 8.3 Marine Physical Process Modelling Report**.

517. While it is unlikely that all offshore infrastructure would be installed at the same time due to the logistics of vessels working in close proximity and vessel availability, if a temporal and/or spatial overlap did occur between the projects, there would not be an AEol of the Dogger Bank SAC in relation to increased SSC and deposition. This is due to the similarity in sediment composition of potential SSCs and deposition within the SAC. Therefore, should the in-combination effect increase the SSC at any one time and/or increase the duration over which the effects occur, the change to the form and function of the Annex I Sandbank feature of the SAC would still be indistinguishable. Furthermore, the benthic communities within the SAC are not sensitive to the effects of smothering (JNCC, 2021).

518. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation increased SSC and deposition with other plans or projects during any project phase.

5.4.3.3 In-combination effect 3: Re-mobilisation of contaminated sediments

519. Re-mobilisation of contaminated sediments will not have in-combination effects with other plans and projects due to absence of contaminants at levels of concern recorded within the offshore development area as discussed **Section 5.4.2.4**. Therefore, there is no potential for an AEol of the Dogger Bank SAC in relation re-mobilisation of contaminated sediments with other plans or projects during any project phase.

5.4.3.4 In-combination effect 4: Long term habitat loss

520. Installation of offshore infrastructure will lead to a physical change to the seabed and sediment type within the Annex I sandbank habitat, resulting in a reduction in the habitats extent and long term habitat loss.

521. There is potential for a temporal and spatial interaction during the construction, operation and maintenance, and decommissioning phases of the Dogger Bank A, Dogger Bank B, Dogger Bank C, Sofia, and Dogger Bank South.

522. Based on the publicly available information for the projects listed above, an area of approximately 15.94km² (including the estimated 2.25km² from DBD) may be permanently lost within the Dogger Bank SAC, representing 0.13% of the total SAC area. This has been derived from those projects RIAAs alongside the calculated area from this project as shown in **Table 5-3**.

523. Although the extent of habitat loss is minimal, as discussed **Section 5.4.2.2**, the Dogger Bank SAC has a restore objective in relation to the extent of the sandbank feature in terms of its sedimentary composition and biological assemblages. With regard to the physical structure the restore objectives relate to finer scale topography and, sediment composition and distribution. With regard to biological structure, the restore objective relates to the key and influential species and characteristic communities present. As discussed in **Section 5.4.2.2.2** permanent footprint would be considered to hinder the restore objectives.

524. As such, it is considered that long term habitat loss in combination with other plans and projects would significantly affect:

- The extent of the sandbank feature in terms of its biological assemblages;
- The physical structure and function in terms finer scale topography and sediment composition and distribution; and
- The function of the feature within the site.

525. Therefore, an AEoI of the Dogger Bank SAC in relation to long term habitat loss in combination with other plans and projects cannot be ruled out for the operational and maintenance phase.

526. As described in **paragraph 418**, further details regarding compensation for these effects on the Dogger Bank SAC are presented in the **Benthic HRA Derogation and Compensation – Roadmap & Evidence** (document reference 5.4.1).

5.4.3.5 In-combination effect 5: Interactions of electromagnetic fields

527. There is potential for a temporal and spatial interaction during the operation and maintenance phase of the Dogger Bank A, Dogger Bank B, Dogger Bank C, Sofia, and Dogger Bank South.

528. The above projects have the potential to contribute to an in-combination effect on the Dogger Bank SAC through interactions of EMF.

529. The offshore ECC and inter-array cables for the Project will not cross any other offshore cables associated with another plan or project within the Dogger Bank SAC.

530. The presence of increased EMF will last over the entirety of the operational phase for the Project, however, indiscernible alteration to baseline EMF levels is predicted. This is due to the cables being planned to be buried in the seabed (where conditions allow) to a depth of between 0.2m to 9m below seabed, though with a target burial depth of 3.5m.

531. As discussed in **Section 5.4.2.7.2**, the biotopes within the SAC are not sensitive to the effects of EMF. In addition, the Advice on Operations for the Dogger Bank SAC (JNCC, 2021) doesn't list electromagnetic changes as a pressure.

532. Given the lack of sensitivity of the biotopes within the Dogger Bank SAC, small footprint of effect and no additive effects between the Project and other plan or projects. It is considered that electromagnetic changes would not significantly affect:

- The extent of the sandbank feature in terms of its biological assemblages;
- The biological structure and function in terms of the key and influential species and characteristic communities present; and
- The function of the feature within the site.

533. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to interactions of EMF in-combination with other plans or projects during any phase of the Project.

5.4.3.6 In-combination effect 6: Introduction of marine INNS from vessel traffic and colonisation of introduced substrate

534. There is potential for a temporal and spatial interaction during the construction, operation and maintenance, and decommissioning phases of the Dogger Bank A, Dogger Bank B, Dogger Bank C, Sofia, and Dogger Bank South.

535. As discussed in **Section 5.4.2.8** and **Section 5.4.2.9**, there are two potential pathways for the introduction of INNS into the Dogger Bank SAC. The potential risk of the spread of INNS by other plans and projects is similar to that discussed for the Project due to similarities in development type. Therefore, as the mitigation measures proposed in **Table 5-2** are considered to be industry standard, it can be assumed that these other projects with a potential for in-combination effects will adhere to the appropriate mitigation.

536. Given the mitigation measures that will be employed by the Project and other plans and projects, it is considered that introduction or spread of invasive INNS would not significantly affect:

- The extent of the sandbank feature in terms of its biological assemblages;
- The biological structure and function in terms of the key and influential species and characteristic communities present; and
- The function of the feature within the site.

537. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to the introduction or spread of invasive INNS in-combination with other plans or projects across all project phases.

5.4.4 Summary of Potential Effects on Site Integrity

5.4.4.1 Construction

538. During construction, **there is no potential for an AEoI of the Annex I sandbank habitat, either by the Project alone or in-combination, and an AEoI of the Dogger Bank SAC can be ruled out.**

5.4.4.2 Operation and Maintenance

539. During operation and maintenance, **the potential for an AEol of Annex I Sandbank habitat for which the Dogger Bank SAC is designated cannot be ruled out, due to the effect of permanent habitat loss resulting from the Project alone and in combination with other plans and projects.** As such, mitigation measures through a derogation case may be required, as outlined in **Section 3.3.3** and **Section 11**. However, there would be **no AEol of the features of the Dogger Bank SAC from the other temporary disturbance impacts assessed in this report; either from the Project alone or in combination with other plans and projects.** Temporary disturbance has been concluded for elements due to the evidence (described earlier) showing the recoverability (and its rapidity) within the habitats and communities within the Dogger Bank SAC to temporary and intermittent activities.

5.4.4.3 Decommissioning

540. During decommissioning, **there is no potential for an AEol of the Annex I sandbank habitat and an AEol of the Dogger Bank SAC, either from the Project alone or in-combination.**

6 Stage 2 Assessment of Sites Designated for Annex II Terrestrial Ecology and Ornithology

6.1 Approach to Assessment

541. This section provides information to allow the determination of the potential for the Project to have an adverse effect on the integrity of sites designated for Annex I and II Terrestrial Ecology and Ornithology features.
542. For each site designated for Terrestrial Ecology and Ornithology screened in for further consideration, the following have been provided:
- A summary of the site and Terrestrial Ecology and Ornithology features considered for assessment;
 - An assessment of potential effects during the construction, operation and maintenance and decommissioning phases of the Project; and
 - Assessment of the potential for in-combination effects alongside other relevant developments and projects.

6.2 Consultation

543. **Table A.1-1 of Appendix A.1 Dogger Bank D HRA Consultation Responses** provides a summary of how the consultation responses relevant to Terrestrial Ecology and Ornithology received to date have influenced the approach that has been taken.

6.3 Assessment of Potential Effects

544. The HRA Screening Report and HRA Screening Addendum Report (**Appendix A.2 Dogger Bank D HRA Screening and HRA Addendum Reports**) identified the following potential effects to be taken forward for further assessment in relation to Terrestrial Ecology and Ornithology:
- Disturbance and/or displacement;
 - Long term and temporary loss of functionally-linked land;
 - Indirect impacts through effects on supporting habitats and prey species; and
 - Indirect habitat degradation through changes in air quality.

6.3.1 Embedded and Standard Mitigation Measures

545. **Table 6-1** outlines the embedded mitigation measures incorporated into the Project relevant to the assessment for Terrestrial Ecology and Ornithology designated sites.

6.3.2 Worst-Case Scenario

546. **Table 6-2** outlines the worst-case scenario for effects which are of relevance to this Stage 2 assessment.

Table 6-1 Mitigation measures implemented in the design of the Project

Parameter	ID	Mitigation Measures	How the Commitment Will be Secured
All parameters	CO81	An Ecological Management Plan (EcoMP) will be developed in accordance with the Outline EcoMP. The EcoMP will set out mitigation and monitoring measures required in advance of construction commencing on-site, during construction and post-construction for habitats and relevant ecological receptors, including but not limited to, hedgerows, trees, birds, bats, badgers, otters, water voles, reptiles, great crested newts, terrestrial invertebrates and other protected and notable species where relevant. The EcoMP will also detail any long-term mitigation and management measures to ensure the establishment of reinstated hedgerows and habitats and include biosecurity measures to prevent the transfer and spread of invasive non-native species.	DCO Requirement - Ecological Management Plan
	CO39	A Code of Construction Practice (CoCP) will be provided in accordance with the Outline CoCP. The CoCP will enable effective planning, monitoring and management of onshore construction works to mitigate potential impacts on the environment and communities and ensure compliance with the latest relevant regulatory requirements and best practice.	DCO Requirement - Code of Construction Practice
Disturbance pathway	CO92	Where construction works are undertaken within or adjacent to open field, wetland or foreshore habitat between November and January, a pre-construction survey will be undertaken as required by a suitably qualified ecologist to record the distribution and abundance of overwintering waterbird flocks in line with the Outline Ecological Management Plan (EcoMP), and the distribution of suitable habitat likely to be affected during the winter season within which construction works will be undertaken. The findings of these pre-construction surveys will determine whether mitigation measures to reduce disturbance to waterbird flocks would be required. During the construction works, should over-wintering waterbirds be present, a suitably qualified ecologist will be responsible for advising on the appropriate levels of mitigation such as watching briefs and toolbox talks to site personnel.	DCO Requirement - Ecological Management Plan
Hydrological linkage	CO35	A Watercourse Crossing Method Statement (WCMS) will be provided as part of the Code of Construction Practice (CoCP). The WCMS will be developed in accordance with the Outline CoCP and will include details of the crossing technique and construction methodology to be undertaken at each crossing and associated environmental mitigation measures. Where open cut trenching is proposed for ordinary watercourses, temporary measures to maintain the flow of water and mitigate adverse effects on the watercourse and flood risk will be implemented during construction. Where the Environment Agency's Main Rivers are to be crossed by temporary haul roads, bailey or similar clear span bridges will be used. For other watercourses, temporary culverts with an overlying haul road will be used where existing access is not available and where temporary bridges are not practicable. Temporary culverts will be adequately sized to avoid impounding flows (including appropriate climate change allowances), and the invert set below the bed level to allow bedload transport.	DCO Requirement - Code of Construction Practice
Drilling	CO38	A Drilling Fluid Breakout Management Plan will be provided as part of the Code of Construction Practice (CoCP). The Drilling Fluid Breakout Management Plan will be developed in accordance with the Outline CoCP and will detail mitigation measures to reduce the risk of fluid breakouts during trenchless installation works and a response plan should a fluid breakout occur.	DCO Requirement - Code of Construction Practice

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Parameter	ID	Mitigation Measures	How the Commitment Will be Secured
Pollutants	CO40	A Pollution Prevention Plan (PPP) will be provided as part of the Code of Construction Practice (CoCP). The PPP will incorporate the latest relevant Environment Agency best practice guidelines for pollution prevention and detail how ground and surface waters will be protected from construction-related pollution. The PPP will include appropriate control measures for the use and storage of any fuels, oils and other chemicals during construction works.	DCO Requirement - Code of Construction Practice
	CO73	<p>A Construction Traffic Management Plan (CTMP) will be developed in accordance with the Outline CTMP. The CTMP will include:</p> <ul style="list-style-type: none"> • Measures to control, monitor and enforce the numbers and routeing of Heavy Goods Vehicle (HGV) movement during construction and include localised road improvements that are necessary to ensure the safe passage of HGV traffic via the public highway network; • Details on the location and design of construction and operational accesses, such as the frontage, general layout and visibility; • Detail on how construction employee traffic will be managed and measures to encourage sustainable alternative modes of travel including but not limited to single occupancy car trips during construction; • Measures to manage peak construction traffic flows and reduce the associated construction traffic noise and vehicle emissions; • Measures to ensure early and ongoing information provision to road users and emergency and healthcare services with regard to any temporary road or lane closures and diversions; and • Details on any site-specific additional mitigation measures required to avoid significant effects identified due to construction traffic. 	DCO Requirement - Construction Traffic Management Plan
Overhead powerlines	CO60	All onshore export cables will be buried underground for the entire length of the cable corridor. No overhead pylons will be installed as part of the consented works.	DCO Works
OCS	CO63	Detailed design of infrastructure in the Onshore Converter Station (OCS) zone will be developed in accordance with the Design Vision. The Design Vision submitted as part of the application for development consent will set out design principles to ensure good design with respect to aesthetic, functionality and sustainability considerations.	DCO Requirement - Detailed Design (Onshore)
Lighting	CO85	Construction site lighting will only operate when required and will be positioned and directed to avoid unnecessary illumination and minimise glare to surrounding residential properties, sensitive ecological receptors, Public Rights of Way (PRoW) users and users of adjoining public highways. Details of the location, height, design and luminance of construction site lighting to be used will be provided in the Code of Construction Practice (CoCP).	DCO Requirement - Code of Construction Practice
Temporarily disturbed land	CO100	All areas of land temporarily disturbed during construction in the Onshore Development Area, including any temporary construction compounds and haul roads, will be reinstated to pre-existing conditions as far as reasonably practicable. Reinstatement will commence as soon as practicable following completion of the relevant works in the area. In areas of agricultural cropland where temporary loss or disturbance is required, soils will be reinstated within no more than 24 months, wherever practicable and unless otherwise requested by the relevant landowners.	DCO Requirement - Landscape Management Plan DCO Requirement - Ecological Management Plan DCO Requirement - Code of Construction Practice
	CO101	Reinstatement of cable trenches, haul roads and other land temporarily disturbed within the onshore export cable corridor will commence as soon as reasonably practicable following the completion of duct installation works in each section. Where access is required to be retained for cable pull-in, jointing and commissioning works, land will be reinstated following the completion of all onshore export cable construction activities.	DCO Requirement - Landscape Management Plan DCO Requirement - Ecological Management Plan DCO Requirement - Code of Construction Practice

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Table 6-2 Realistic Worst-Case Scenarios for Effects on Sites Designated for Annex I and II Terrestrial Ecology and Ornithology Features

Impact	Worst-case scenario	Notes and rationale
Construction phase		
Disturbance and/or displacement	<p>Landfall:</p> <ul style="list-style-type: none"> Anticipated duration of landfall construction works: approximately three years (including one year of trenchless installation works). <p>Onshore ECC:</p> <ul style="list-style-type: none"> Indicative number of main construction compounds for onshore export cable works: 4. Indicative main temporary construction compound area per compound: 20,000m². Indicative number of intermediate construction compounds for onshore export cable works: 8. Indicative intermediate temporary construction compound area per compound: 5,625m². Anticipated duration of onshore export cable construction works: approximately four years. <p>OCS Zone:</p> <ul style="list-style-type: none"> Anticipated duration of OCS and ESBI construction works: approximately five years Combined OCS and ESBI. Maximum developable area for OCS and ESBI: 25ha (including but not limited to, the platform footprint, landscaping, access, drainage and attenuation but exclude areas for ecological mitigation / enhancement). Total temporary area: 4.5ha (including 2 temporary construction compounds for the OCS and ESBI). Total permanent area: 20.5ha (including but not limited to platform footprint, landscaping, access, drainage and attenuation but exclude areas for ecological mitigation / enhancement). 	Disturbance and displacement relate to noise emissions and visual imposition of construction preparation and activities, if this occurs in FLL of a SPA.
Loss of Functionally Linked Land	<p>Onshore ECC:</p> <ul style="list-style-type: none"> Maximum length of HVDC export cable corridor: 50km (from landfall to OCS zone). Maximum length of HVAC export cable corridor: 5km (from OCS zone to Birkhill Wood Substation). Maximum number of trenches of HVDC onshore export cables: 2. Maximum number of trenches of HVAC onshore export cables: 4. Indicative width of trench at surface: 3m. Target minimum cable burial depth using open cut trenching: 1.2m. Indicative temporary construction corridor width for HVDC onshore export cables: 32m (50m at trenchless crossing locations). Indicative temporary construction corridor width for HVAC onshore export cables: 55m (60m at trenchless crossing locations). Target maximum cable burial depth using trenchless installation techniques: 20m. Target minimum cable burial depth using open cut trenching: 1.2m. Indicative number of jointing bay locations along onshore ECC: 62. Maximum permanent jointing bay area: 30m² (per jointing bay). 	<p>Temporary loss of FLL relates to temporary construction activities such as compounds and structures subsequently buried underground including the export cable (further to disturbance and displacement) if these occur in FLL of a SPA.</p> <p>Permanent loss of FLL relates to construction of permanent structures (including hardstanding) such as the OCS, if this occurs in FLL of a SPA.</p>

Impact	Worst-case scenario	Notes and rationale
	<ul style="list-style-type: none">Maximum jointing bay and link box temporary construction area for HVDC export cables: 660 m² (per location).Maximum jointing bay and link box temporary construction area for HVAC export cables: 1,040m² (per location).Indicative number of link box locations along onshore ECC: 56.Indicative number of trenchless crossing locations: 70.Indicative trenchless installation compound area for HVDC export cables: 300m² (5,625 m² for non-HDD techniques) (per compound).Indicative trenchless installation compound dimensions for HVAC export cables: 800m² (5,625 m² for non-HDD techniques) (per compound).Indicative number of main construction compounds for onshore export cable works: 4.Indicative main construction compound area: 20,000m².Indicative number of intermediate construction compounds for onshore export cable works: 8.Indicative intermediate construction compound area: 5,625m² (per compound).Anticipated duration of onshore export cable construction works: approximately four years. <p>Combined OCS and ESBI:</p> <ul style="list-style-type: none">Indicative access road width: 7.3m (including site access road from public highway and internal tracks within the site).Maximum developable area for OCS and ESBI: 25ha (including but not limited to, the platform footprint, landscaping, access, drainage and attenuation but exclude areas for ecological mitigation / enhancement).Total temporary area: 4.5ha (including 2 temporary construction compounds for the OCS and ESBI).Total permanent area: 20.5ha (including but not limited to platform footprint, landscaping, access, drainage and attenuation but exclude areas for ecological mitigation / enhancement).Indicative quantity of topsoil excavated within OCS zone: 100,000m³ (assumed 50% of topsoil to be removed off-site – 50,000m³).Anticipated duration of OCS and ESBI construction works: approximately five years.	

Indirect impacts through effects on supporting habitats and prey species	<p>Landfall:</p> <ul style="list-style-type: none">• Maximum number of TJB at landfall: 1.• Maximum number of underground link box at landfall: 1.• Maximum permanent TJB area: 30m².• Maximum permanent underground link box area: 10m².• Maximum TJB and underground link box burial depth: 3m.• Maximum number of landfall ducts: 3 (including 1 spare).• Indicative temporary landfall construction compound area: 12,500m² (including construction footprint of TJB and underground link box).• Maximum horizontal length of trenchless installation: 2,000m.• Indicative minimum depth of trenchless installation at cliff : 5m.• Indicative haul road width at landfall: 7m.• Anticipated duration of landfall construction works: approximately three years (including one year of trenchless installation works). <p>Onshore ECC:</p> <ul style="list-style-type: none">• Maximum length of HVDC export cable corridor: 50km (from landfall to OCS zone).• Maximum length of HVAC export cable corridor: 5km (from OCS zone to Birkhill Wood Substation).• Maximum number of trenches of HVDC onshore export cables: 2.• Maximum number of trenches of HVAC onshore export cables: 4.• Indicative width of trench at surface: 3m.• Target minimum cable burial depth using open cut trenching: 1.2m.• Indicative temporary construction corridor width for HVDC onshore export cables: 32m (50m at trenchless crossing locations).• Indicative temporary construction corridor width for HVAC onshore export cables: 55m (60m at trenchless crossing locations).• Target maximum cable burial depth using trenchless installation techniques: 20m.• Target minimum cable burial depth using open cut trenching: 1.2m.• Indicative number of jointing bay locations along onshore ECC: 62.• Maximum permanent jointing bay area: 30m² (per jointing bay).• Maximum jointing bay and link box temporary construction area for HVDC export cables: 660m² (per location).• Maximum jointing bay and link box temporary construction area for HVAC export cables: 1,040m² (per location).• Indicative number of link box locations along onshore ECC: 56.• Indicative number of trenchless crossing locations: 70.• Indicative trenchless installation compound area for HVDC export cables: 300m² (5,625 m² for non-HDD techniques) (per compound).	Indirect impact via habitats and prey relates to ground preparation in onshore areas and the landfall, if this occurs in FLL of a SPA.
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Impact	Worst-case scenario	Notes and rationale
	<ul style="list-style-type: none">Indicative trenchless installation compound dimensions for HVAC export cables: 800m² (5,625m² for non-HDD techniques) (per compound).Indicative number of main construction compounds for onshore export cable works: 4.Indicative main construction compound area: 20,000m².Indicative number of intermediate construction compounds for onshore export cable works: 8.Indicative intermediate construction compound area: 5,625m² (per compound).Anticipated duration of onshore export cable construction works: approximately four years OCS Zone.Maximum depth of topsoil strip: 400mm.OCS base: maximum quantity of topsoil excavated: 36,000m³ (estimated approx. 50% to be reinstated).Indicative haul road width: 7.3m.Total OCS construction duration: 3.5 years. <p>Combined OCS and ESBI:</p> <ul style="list-style-type: none">Indicative access road width: 7.3m (including site access road from public highway and internal tracks within the site).Maximum developable area for OCS and ESBI: 25ha (including but not limited to, the platform footprint, landscaping, access, drainage and attenuation but exclude areas for ecological mitigation / enhancement).Total temporary area: 4.5ha (including 2 temporary construction compounds for the OCS and ESBI).Total permanent area: 20.5ha (including but not limited to platform footprint, landscaping, access, drainage and attenuation but exclude areas for ecological mitigation / enhancement).Indicative quantity of topsoil excavated within OCS zone: 100,000m³ (assumed 50% of topsoil to be removed off-site – 50,000m³).Anticipated duration of OCS and ESBI construction works: approximately five years.	
Indirect habitat degradation through changes in air quality	<p>Earliest construction commencement year is 2029.</p> <p>The realistic worst-case scenario upon which these flows have been derived is set out in PEIR Volume 1, Chapter 26 Traffic and Transport and presented in PEIR Volume 2, Appendix 20.3 Construction Road Vehicle Exhaust Emissions Assessment – Traffic Data.</p>	<p>The impact of construction road vehicle exhaust emissions is dependent on the change in baseline traffic flows as a result of the Project. The baseline data are provided based on the first year of construction (currently assumed to be 2029). This is anticipated to be the peak year for construction traffic. In addition, pollutant emission rates and background concentrations will be higher than in later years of construction.</p> <p>Changes in air quality, in particular increased deposition of NO_x, NH₃ and nitrogen have the potential to degrade the condition of designated habitats within 200m of the roads used for construction traffic during the construction phase. As such, the Humber Estuary SAC has been screened in and assessed because of potential changes to air quality linked to construction traffic.</p>

Impact	Worst-case scenario	Notes and rationale
Operation and Maintenance phase		
Disturbance and/or displacement	<p>Landfall:</p> <ul style="list-style-type: none">Total installation duration at landfall: 2 years. <p>Onshore ECC:</p> <ul style="list-style-type: none">Number of main construction compounds: 4 (1 every 10km).Indicative main construction compound dimensions: 200m x 100m.Number of intermediate construction compounds: 8 (1 every 5km).Indicative intermediate construction compound dimensions: 75m x 75m.Total duration of onshore export cable installation works: 3.5 to 4 years. <p>OCS Zone:</p> <ul style="list-style-type: none">Total OCS construction duration: 3.5 years. <p>Combined OCS and ESBI:</p> <ul style="list-style-type: none">Maximum land take for OCS and ESBI construction and operation: 20.3ha (including temporary construction compounds which have a land take of 4.25ha).	Disturbance and displacement impacts as a result of maintenance activities are assumed to resemble those relating to construction activities for temporary/buried structures, if this occurs in FLL of a SPA, but at significantly lower frequency and intensity.
Loss of Functionally Linked Land	<p>Onshore ECC:</p> <ul style="list-style-type: none">Permanent easement: 20m.<ul style="list-style-type: none">HVDC: 2.HVAC: 4.Maximum burial depth: 20m for HDD.Minimum burial depth: 1.2m for open cut trenches.Jointing bay permanent land take: 40m² per jointing bay (10m² for link box + 30m² for buried jointing bay slab).Number of link boxes: between 43 and 56.Number of jointing bays:<ul style="list-style-type: none">HVDC: between 40 – 50.HVAC: between 6 – 12. <p>Combined OCS and ESBI:</p> <ul style="list-style-type: none">Permanent footprint: 16.05ha comprised of:<ul style="list-style-type: none">OCS 3.5ha.ESBI: 7.7ha.Drainage / landscaping / access:<ul style="list-style-type: none">OCS: 3.25ha.ESBI:1.6ha.	Permanent loss of FLL due to permanent structures, if they occur in FLL of a SPA.

REPORT TO INFORM APPROPRIATE ASSESSMENT

Impact	Worst-case scenario	Notes and rationale
Indirect impacts through effects on supporting habitats and prey species	<p>Landfall:</p> <ul style="list-style-type: none"> Permanent land take: <ul style="list-style-type: none"> 10m² for link boxes. Buried concrete slab below TJB: 30m². <p>Onshore ECC:</p> <ul style="list-style-type: none"> Permanent easement: 20m. <ul style="list-style-type: none"> HVDC: 2. HVAC: 4. Maximum burial depth: 20m for HDD. Minimum burial depth: 1.2m for open cut trenches. Jointing bay permanent land take: 40m² per jointing bay (10m² for link box + 30m² for buried jointing bay slab). Number of link boxes: between 43 and 56. Number of jointing bays: <ul style="list-style-type: none"> HVDC: between 40 – 50. HVAC: between 6 – 12. <p>Combined OCS and ESBI:</p> <ul style="list-style-type: none"> Permanent footprint: 16.05ha comprised of: <ul style="list-style-type: none"> OCS 3.5ha. ESBI: 7.7ha. Drainage / landscaping / access: <ul style="list-style-type: none"> OCS: 3.25ha. ESBI: 1.6ha. 	Impacts on habitats and prey as a result of maintenance activities are assumed to resemble those relating to construction activities but at significantly lower frequency and intensity.
Decommissioning phase		
Disturbance and / or displacement	No final decision regarding the final decommissioning policy for the onshore project infrastructure including landfall, onshore cable route and onshore substation has yet been made. It is also recognised that legislation and industry best practice change over time. 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. It is anticipated that for the worst-case scenario, the impacts will be no greater than those identified for the construction phase.	Disturbance and displacement relate to noise emissions and visual imposition of decommissioning preparation and activities.
Loss of Functionally Linked Land		<p>Temporary loss of FLL relates to temporary decommissioning activities such as compounds and recovery of buried structures (further to disturbance and displacement) if these occur in FLL of a SPA.</p> <p>Permanent loss of FLL relates to whether any above ground structures are left in situ, if this occurs in FLL of a SPA.</p>
Indirect impacts through effects on supporting habitats and prey species		Indirect impact via habitats and prey relates to ground preparation or disturbance in onshore areas and the landfall, if this occurs in FLL of a SPA.

6.4 Humber Estuary SPA

6.4.1 Site Description

547. The Humber Estuary SPA is located off the east coast of England and extends from the mouth of the River Humber to the limit of saline intrusion on the river Ouse and 2km south to the river Trent. The Humber Estuary SPA is characterised as a large macro-tidal coastal plain estuary which supports high suspended sediment loads. This dynamic system feeds a range of shifting habitat types including intertidal and subtidal mudflats, sandflats, saltmarsh and reedbeds.
548. The variety of habitats found across the Humber Estuary SPA in turn supports a large variety of wintering, passage and breeding bird species, including some found in internationally important populations. The impact of extensive historical land claim, coastal squeeze and lack of suitable habitats has put a combined pressure on the availability of critical roosting sites.

6.4.1.1 Qualifying Features

549. The Humber Estuary SPA is designated for the following qualifying features:
- Avocet *Recurvirostra avosetta*, breeding and non-breeding populations;
 - Bar-tailed godwit *Limosa lapponica*, non-breeding population;
 - Bittern *Botaurus stellaris*, breeding and non-breeding population;
 - Black-tailed godwit *Limosa limosa islandica*, non-breeding population;
 - Dunlin *Calidris alpina alpina*, non-breeding population;
 - Golden plover *Pluvialis apricaria*, non-breeding population;
 - Hen harrier *Circus cyaneus*, non-breeding population;
 - Knot *Calidris canutus*, non-breeding population;
 - Little tern *Sternula albifrons*, breeding population;
 - Marsh harrier *Circus aeruginosus*, breeding population;
 - Redshank *Tringa totanus*, non-breeding population;
 - Ruff *Calidris pugnax*, non-breeding population;
 - Shelduck *Tadorna tadorna*, non-breeding population; and
 - Waterbird assemblage, non-breeding.

6.4.1.2 Conservation Objectives

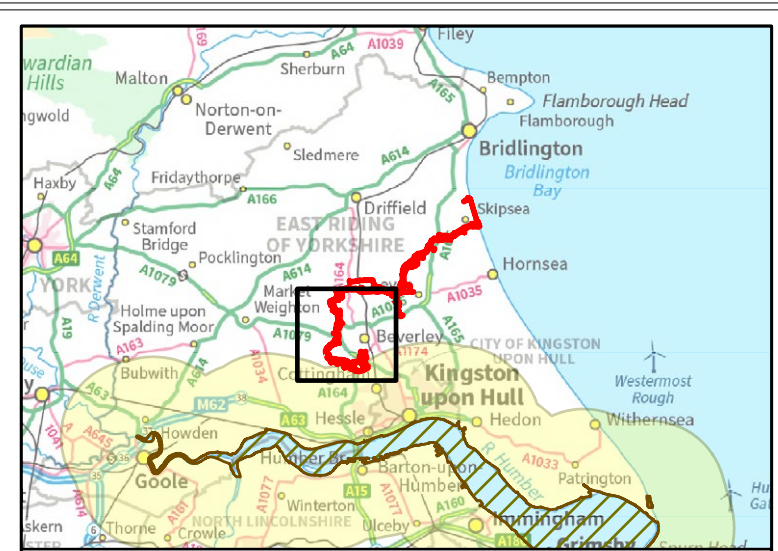
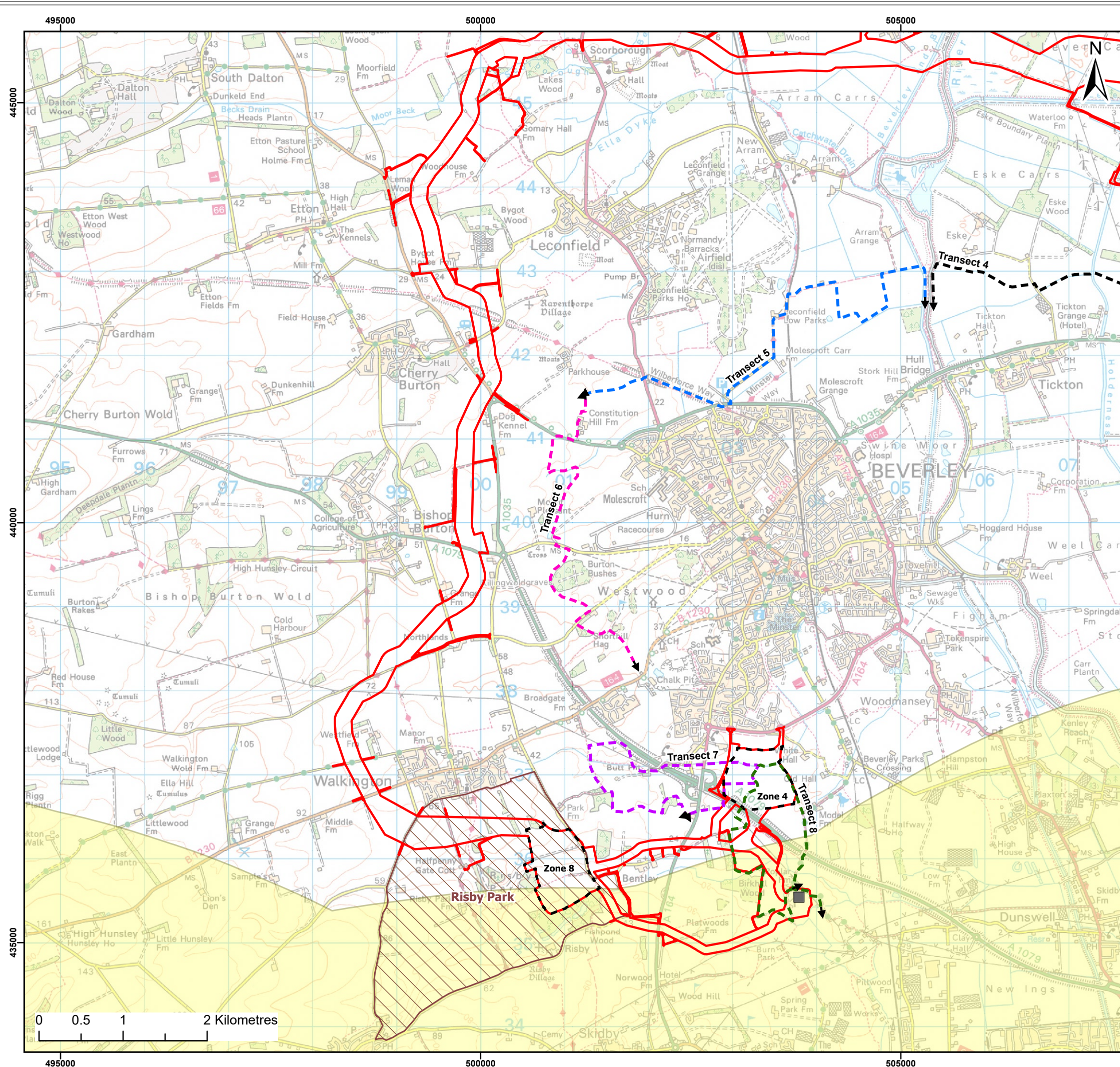
550. The Humber Estuary SPA's qualifying features (outlined in **Section 6.4.1.1**) are subject to a number of conservation objectives to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate.
551. The conservation objectives for the Humber Estuary SPA aim to maintain or restore:
- The extent and distribution of the habitats of the qualifying features;
 - The structure and function of the habitats of the qualifying features;
 - The supporting processes on which the habitats of the qualifying features rely;
 - The populations of each of the qualifying features; and
 - The distribution of qualifying features within the site.

6.4.1.3 Condition Assessment

552. The site is reported by Natural England (2023a) to have seen a reduction in extent of mudflat and sand flat, and Atlantic saltmeadow, both of which are supporting habitats to the SPA qualifying features. Parts of the site are subjected to recreational disturbance “*at levels which could significantly influence waterbird usage, including evidence that waterbirds are vacating some areas during periods of increased disturbance.*”
553. Disturbance is attributed to a wide range of activities, with dog walking being the primary source when birds exhibited a behavioural response. The water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients.

6.4.2 Functionally Linked Land Assessment

554. Natural England defines Functionally Linked Land (FLL) of the Humber Estuary SPA through their Discretionary Advice Service as “*suitable habitat for SPA bird populations within 10km of the Humber Estuary SPA*”. An assessment of the suitability of land in and adjacent to the Onshore Development Area within 10km of the SPA boundary (see **Figure 6-1**) to act as FLL of the SPA for qualifying features or key assemblage components is required.





Legend:

- Onshore Development Area
- Onshore Converter Station Options
- Indicative Birkhill Wood Substation
- Humber Estuary Special Protection Area (SPA)
- Humber Estuary Special Protection Area (SPA) 10km Buffer
- Risby Park

Dogger Bank South survey transects

- Transect 4
- Transect 5
- Transect 6
- Transect 7
- Transect 8

Source: © Haskoning DHV UK Ltd, 2025; © Natural England, 2025.
© Crown copyright and database rights 2025 Ordnance Survey 0100031673

Project:		DOGGER BANK WIND FARM			
Dogger Bank D Offshore Wind Farm					
Title: Figure Coverage of DBD Onshore Development Area by Desk-Based Data Sources					
Figure:	6.1	Drawing No: PC6250-RHD-XX-ON-DR-GS-0518			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	03/02/2025	AB	LMF	A3	1:45,000
Co-ordinate system: British National Grid					
<div style="display: flex; justify-content: space-between; align-items: center;"><div></div><div></div></div>					

555. At this PEIR stage the assessment is based primarily on the desk-based study, plus preliminary data from site-specific surveys (August to December 2024). Site-specific transect and vantage point surveys are ongoing to identify use of FLL in or within 300m of the Onshore Development Area by waterbirds, and to assess the nature and regularity of use of the land by identified species. The methodology of onshore surveys is detailed in **Section 23.4.1 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**.
556. It is noted that for the ES submission (and RIAA update), the assessment will be based on the full site-specific survey results obtained by employing a combination of walked transect and stationary vantage point survey methodologies, plus a desk-based study of existing bird abundance and distribution data and landscape and habitat data. This is in line with Natural England advice (Natural England comments at Appendix 2 of DBD Scoping Opinion 02 Aug 2024) and consultation (**PEIR Volume 2, Appendix 23.1 Consultation Responses for Onshore Ecology and Ornithology**).
557. Desk-study data sources covering the potential FLL within the Onshore Development Area and surrounding fields comprise:
- Dogger Bank South onshore baseline surveys transect 8 data as mapped in Dogger Bank South ES Appendices (Peak Ecology, 2023 and 2024);
 - BTO Birdtrack data for Risby Park estate; and
 - eBird Basic Dataset (2024) data for Risby Park estate.
558. Humber Estuary SPA (and concurrently Ramsar site) populations for species were sourced from the British Trust for Ornithology (BTO) Wetland Bird Survey (WeBS) report (Woodward *et al.*, 2024)⁴. National populations for species were sourced from Woodward *et al.* (2020).
559. Open source data sources were searched for occurrence of species which:
- Are an SPA qualifying feature; or
 - Are named as part of the assemblage on the SPA citation; or
 - Occur [in the SPA] at site levels (per most recent BTO WeBS five-year average (Woodward *et al.*, 2024)) equalling or exceeding 1% of the national [GB] population (per Woodward *et al.*, 2020); or
 - Occur at more than 2000 individuals [in the SPA] according to the most recent (2022/23) BTO WeBS count; and
 - Are in or within 300m of the Onshore Development Area that lies within 10km of the SPA, in numbers which are significant (>1% of their SPA population per BTO WeBS five-year average).
560. Of the total 3.5km² area of potential FLL (Onshore Development Area plus 300m buffer, falling within 10km of the Humber Estuary SPA boundary (see **Table 6-3**) – hereafter ‘the potential FLL area’), preliminary transect survey data provides spatial coverage approaching 100% and desk-based data sources provide spatial coverage of approximately 0.9km² or 25%. The habitat within the 3.5km² total area varies from approximately 10m to 50m altitude above sea level and comprises productive (drained) arable agricultural land with a network of drainage ditches, pockets of mixed woodland, including Birkhill Wood, and recreational fishing ponds at Risby Park. The A164 road bisects the area, and the A1079 runs along approximately 400m of the north border of the area (see **Table 6-4**). The portion of the potential FLL area that lies southeast of the junction of these two roads is traversed by overhead high-voltage electrical transmission lines between pylons running north-south (see **Table 6-5**). In summary, the area is suitable for the minority of SPA bird species which occupy productive agricultural land (including agricultural drains), or recreational fishing ponds, farm ponds or duck ponds where human disturbance is high; and are tolerant of tall landscape features such as woodland and overhead powerlines within their viewshed or flightpaths.
561. The occurrence of bird species associated with the SPA within the Onshore Development Area (or adjacent land) within 10km from the SPA following a desk study and preliminary onshore survey data is shown in **Table 6-3**. Three named non-breeding waterbird assemblage species of the SPA – mallard, teal, and lapwing – were recorded within the potential FLL area in small numbers, and one further such species – whimbrel – was recorded once as a flyover migrant and once foraging outside the potential FLL area within eBird data, in both cases involving single birds. Curlew is reported in desk data in the wider locality in small numbers and is also a named assemblage species but has not been recorded in site-specific surveys to date. One further species not listed on the SPA citation but indicated from BTO WeBS five-year average count data to occur within the SPA in nationally important numbers (>1% of GB population) was recorded: greylag goose. One further such species – pink-footed goose – was recorded multiple times flying over the site often involving large numbers of migrating or commuting birds.

⁴ Contains Wetland Bird Survey (WeBS) data from Waterbirds in the UK 2022/23 © copyright and database right 2024. WeBS is a partnership jointly funded by the BTO, RSPB and JNCC, with fieldwork conducted by volunteers and previous support from WWT

Table 6-3 Occurrence in the DBD Onshore Development Area + 300m buffer and within 10km of the Humber Estuary SPA of qualifying feature or assemblage species (DBD surveys Aug to Dec 2024, Dogger Bank South surveys Oct 2022 to Aug 2023, Risby Park BTO BirdTrack data and eBird data 2019 to 2024, NEYEDC data)

Species	Status in Humber Estuary SPA	Occurrence in Potential FLL Area
Golden plover	Qualifying feature (non-breeding) BTO WeBS five-year average count (2018/19-2022/23) 21160 individuals	None. Single record outside the area, of 62 individuals loafing or foraging in fields at or adjacent to Beverley Parks Nature Reserve (over 300m east of the Onshore Development Area), in December 2024 DBD transect survey.
Marsh harrier	Qualifying feature (breeding) Most recent reported SPA population 21 breeding females (Natural England, 2023)	None. Single record of a juvenile male flying north, over land north of the potential FLL in December 2022 Dogger Bank South transect 7 survey.
Mallard	Named assemblage species at citation BTO WeBS five-year average count (2018/19-2022/23) 1459 individuals	Recorded in typically small numbers (<10 individuals) in Sep, Nov, Dec, Jan, Mar-Jul in the potential FLL across DBD surveys to Dec 2024, eBird, DBS survey data and Risby Park BTO Birdtrack data. Peak count of 28 individuals in Dec 2024 transect survey (at Risby Park fishing ponds). Most occurrences in DBD surveys involve birds on small waterbodies or drainage ditches, or commute flights between these.
Teal	Named assemblage species at citation BTO WeBS five-year average count (2018/19-2022/23) 5710 individuals	Single record of 8 individuals in Feb 2023 DBS transect 8 survey on agricultural drain.
Lapwing	Named assemblage species at citation BTO WeBS five-year average count (2018/19-2022/23) 15951 individuals	Recorded in November, December and April in the potential FLL across DBD surveys to Dec 2024, DBS survey data and Risby Park BTO Birdtrack data. Most birds recorded in flight and in small numbers (<10 individuals) but considered likely to use land for roosting and foraging. Peak count of 34 individuals in December 2024 transect survey but location was over 700m from the Onshore Development Area boundary.
Whimbrel	Named assemblage species at citation BTO WeBS five-year average count (2018/19-2022/23) 50 individuals	Peak counts of one individual flying over potential FLL area in August 2024 Dogger Bank D site-specific VP survey, and one individual feeding outside the potential FLL area on land at White Hall in April 2022 (per eBird) (over 400m east of the Onshore Development Area).
Curlew	Named assemblage species at citation BTO WeBS five-year average count (2018/19-2022/23) 2291 individuals	None. Local records outside the area in eBird data, frequent east and north of Beverley at Figham Common, Swinemoor, Leconfield, typically in small numbers (<10 individuals), plus record of 20 individuals in Jan 2021 and 10 individuals in Feb 2021 in vicinity of Haltemprice Farm (over 2600m south of the Onshore Development Area).
Greylag goose (British/Irish naturalised population)	Not named in assemblage but present in SPA in nationally significant numbers (>1% GB population) BTO WeBS five-year average count (2018/19-2022/23) 2154 individuals	Recorded in August, September, November, December, January, March, and April in the potential FLL across DBD surveys to Dec 2024, eBird, DBS survey data and Risby Park BTO Birdtrack data. There is a count of 67 at rest within the potential FLL area in August 2023 Dogger Bank South transect 8 survey, but other records involve small numbers (<10 indivs) and/or birds making commute flights over the area only. Birds are regularly recorded outside the potential FLL area at Beverley Parks Nature Reserve, and the Cottingham Parks golf course wetlands (over 400m south of the Onshore Development Area), numbering up to c. 40 individuals (pers. comm.).
Pink-footed goose	Not named in assemblage but present in nationally significant numbers BTO WeBS five-year average count (2018/19-2022/23) 23330 individuals	Flyover records in September 2024 to December 2024 across DBD surveys to Dec 2024, NEYEDC records and DBS survey data. All records involve birds in flight on migration or local commute and regularly number hundreds of birds, with a peak count of 1850 individuals in the DBD November vantage point survey.

562. Marsh harrier occurrence – a qualifying feature species of the Humber Estuary SPA – was one record of a juvenile male flying north over land 1.3km north of the potential FLL (and more than 11km from the SPA) in the December 2022 Dogger Bank South transect 7 survey. Natural England (2017) guideline seasonality of marsh harrier as a breeding qualifying feature of the SPA is March to October, inclusive. In summary, the record concerns a non-adult bird rather than a potential SPA breeding adult, outside the species' seasonality in the SPA, and outside the focal area though it may have overflowed the potential FLL area. There is no indication the bird was foraging the overflowed land or the potential FLL area. There is one occurrence of golden plover, also a qualifying feature of the SPA, across desk data and preliminary survey data, and this involved 62 individuals (well below 1% of the SPA population) outside the potential FLL area, in vicinity of Beverley Parks Nature Reserve (**Table 6-3**).
563. The only waterbird species recorded in the potential FLL area in numbers that are significant in terms of SPA population was a single record of 67 greylag geese in August 2023 at approximate latitude 53.809105, longitude -0.422731. This is equivalent to approximately 3.1% of the Humber Estuary five-year average BTO WeBS population for the species (which is reported in the BTO WeBS Report to be part of the British/Irish re-introduced/naturalised population), though only 0.05% of the five-year average size of the waterbird assemblage feature (136,310 individual waterbirds, 2018/19 to 2022/23). Across all other records within preliminary survey data and desk-based sources, greylag goose occurred in similar numbers once, involving birds flying over the area only, and all other records involved ten or fewer individuals. There is no evidence at the PEIR stage that the potential FLL area is regularly used by greylag goose in numbers sufficient for 1% of their SPA population to be potentially affected by the Project.
564. In summary there is preliminary indication that land in or adjacent to the Onshore Development Area within 10km of the Humber Estuary does not act as FLL of the SPA. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be regularly or even repeatedly used by SPA feature or assemblage waterbirds in significant numbers for roosting, foraging, feeding, moulting and/or loafing. Should the completed programme of site-specific transect and vantage point surveys identify additional use of FLL in or within 300m of the Onshore Development Area, the nature and regularity of use of the land will be outlined and used in assessment for the ES. Based on assessment of the habitat type and structure (predominantly productive arable farmland, plus disturbed or poor quality wetland features (fishing ponds, drainage ditches)), and presence and locations of anthropogenic features (roads, pylons) and woodland, there is potential suitability of the 3.5km² area to support some other qualifying feature or assemblage species of the SPA, such as golden plover, curlew, wigeon and common crane. This suitability is likely to extend only to foraging by a small, dispersed number of individuals, rather than roosting aggregations which are unlikely to occur due to the presence of skyline features such as pylons which are favourable to predators and avoided by roosting waterbirds.

6.4.3 Avocet (non-breeding)

6.4.3.1 Status

565. Natural England (2023a) reports that since classification there has been an overall rise in the avocet population. The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients.

6.4.3.2 Connectivity

566. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that non-breeding avocet in the SPA primarily use tidal waters, and the following habitats of the SPA support the non-breeding avocet qualifying feature:
- Intertidal sand and mudflats;
 - Coastal lagoons; and
 - Saltmarsh.
567. These habitats are not found within the potential FLL area of the Onshore Development Area. Avocet is not cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Avocet has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Avocet was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**). Avocet has only been recorded at the landfall in Dogger Bank D surveys to date (see **Section 3.2** in **PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**). The individuals recorded are not functionally linked to the Humber Estuary population, on the basis of distance from the SPA.

6.4.3.3 Assessment of Potential Effects of the Project Alone

6.4.3.3.1 Disturbance / Displacement

568. On the basis that the main habitats outlined as supporting the non-breeding avocet qualifying feature are not found within the potential FLL area, avocet are not known to make regular use of FLL off-site, and avocet has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause disturbance and displacement of the non-breeding avocet qualifying feature.

6.4.3.3.2 Long Term and Temporary Loss of Functionally Linked Land

569. On the basis that the main habitats outlined as supporting the non-breeding avocet qualifying feature are not found within the potential FLL area, avocet are not known to make regular use of FLL off-site, and avocet has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause long-term or temporary loss of FLL for the non-breeding avocet qualifying feature.

6.4.3.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

570. Natural England (2023a) reports that main food sources of avocet are held within intertidal habitats and lagoons, with important prey species are cited to include “*Gammas spp.*, *Corophium spp.*, *Nereis spp.*, *Hydrobia ulvae*, *Cardium spp.*, gobies, flies and beetles”.
571. On the basis that the habitats supporting the main food sources of non-breeding avocet do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no significant effect on the Humber Estuary SPA via air quality changes or hydrological linkage. Therefore there is no potential for the Project to cause indirect impacts through effects on habitats and prey species of the non-breeding avocet qualifying feature.

6.4.3.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

572. The in-combination assessment considers other developments (plans or projects) in planning, construction or operation where the predicted effects on the Humber Estuary SPA may have the potential to interact with effects from the proposed construction, operation and maintenance or decommissioning of the Project.
573. The 2024 survey data **does not** indicate any potential pathways, therefore no in-combination effects are anticipated.

6.4.3.4.1 Disturbance / Displacement

574. On the basis that there is no potential for the Project alone to cause disturbance and displacement of the non-breeding avocet qualifying feature of the SPA, there is subsequently considered to be no potential for the Project to cause disturbance and displacement in-combination with other projects.

6.4.3.4.2 Long Term and Temporary Loss of Functionally Linked Land

575. On the basis that there is no potential for the Project alone to cause long term or temporary loss of FLL for the non-breeding avocet qualifying feature of the SPA, there is subsequently considered to be no potential for the Project to cause loss of FLL in-combination with other projects.

6.4.3.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

576. On the basis that the habitats supporting the main food sources of non-breeding avocet do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no cumulative significant effect from the Project and other projects on the Humber Estuary SPA via air quality changes or hydrological linkage, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other projects.

6.4.4 Bar-tailed godwit (non-breeding)

6.4.4.1 Status

577. Natural England (2023a) reports that since classification there has been a recent decline in the bar-tailed godwit population, from a peak of 3,011 individuals in 2006/7 to 2010/11 to 1,395 individuals in 2013/14 to 2017/18. The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) states that population trends for the species in the SPA relative to regional and national trends indicate that site-specific pressures are likely to be drivers of the species’ decline in the SPA.

6.4.4.2 Connectivity

578. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the non-breeding bar-tailed godwit qualifying feature:

- Intertidal mud;
- Coastal lagoons;
- Freshwater and coastal grazing marsh;
- Salicornia and other annuals colonising mud and sand;
- Saltmarsh; and
- Intertidal sand and muddy sand.

579. These habitats are not found within the potential FLL area of the Onshore Development Area. Bar-tailed godwit is not cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Bar-tailed godwit has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Bar-tailed godwit was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.4.4.3 Assessment of Potential Effects of the Project Alone

6.4.4.3.1 Disturbance / Displacement

580. On the basis that the main habitats outlined as supporting the non-breeding bar-tailed godwit qualifying feature are not found within the potential FLL area, bar-tailed godwit are not known to make regular use of FLL off-site, and bar-tailed godwit has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause disturbance and displacement of the non-breeding bar-tailed godwit qualifying feature.

6.4.4.3.2 Long Term and Temporary Loss of Functionally Linked Land

581. On the basis that the main habitats outlined as supporting the non-breeding bar-tailed godwit qualifying feature are not found within the potential FLL area, bar-tailed godwit are not known to make regular use of FLL off-site, and bar-tailed godwit has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause long-term or temporary loss of FLL for the non-breeding bar-tailed godwit qualifying feature.

6.4.4.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

582. Natural England (2023a) reports that main food sources of bar-tailed godwit are found within lagoons, with important prey species including *Arenicola marina* and *Nereis* spp.

583. On the basis that the habitats supporting the main food sources of bar-tailed godwit do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no significant effect on the Humber Estuary SPA via air quality changes or hydrological linkage, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species of the non-breeding bar-tailed godwit qualifying feature.

6.4.4.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.4.4.1 Disturbance / Displacement

584. On the basis that there is no potential for the Project alone to cause disturbance and displacement of the non-breeding bar-tailed godwit qualifying feature of the SPA, there is subsequently considered to be no potential for the Project to cause disturbance and displacement in-combination with other projects.

6.4.4.4.2 Long Term and Temporary Loss of Functionally Linked Land

585. On the basis that there is no potential for the Project alone to cause long term or temporary loss of FLL for the non-breeding bar-tailed godwit qualifying feature of the SPA, there is subsequently considered to be no potential for the Project to cause loss of FLL in-combination with other projects.

6.4.4.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

586. On the basis that the habitats supporting the main food sources of non-breeding bar-tailed godwit do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no cumulative significant effect from the Project and other projects on the Humber Estuary SPA via air quality changes or hydrological linkage, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other projects.

6.4.5 Black-tailed godwit (non-breeding)

6.4.5.1 Status

587. Natural England (2023a) reports that since classification there has been a significant rise in the black-tailed godwit population. The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and / or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and / or currently un-impacted by anthropogenic activities with regard to nutrients. BTO WeBS Alerts (Woodward *et al.*, 2019) reports that the SPA, regional and national population trends for this species indicate that the SPA's environmental conditions remain relatively favourable for black-tailed godwit.

6.4.5.2 Connectivity

588. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the non-breeding black-tailed godwit qualifying feature:
- Intertidal sand and mudflats;
 - Coastal lagoons;
 - Freshwater and coastal grazing marsh;
 - Saltmarsh; and
 - Inland areas of wet grassland and agricultural land (both arable land and permanent pasture).
589. The latter habitat is found within the potential FLL area of the Onshore Development Area. Black-tailed godwit is cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Black-tailed godwit has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Black-tailed godwit was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.4.5.3 Assessment of Potential Effects of the Project Alone

6.4.5.3.1 Disturbance / Displacement

590. The Project has no pathway to cause direct disturbance impact to birds present within the SPA. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the SPA is via disturbance and displacement of birds present in FLL of the SPA. The ZoI for disturbance of SPA birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be within the Onshore Development Area and within 300m of the Onshore Development Area (see **Appendix A.1 Dogger Bank D HRA Consultation Responses**).
591. Black-tailed godwit of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). Fulfilment of the conservation objectives of black-tailed godwit in the SPA includes a target to “*reduce the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed [in the non-breeding season]*” (Natural England, 2023a). ‘Significant’ disturbance is defined by the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
592. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.
593. Construction – It is not likely that disturbance from the project alone will be significant during construction, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by black-tailed godwit for roosting, foraging, feeding, moulting and/or loafing (**Section 6.4.2**). Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by black-tailed godwit, the nature and regularity of use of the land will be outlined and used in assessment for the ES.

594. Construction disturbance from the Project alone is not likely to cause a changed local distribution of black-tailed godwit on a continuing basis as this would require: a) birds to be regularly present within the Zol for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of black-tailed godwit in similar habitat in desk-based data (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by black-tailed godwit or has any importance to the population. A review of black-tailed godwit use of the Humber Estuary by Percival (2011) demonstrated the vast majority of roosting and feeding occurs within the SPA boundary. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded black-tailed godwit on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed temporary activities.
595. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as black-tailed godwit are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
596. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the SPA may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale. With regard to the conservation objectives of the black-tailed godwit feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the black-tailed godwit feature will be maintained in the long term.
597. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the black-tailed godwit feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the black-tailed godwit feature will be maintained in the long term.
598. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the black-tailed godwit feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the decommissioning phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the black-tailed godwit feature will be maintained in the long term. Long Term and Temporary Loss of Functionally Linked Land
599. Fulfilment of the conservation objectives of black-tailed godwit in the SPA includes a target to “*restore the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding / wintering period (moulting, roosting, loafing, feeding) to an unspecified extent,*” on a year-round basis.

600. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any SPA birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.

601. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of black-tailed godwit in similar habitat in desk-based data (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by black-tailed godwit or has any importance to the population in supporting necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding). With regard to the conservation objectives of the black-tailed godwit feature of the Humber Estuary SPA in relation to loss of Functionally Linked Land from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the black-tailed godwit feature will be maintained in the long term.

6.4.5.3.2 Indirect Impacts Through Effects on Habitats and Prey Species

602. Fulfilment of the conservation objectives of black-tailed godwit in the SPA includes a target to “*maintain the distribution, abundance and availability of key food and prey items at preferred sizes*” on a year-round basis.

603. Natural England (2023a) reports that main food sources of black-tailed godwit are held within wet or marshy grassland, lagoons and the intertidal zone. Important prey species of black-tailed godwit in the SPA are cited to include “*Macoma balthica*, *Cardium spp.* and *Nereis spp.* in intertidal feeding areas and earthworm, leatherjacket and chironomids in terrestrial feeding areas.”

604. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of black-tailed godwit in similar habitat in desk-based data (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by black-tailed godwit or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential black-tailed godwit habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key black-tailed godwit food and prey items at preferred sizes. With regard to the conservation objectives of the black-tailed godwit feature of the Humber Estuary SPA in relation to impacts via habitats and prey from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the black-tailed godwit feature will be maintained in the long term.

6.4.5.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.5.4.1 Disturbance / Displacement

605. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to black-tailed godwit of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of black-tailed godwit occurring in the potential FLL area or similar habitat in the desk-study data.

606. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.4.5.4.2 Long Term and Temporary Loss of Functionally Linked Land

607. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for black-tailed godwit of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of black-tailed godwit occurring in the potential FLL area or similar habitat in the desk-study data.

608. Subsequently, there is no potential for the Project to cause loss of FLL, or act in opposition to the Conservation Objectives of the SPA or the specific target to restore the extent of supporting habitat, in-combination with other plans and projects.

6.4.5.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

609. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of black-tailed godwit of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the non-breeding period, and there are no records of black-tailed godwit occurring in the potential FLL area or similar habitat in the desk-study data.
610. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.4.6 Dunlin (non-breeding)

6.4.6.1 Status

611. Natural England (2023a) reports that since classification there has been a decline of approximately 30% in the SPA dunlin population. The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and / or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and / or currently un-impacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) suggests that the species' decline in the SPA relates to broad-scale population trends.

6.4.6.2 Connectivity

612. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the non-breeding dunlin qualifying feature:
- Intertidal sand and mudflats;
 - Coastal lagoons;
 - Saltmarsh;
 - Inland areas of wet grassland and agricultural land (both arable land and permanent pasture); and
 - Salicornia and other annual colonising mud and sand.

613. The grassland and agricultural habitat is found within the potential FLL area of the Onshore Development Area. Dunlin is cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Dunlin has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Dunlin was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.4.6.3 Assessment of Potential Effects of the Project Alone

6.4.6.3.1 Disturbance / Displacement

614. The Project has no pathway to cause direct disturbance impact to birds present within the SPA. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the SPA is via disturbance and displacement of birds present in FLL of the SPA. The Zol for disturbance of SPA birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **Appendix A.1 Dogger Bank D HRA Consultation Responses**).
615. Dunlin of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). Fulfilment of the conservation objectives of dunlin in the SPA includes a target to *“reduce the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed [in the non-breeding season]”* (Natural England, 2023a). ‘Significant’ disturbance is defined by the AEWA (2016) as follows: *“Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
 - For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.

616. Construction – It is not likely that disturbance from the project alone will be significant during construction, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by dunlin for roosting, foraging, feeding, moulting and / or loafing (**Section 6.4.2**). Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by dunlin, the nature and regularity of use of the land will be outlined and used in assessment for the ES.
617. Construction disturbance from the Project alone is not likely to cause a changed local distribution of dunlin on a continuing basis as this would require: a) birds to be regularly present within the ZOI for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of dunlin in similar habitat in desk-based data (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by dunlin or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded dunlin on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
618. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as dunlin are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
619. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the SPA may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale. With regard to the conservation objectives of the dunlin feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the dunlin feature will be maintained in the long term.
620. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the dunlin feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the dunlin feature will be maintained in the long term.
621. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the dunlin feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the decommissioning phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the dunlin feature will be maintained in the long term.
- 6.4.6.3.2 Long Term and Temporary Loss of Functionally Linked Land
622. Fulfilment of the conservation objectives of dunlin in the SPA includes a target to “*restore the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) to an unspecified extent,*” on a year-round basis.

623. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any SPA birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of dunlin in similar habitat in desk-based data (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by dunlin or has any importance to the population in supporting necessary stages of the non-breeding / wintering period (moulting, roosting, loafing, feeding). With regard to the conservation objectives of the dunlin feature of the Humber Estuary SPA in relation to loss of Functionally Linked Land from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the dunlin feature will be maintained in the long term

6.4.6.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

624. Fulfilment of the conservation objectives of dunlin in the SPA includes a target to “*maintain the distribution, abundance and availability of key food and prey items at preferred sizes*” on a year-round basis.
625. Natural England (2023a) reports that main food sources of dunlin include *Nereis spp*, *Macoma balthica*, *Peringia ulvae*, *Crangon spp* and *Carcinus spp* in intertidal feeding areas and grassland / marsh invertebrates in terrestrial feeding areas.
626. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of dunlin in similar habitat in desk-based data (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by dunlin or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential dunlin habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key dunlin food and prey items at preferred sizes. With regard to the conservation objectives of the dunlin feature of the Humber Estuary SPA in relation to impacts via habitats and prey from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the dunlin feature will be maintained in the long term

6.4.6.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.6.4.1 Disturbance / Displacement

627. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to dunlin of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of dunlin occurring in the potential FLL area or similar habitat in the desk-study data.
628. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.4.6.4.2 Long Term and Temporary Loss of Functionally Linked Land

629. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for dunlin of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of dunlin occurring in the potential FLL area or similar habitat in the desk-study data.
630. Subsequently, there is no potential for the Project to cause loss of FLL, or act in opposition to the Conservation Objectives of the SPA or the specific target to restore the extent of supporting habitat, in-combination with other plans and projects.

6.4.6.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

631. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of dunlin of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the non-breeding period, and there are no records of dunlin occurring in the potential FLL area or similar habitat in the desk-study data.
632. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.4.7 Golden plover (non-breeding)

6.4.7.1 Status

633. Natural England (2023a) reports that since classification there was an initial increase but subsequent decline in the golden plover population. The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and / or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and / or currently un-impacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) suggests that the species' decline in the SPA relates to broad-scale population trends.

6.4.7.2 Connectivity

634. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the non-breeding golden plover qualifying feature:
- Intertidal sand and mudflats;
 - Coastal lagoons;
 - Saltmarsh; and
 - Inland areas of wet grassland and agricultural land (both arable land and permanent pasture).
635. The latter habitat is found within the potential FLL area of the Onshore Development Area, and Natural England (2023a) report that golden plover “*primarily feed outside the SPA boundary on inland areas of wet grassland and agricultural land (both arable and permanent pasture).*” Golden plover has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Golden plover was recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.4.7.3 Assessment of Potential Effects of the Project Alone

6.4.7.3.1 Disturbance / Displacement

636. The Project has no pathway to cause direct disturbance impact to birds present within the SPA. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the SPA is via disturbance and displacement of birds present in FLL of the SPA. The ZoI for disturbance of SPA birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **Appendix A.1 Dogger Bank D HRA Consultation Responses**).
637. Golden plover of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). Fulfilment of the conservation objectives of golden plover in the SPA includes a target to “*reduce the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed [in the non-breeding season]*” (Natural England, 2023a). ‘Significant’ disturbance is defined by the AEWA (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
638. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.
639. Construction – It is not likely that disturbance from the project alone will be significant during construction, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by golden plover for roosting, foraging, feeding, moulting and / or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by golden plover, the nature and regularity of use of the land will be outlined and used in assessment for the ES.

640. Construction disturbance from the Project alone is not likely to cause a changed local distribution of golden plover on a continuing basis as this would require: a) birds to be regularly present within the Zol for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of golden plover in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by golden plover or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded golden plover in the potential FLL area on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
641. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as golden plover are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
642. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the SPA may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale. With regard to the conservation objectives of the golden plover feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the golden plover feature will be maintained in the long term.
643. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the golden plover feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the golden plover feature will be maintained in the long term.
644. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the golden plover feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the decommissioning phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the golden plover feature will be maintained in the long term.
- 6.4.7.3.2 Long Term and Temporary Loss of Functionally Linked Land
645. Fulfilment of the conservation objectives of golden plover in the SPA includes a target to “*restore the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) to an unspecified extent,*” on a year-round basis.

646. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any SPA birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.

647. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of golden plover in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by golden plover or has any importance to the population in supporting necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding). With regard to the conservation objectives of the golden plover feature of the Humber Estuary SPA in relation to loss of Functionally Linked Land from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the golden plover feature will be maintained in the long term

6.4.7.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

648. Fulfilment of the conservation objectives of golden plover in the SPA includes a target to “*maintain the distribution, abundance and availability of key food and prey items at preferred sizes*” on a year-round basis.

649. Natural England (2023a) reports that main food sources of golden plover include earthworm, leatherjackets, beetles and spiders, and that the species’ SPA population’s foraging ecology sees the majority of feeding undertaken “*outside the SPA boundary on inland areas of wet grassland and agricultural land*”.

650. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of golden plover in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by golden plover or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential golden plover habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key golden plover food and prey items at preferred sizes. With regard to the conservation objectives of the golden plover feature of the Humber Estuary SPA in relation to impacts via habitats and prey from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the golden plover feature will be maintained in the long term

6.4.7.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.7.4.1 Disturbance / Displacement

651. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to golden plover of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of golden plover occurring in the potential FLL area in the desk-study data.

652. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.4.7.4.2 Long Term and Temporary Loss of Functionally Linked Land

653. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for golden plover of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of golden plover occurring in the potential FLL area in the desk-study data.

654. Subsequently, there is no potential for the Project to cause loss of FLL, or act in opposition to the Conservation Objectives of the SPA or the specific target to restore the extent of supporting habitat, in-combination with other plans and projects.

6.4.7.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

655. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of golden plover of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the non-breeding period, and there are no records of golden plover occurring in the potential FLL area in the desk-study data.
656. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.4.8 Hen harrier (non-breeding)

6.4.8.1 Status

657. Natural England (2023a) reports that since classification the non-breeding hen harrier population has been stable. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and / or currently un-impacted by anthropogenic activities with regard to nutrients.

6.4.8.2 Connectivity

658. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the non-breeding hen harrier qualifying feature:
- Tidal reedbeds;
 - Saltmarsh;
 - Intertidal mixed sediments;
 - Intertidal sand and muddy sand; and
 - Inland areas of wet grassland, rough grassland and agricultural land (both arable land and permanent pasture).

659. The latter habitat is found within the potential FLL area of the Onshore Development Area. Hen harrier is cited in Natural England's (2023b) Annex B list as a species known to use off-site supporting habitat or FLL in the non-breeding season. Hen harrier has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Hen harrier was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.4.8.3 Assessment of Potential Effects of the Project Alone

6.4.8.3.1 Disturbance / Displacement

660. The Project has no pathway to cause direct disturbance impact to birds present within the SPA. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the SPA is via disturbance and displacement of birds present in FLL of the SPA. The ZoI for disturbance of SPA birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **Appendix A.1 Dogger Bank D HRA Consultation Responses**).
661. There is insufficient evidence to assess sensitivity of hen harrier of the SPA to noise and visual disturbance associated with construction (Natural England, 2024a), but based on expert judgement, fulfilment of the conservation objectives of hen harrier in the SPA includes a target to “*reduce the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed [in the non-breeding season]*” (Natural England, 2023a).
662. Construction – It is not likely that disturbance from the project alone will be significant during construction, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by hen harrier for roosting, foraging, feeding, moulting and/or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by hen harrier, the nature and regularity of use of the land will be outlined and used in assessment for the ES.

663. Construction disturbance from the Project alone is not likely to cause a changed local distribution of hen harrier on a continuing basis as this would require: a) birds to be regularly present within the Zol for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of hen harrier in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by hen harrier or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and birds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded hen harrier on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
664. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as hen harrier are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
665. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the SPA may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale. With regard to the conservation objectives of the hen harrier feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the hen harrier feature will be maintained in the long term.
666. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the hen harrier feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the hen harrier feature will be maintained in the long term.
667. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the hen harrier feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the decommissioning phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the hen harrier feature will be maintained in the long term.
- 6.4.8.3.2 Long Term and Temporary Loss of Functionally Linked Land
668. Fulfilment of the conservation objectives of hen harrier in the SPA includes a target to “maintain the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding),” on a year-round basis.
669. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any SPA birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.
670. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of hen harrier in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by hen harrier or has any importance to the population in supporting necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding). With regard to the conservation objectives of the hen harrier feature of the Humber Estuary SPA in relation to loss of Functionally Linked Land from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the hen harrier feature will be maintained in the long term.

6.4.8.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

671. Fulfilment of the conservation objectives of hen harrier in the SPA includes a target to “*maintain the distribution, abundance and availability of key food and prey items at preferred sizes*” on a year-round basis.
672. Natural England (2023a) reports that main food sources of hen harrier in the SPA include birds of size range, “pipits to gamebirds,” and mammals of size range, “voles to young rabbit.” These food sources are likely to be found in agricultural land of the type found within the potential FLL area – but which is also widely available throughout the landscape including in closer proximity to the SPA.
673. In absence of any records of hen harrier in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by hen harrier or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential hen harrier habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key hen harrier food and prey items at preferred sizes. With regard to the conservation objectives of the hen harrier feature of the Humber Estuary SPA in relation to impacts through habitats and prey from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the hen harrier feature will be maintained in the long term.

6.4.8.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.8.4.1 Disturbance / Displacement

674. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to hen harrier of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of hen harrier occurring in the potential FLL area or similar habitat in the desk-study data.
675. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.4.8.4.2 Long Term and Temporary Loss of Functionally Linked Land

676. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for hen harrier of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of hen harrier occurring in the potential FLL area in the desk-study data.
677. Subsequently, there is no potential for the Project to cause loss of FLL, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the extent of supporting habitat, in-combination with other plans and projects.

6.4.8.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

678. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of hen harrier of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the non-breeding period, and there are no records of hen harrier occurring in the potential FLL area in the desk-study data.
679. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.4.9 Knot (non-breeding)

6.4.9.1 Status

680. Natural England (2023a) reports that since classification the population of knot has remained relatively stable. The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients.

6.4.9.2 Connectivity

681. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the non-breeding knot qualifying feature:
- Intertidal sand and mudflats;
 - Coastal lagoons;
 - Saltmarsh;
 - Annual vegetation of driftlines (sand and shingle); and
 - Artificial structures such as derelict pier/jetty structures, flood defences.
682. These habitats are not found within the potential FLL area of the Onshore Development Area. Knot is not cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Knot has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Knot was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.4.9.3 Assessment of Potential Effects of the Project Alone

6.4.9.3.1 Disturbance / Displacement

683. On the basis that the main habitats outlined as supporting the non-breeding knot qualifying feature are not found within the potential FLL area, knot are not known to make regular use of FLL off-site, and knot has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause disturbance and displacement of the non-breeding knot qualifying feature.

6.4.9.3.2 Long Term and Temporary Loss of Functionally Linked Land

684. On the basis that the main habitats outlined as supporting the non-breeding knot qualifying feature are not found within the potential FLL area, knot are not known to make regular use of FLL off-site, and knot has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause long-term or temporary loss of FLL for the non-breeding knot qualifying feature.

6.4.9.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

685. Natural England (2023a) reports that main food sources of knot in the SPA are found in intertidal habitats and include "*Macoma balthica*, *Mytilus edulis* and *Cerastoderma edule spat* and the mud snail *Peringia ulvae*".
686. On the basis that the habitats supporting the main food sources of knot do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no significant effect on the Humber Estuary SPA via air quality changes or hydrological linkage, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species of the non-breeding knot qualifying feature.

6.4.9.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.9.4.1 Disturbance / Displacement

687. On the basis that there is no potential for the Project alone to cause disturbance and displacement of the non-breeding knot qualifying feature of the SPA, there is subsequently considered to be no potential for the Project to cause disturbance and displacement in-combination with other projects.

6.4.9.4.2 Long Term and Temporary Loss of Functionally Linked Land

688. On the basis that there is no potential for the Project alone to cause long term or temporary loss of FLL for the non-breeding knot qualifying feature of the SPA, there is subsequently considered to be no potential for the Project to cause loss of FLL in-combination with other projects.

6.4.9.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

689. On the basis that the habitats supporting the main food sources of non-breeding knot do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no cumulative significant effect from the Project and other projects on the Humber Estuary SPA via air quality changes or hydrological linkage, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other projects.

6.4.10 Marsh harrier (breeding)

6.4.10.1 Status

690. Natural England (2023a) reports that the breeding marsh harrier population has a ‘maintain’ conservation objective owing to overall stability, although the site has hosted higher numbers historically (30 confirmed pairs in 2012). The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients.

6.4.10.2 Connectivity

691. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the breeding marsh harrier qualifying feature:

- Tidal reedbeds;
- Intertidal mixed sediments;
- Intertidal sand and muddy sand;
- Freshwater wetlands; and
- Inland areas of wet grassland, rough grassland and agricultural land (both arable land and permanent pasture).

692. The latter habitat is found within the potential FLL area of the Onshore Development Area. Marsh harrier is cited in Natural England’s (2023b) Annex B list as a species known to use off-site supporting habitat or FLL in the non-breeding season. Marsh harrier has been recorded once in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**) but this involved a flight-only sighting outside of the breeding season. Surveys for the wider Dogger Bank South onshore survey area identified and confirmed breeding by marsh harrier approximately 15km north of the SPA boundary in the River Hull catchment. The assessment of the breeding attempts for the Dogger Bank South project, concerning two nests and females sired by one male, considered the breeding birds not to be functionally linked to the SPA breeding population on the basis of “*distance and [breeding birds] typical home ranges.*” In support of this conclusion, the status of marsh harrier as a breeding feature of the SPA denotes that protection is afforded by SPA policy to pairs nesting within the SPA boundary only. Furthermore, breeding marsh harrier are indicated to generally forage less than 10km from their nest (Cardador & Mañosa, 2011; Hardey *et al.*, 2013) and as the breeding population is increasing in Yorkshire (Dobbs, 2022), competition is expected to lead some individuals to establish sub-optimal territories outside of prime breeding habitat (Hinde, 1956) with little or no range overlap with protected areas.

6.4.10.3 Assessment of Potential Effects of the Project Alone

6.4.10.3.1 Disturbance / Displacement

693. The Project has no pathway to cause direct disturbance impact to birds present within the SPA. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the SPA is via disturbance and displacement of birds present in FLL of the SPA. The ZoI for disturbance of SPA birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (**Appendix A.1 Dogger Bank D HRA Consultation Responses**).

694. Breeding marsh harrier of the Humber Estuary SPA are assessed to have potentially high sensitivity to visual disturbance, although the confidence of this assessment is reported as low (Natural England, 2024a). Fulfilment of the conservation objectives of marsh harrier in the SPA includes a target to “*reduce the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed [in the breeding season]*” (Natural England, 2023a). ‘Significant’ disturbance is defined by the AEWA (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*

- changed local distribution on a continuing basis; and/or
- changed local abundance on a sustained basis; and/or

- the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
695. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.
696. Construction – It is not likely that disturbance from the project alone will be significant during construction, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by marsh harrier for roosting, foraging, feeding, moulting and/or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by marsh harrier, the nature and regularity of use of the land will be outlined and used in assessment for the ES.
697. Construction disturbance from the Project alone is not likely to cause a changed local distribution of marsh harrier on a continuing basis as this would require: a) birds to be regularly present within the ZOI for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of marsh harrier in the potential FLL area in the breeding season in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by marsh harrier or has any importance to the population.
698. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as marsh harrier are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area in the breeding season (or present irregularly or infrequently) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
699. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the SPA may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale. With regard to the conservation objectives of the marsh harrier feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the marsh harrier feature will be maintained in the long term.
700. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the marsh harrier feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the marsh harrier feature will be maintained in the long term.
701. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the marsh harrier feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the decommissioning phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the marsh harrier feature will be maintained in the long term.
- 6.4.10.3.2 Long Term and Temporary Loss of Functionally Linked Land
702. Fulfilment of the conservation objectives of marsh harrier in the SPA includes a target to “*maintain the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of its breeding cycle (courtship, nesting, feeding) at current level,*” on a year-round basis.

703. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any SPA birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.
704. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of adult or breeding marsh harrier in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by marsh harrier or has any importance to the population in supporting necessary stages of the breeding cycle. With regard to the conservation objectives of the marsh harrier feature of the Humber Estuary SPA in relation to loss of Functionally Linked Land from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the marsh harrier feature will be maintained in the long term.

6.4.10.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

705. Fulfilment of the conservation objectives of hen harrier in the SPA includes a target to “*maintain the distribution, abundance and availability of key food and prey items at preferred sizes*” on a year-round basis.
706. Natural England (2023a) reports that main food sources of marsh harrier in the SPA are found within freshwater marsh and reedbed, and include birds of size range “pipit to duck size,” and mammals of size range, “mice/vole to rabbit.” The cited habitats are rare or absent from the potential FLL area. The cited prey species are likely to be found in agricultural land of the type found within the potential FLL area – but which is also widely available throughout the landscape including in closer proximity to the SPA.

707. In absence of any records of breeding or adult marsh harrier in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by marsh harrier or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential marsh harrier habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key marsh harrier food and prey items at preferred sizes. With regard to the conservation objectives of the marsh harrier feature of the Humber Estuary SPA in relation to impacts via habitats and prey from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the marsh harrier feature will be maintained in the long term.

6.4.10.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.10.4.1 Disturbance / Displacement

708. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to marsh harrier of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the breeding period, and there are no records of breeding or adult marsh harrier occurring in the potential FLL area in the desk-study data.
709. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.4.10.4.2 Long Term and Temporary Loss of Functionally Linked Land

710. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for marsh harrier of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the breeding period, and there are no records of breeding or adult marsh harrier occurring in the potential FLL area in the desk-study data.
711. Subsequently, there is no potential for the Project to cause loss of FLL, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the extent of supporting habitat, in-combination with other plans and projects.

6.4.10.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

712. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of marsh harrier of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the breeding period, and there are no records of breeding or adult marsh harrier occurring in the potential FLL area in the desk-study data.
713. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.4.11 Redshank (non-breeding)

6.4.11.1 Status

714. Natural England (2023a) reports that since classification there has been steady decline in the redshank population, both in winter and passage populations. The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) states that population trends for the species in the SPA relative to regional and national trends indicate that site-specific pressures are likely to be drivers of the species' decline in the SPA.

6.4.11.1.1 Connectivity

715. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the non-breeding redshank qualifying feature:
- Intertidal sand and mudflats;
 - Coastal lagoons;
 - Saltmarsh;
 - Inland areas of wet grassland and agricultural land (both arable land and permanent pasture);

- Supralittoral sand and shingle; and
- Artificial structures such as derelict pier/jetty structures, flood defences.

716. The agricultural habitat is found within the potential FLL area of the Onshore Development Area. Redshank is cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Redshank has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Redshank was not recorded in onshore habitats of the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) with all records from these surveys occurring in intertidal habitats (see **Section 3.1** in **PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**).

6.4.11.2 Assessment of Potential Effects of the Project Alone

6.4.11.2.1 Disturbance / Displacement

717. The Project has no pathway to cause direct disturbance impact to birds present within the SPA. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the SPA is via disturbance and displacement of birds present in FLL of the SPA. The ZoI for disturbance of SPA birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **Appendix A.1 Dogger Bank D HRA Consultation Responses**).
718. Redshank of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). Fulfilment of the conservation objectives of redshank in the SPA includes a target to “*reduce the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed [in the non-breeding season]*” (Natural England, 2023a). ‘Significant’ disturbance is defined by the AEWA (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
719. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.

720. Construction – It is not likely that disturbance from the project alone will be significant during construction, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by redshank for roosting, foraging, feeding, moulting and/or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by redshank, the nature and regularity of use of the land will be outlined and used in assessment for the ES.
721. Construction disturbance from the Project alone is not likely to cause a changed local distribution of redshank on a continuing basis as this would require: a) birds to be regularly present within the ZoI for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of redshank in similar habitat in desk-based data or surveys to date (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by redshank or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded redshank on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
722. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as redshank are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
723. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the SPA may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale. With regard to the conservation objectives of the redshank feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the redshank feature will be maintained in the long term.
724. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the redshank feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the redshank feature will be maintained in the long term.
725. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the redshank feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the decommissioning phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the redshank feature will be maintained in the long term.
- 6.4.11.2.2 Long Term and Temporary Loss of Functionally Linked Land
726. Fulfilment of the conservation objectives of redshank in the SPA includes a target to “*restore the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) to an unspecified extent,*” on a year-round basis.

727. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any SPA birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.

728. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of redshank in similar habitat in desk-based data or surveys to date (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by redshank or has any importance to the population in supporting necessary stages of the non-breeding / wintering period (moulting, roosting, loafing, feeding). With regard to the conservation objectives of the redshank feature of the Humber Estuary SPA in relation to loss of Functionally Linked Land from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the redshank feature will be maintained in the long term.

6.4.11.2.3 Indirect Impacts Through Effects on Habitats and Prey Species

729. Fulfilment of the conservation objectives of redshank in the SPA includes a target to “*maintain the distribution, abundance and availability of key food and prey items at preferred sizes*” on a year-round basis.

730. Natural England (2023a) reports that main food sources of redshank are found in intertidal substrates, lagoons and wet/marshy grassland. Important prey species include “*Peringia ulvae*, *Macoma balthica*, *Corophium spp.* and *Nereis spp.* in intertidal feeding areas and earthworm, leatherjacket and other grassland/marsh invertebrates in terrestrial feeding areas.”

731. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of redshank in similar habitat in desk-based data or surveys to date (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by redshank or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential redshank habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key redshank food and prey items at preferred sizes. With regard to the conservation objectives of the redshank feature of the Humber Estuary SPA in relation to impacts via habitats and prey from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the redshank feature will be maintained in the long term.

6.4.11.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.11.3.1 Disturbance / Displacement

732. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to redshank of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of redshank occurring in the potential FLL area or similar habitat in the desk-study data.

733. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.4.11.3.2 Long Term and Temporary Loss of Functionally Linked Land

734. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for redshank of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of redshank occurring in the potential FLL area or similar habitat in the desk-study data.

735. Subsequently, there is no potential for the Project to cause loss of FLL, or act in opposition to the Conservation Objectives of the SPA or the specific target to restore the extent of supporting habitat, in-combination with other plans and projects.

6.4.11.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

736. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of redshank of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the non-breeding period, and there are no records of redshank occurring in the potential FLL area or similar habitat in the desk-study data.
737. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.4.12 Ruff (non-breeding)

6.4.12.1 Status

738. Natural England (2023a) reports that since classification there has been a decline of over 50% in the ruff population. The extent of supporting intertidal habitat has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients.

6.4.12.2 Connectivity

739. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the non-breeding ruff qualifying feature:
- Intertidal sand and mudflats;
 - Coastal lagoons;
 - Saltmarsh; and
 - Inland areas of wet grassland and agricultural land (both arable land and permanent pasture).

740. The latter habitat is found within the potential FLL area of the Onshore Development Area. Ruff is cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Ruff has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific surveys to date (**Section 6.4.2**). Ruff was recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.4.12.3 Assessment of Potential Effects of the Project Alone

6.4.12.3.1 Disturbance / Displacement

741. The Project has no pathway to cause direct disturbance impact to birds present within the SPA. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the SPA is via disturbance and displacement of birds present in FLL of the SPA. The ZOI for disturbance of SPA birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **Appendix A.1 Dogger Bank D HRA Consultation Responses**).
742. Ruff of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). Fulfilment of the conservation objectives of ruff in the SPA includes a target to “*reduce the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed [in the non-breeding season]*” (Natural England, 2023a). ‘Significant’ disturbance is defined by the AEWA (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
743. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.

744. Construction – It is not likely that disturbance from the project alone will be significant during construction, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by ruff for roosting, foraging, feeding, moulting and / or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by ruff, the nature and regularity of use of the land will be outlined and used in assessment for the ES.
745. Construction disturbance from the Project alone is not likely to cause a changed local distribution of ruff on a continuing basis as this would require: a) birds to be regularly present within the Zol for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5 km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of ruff in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by ruff or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded ruff on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
746. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as ruff are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
747. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the SPA may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale. With regard to the conservation objectives of the ruff feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the ruff feature will be maintained in the long term.
748. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the ruff feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the ruff feature will be maintained in the long term.
749. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the ruff feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the decommissioning phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the ruff feature will be maintained in the long term.
- 6.4.12.3.2 Long Term and Temporary Loss of Functionally Linked Land
750. Fulfilment of the conservation objectives of ruff in the SPA includes a target to “*restore the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) to an unspecified extent,*” on a year-round basis.

751. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any SPA birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.

752. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of ruff in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by ruff or has any importance to the population in supporting necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding). With regard to the conservation objectives of the ruff feature of the Humber Estuary SPA in relation to loss of Functionally Linked Land from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the ruff feature will be maintained in the long term.

6.4.12.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

753. Fulfilment of the conservation objectives of ruff in the SPA includes a target to “*maintain the distribution, abundance and availability of key food and prey items at preferred sizes*” on a year-round basis.

754. Natural England (2023a) reports that main food sources of ruff are found in intertidal substrates, lagoons and wet/marshy grassland. Important prey species include “*crustaceans, molluscs and worms in intertidal feeding areas and dipteran flies, beetles and earthworms in terrestrial feeding areas.*”

755. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of ruff in the potential FLL area in desk-based data or surveys to date (**Section 6.4.2**) it is unlikely the potential FLL area is used by ruff or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential ruff habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key ruff food and prey items at preferred sizes. With regard to the conservation objectives of the ruff feature of the Humber Estuary SPA in relation to impacts via habitats and prey from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the ruff feature will be maintained in the long term.

6.4.12.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.12.4.1 Disturbance / Displacement

756. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to ruff of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of ruff occurring in the potential FLL area in the desk-study data.

757. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.4.12.4.2 Long Term and Temporary Loss of Functionally Linked Land

758. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for ruff of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no records of ruff occurring in the potential FLL area in the desk-study data.

759. Subsequently, there is no potential for the Project to cause loss of FLL, or act in opposition to the Conservation Objectives of the SPA or the specific target to restore the extent of supporting habitat, in-combination with other plans and projects.

6.4.12.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

760. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of ruff of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the non-breeding period, and there are no records of ruff occurring in the potential FLL area in the desk-study data.

761. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.4.13 Shelduck (non-breeding)

6.4.13.1 Status

762. Natural England (2023a) reports that since classification the shelduck population has fluctuated but shown overall stability. The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and / or currently un-impacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) states that SPA population as a proportion of regional population indicates that environmental conditions remain relatively favourable and that the SPA is increasingly important for the species regionally.

6.4.13.2 Connectivity

763. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the SPA which is defined by Natural England as potential functionally linked land of the SPA. Natural England (2023a) reports that the following habitats of the SPA support the non-breeding shelduck qualifying feature:
- Intertidal sand and mudflats;
 - Coastal lagoons; and
 - Saltmarsh.
764. These habitats are not found within the potential FLL area of the Onshore Development Area. The same report refers to use of inland areas of wet grassland and agricultural land (both arable land and permanent pasture) for foraging, and this habitat is found within the potential FLL area of the Onshore Development Area. Shelduck is cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Shelduck has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific surveys to date (**Section 6.4.2**). Shelduck was recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) as a flyover species only (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.4.13.3 Assessment of Potential Effects of the Project Alone

6.4.13.3.1 Disturbance / Displacement

765. The Project has no pathway to cause direct disturbance impact to birds present within the SPA. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the SPA is via disturbance and displacement of birds present in FLL of the SPA. The ZoI for disturbance of SPA birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **Appendix A.1 Dogger Bank D HRA Consultation Responses**).
766. Shelduck of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). Fulfilment of the conservation objectives of shelduck in the SPA includes a target to “*reduce the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed [in the non-breeding season]*” (Natural England, 2023a). ‘Significant’ disturbance is defined by the AEWA (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
767. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.
768. Construction – It is not likely that disturbance from the project alone will be significant during construction, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by shelduck for roosting, foraging, feeding, moulting and/or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by shelduck, the nature and regularity of use of the land will be outlined and used in assessment for the ES.

769. Construction disturbance from the Project alone is not likely to cause a changed local distribution of shelduck on a continuing basis as this would require: a) birds to be regularly present within the Zol for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of shelduck in similar habitat in desk-based data or surveys to date (see **Section 23.6.3.4.10 in PEIR Volume 1 Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by shelduck or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded shelduck on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
770. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as shelduck are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
771. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the SPA may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale. With regard to the conservation objectives of the shelduck feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the shelduck feature will be maintained in the long term.
772. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the shelduck feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the shelduck feature will be maintained in the long term.
773. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the shelduck feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the decommissioning phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the shelduck feature will be maintained in the long term.
- 6.4.13.3.2 Long Term and Temporary Loss of Functionally Linked Land
774. Fulfilment of the conservation objectives of shelduck in the SPA includes a target to “restore the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) to an unspecified extent,” on a year-round basis.

775. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any SPA birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.
776. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of shelduck in similar habitat in desk-based data or surveys to date (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by shelduck or has any importance to the population in supporting necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding). With regard to the conservation objectives of the shelduck feature of the Humber Estuary SPA in relation to loss of Functionally Linked Land from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the shelduck feature will be maintained in the long term.

6.4.13.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

777. Fulfilment of the conservation objectives of shelduck in the SPA includes a target to “*maintain the distribution, abundance and availability of key food and prey items at preferred sizes*” on a year-round basis.
778. Natural England (2023a) reports that main food sources of shelduck are found in lagoons and the intertidal zone. Important prey species are primarily *Hydrobia* (*Peringia ulvae*), plus *Nereis* and *Corophium* species. The above target of maintaining the food resource also relates explicitly to inland or terrestrial areas.

779. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of shelduck in similar habitat in desk-based data or surveys to date (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by shelduck or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential shelduck terrestrial habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key shelduck food and prey items at preferred sizes. With regard to the conservation objectives of the shelduck feature of the Humber Estuary SPA in relation to impacts via habitats and prey from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the shelduck feature will be maintained in the long term.

6.4.13.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.13.4.1 Disturbance / Displacement

780. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to shelduck of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no non-flyover records of shelduck occurring in the potential FLL area or similar habitat in the desk-study data.
781. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.4.13.4.2 Long Term and Temporary Loss of Functionally Linked Land

782. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for shelduck of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the non-breeding period, and there are no non-flyover records of shelduck occurring in the potential FLL area or similar habitat in the desk-study data.
783. Subsequently, there is no potential for the Project to cause loss of FLL, or act in opposition to the Conservation Objectives of the SPA or the specific target to restore the extent of supporting habitat, in-combination with other plans and projects.

6.4.13.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

784. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of shelduck of the SPA. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the non-breeding period, and there are no records of shelduck occurring in the potential FLL area or similar habitat in the desk-study data.
785. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.4.14 Waterbird Assemblage (non-breeding)

6.4.14.1 Status

786. The overall size of the assemblage is reported to have a 'restore' conservation objective as it has undergone an overall decline in numbers since classification. Species site trends in comparison to national and regional trends suggest that SPA populations of redshank, wigeon, ringed plover and lapwing (all termed as main contributors to the assemblage as defined by Natural England) are being driven by site-specific factors. The most recent site total in the BTO WeBS Report is 136,310 individual waterbirds (2018/19 to 2022/23). The diversity of the waterbird assemblage is not indicated to have changed and is subject to a 'maintain' conservation objective. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients.
787. Natural England (2023b) Annex B guidance advises that species which should be considered in assessment as main components of the SPA assemblage are:
- a) Species listed individually under the assemblage feature on the SPA citation: Avocet, bar-tailed godwit, bittern, black-tailed godwit, brent goose, curlew, dunlin, golden plover, goldeneye, greenshank, grey plover, knot, lapwing, mallard, oystercatcher, pochard, redshank, ringed plover, ruff, sanderling, scaup, shelduck, teal, turnstone, whimbrel, and wigeon.

- b) Species which are not listed on the SPA citation but occur at site levels of more than 1% of national population (Woodward *et al.*, 2020) according to most recent BTO WeBS five-year average count (2018/19 to 2022/23): Common crane, green sandpiper, greylag goose, little egret, pink-footed goose and shoveler.
- c) Species which are not listed on the SPA citation but occur at site levels exceeding 2000 individuals according to the most recent BTO WeBS count (2022/23).

6.4.14.2 Connectivity

788. A 3.5km stretch of the onshore ECC (the southernmost corridor between Bentley and Creyke Beck Substation, and from Creyke Beck Substation up the east side of Birkhill Wood) and the south corner of OCS Zone 8 lie within 10km of the SPA, which is defined by Natural England as potential functionally linked land of the SPA. There is preliminary indication that there is no frequent or even repeated use of the land in or within 300m of the Onshore Development Area that is within 10km of the SPA boundary by components of the waterbird assemblage in numbers which would be significant relative to SPA population (>1%). Site-specific transect and vantage point surveys are ongoing to assess the nature, frequency and regularity of use of the land by greylag geese and other waterbird assemblage species.

6.4.14.3 Assessment of Potential Effects of the Project Alone

6.4.14.3.1 Disturbance / Displacement

789. The Project has no pathway to cause direct disturbance impact to birds present within the SPA. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the SPA is via disturbance and displacement of birds present in FLL of the SPA. The ZoI for disturbance of SPA birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **Appendix A.1 Dogger Bank D HRA Consultation Responses**).
790. Waterbirds of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). Fulfilment of the conservation objectives of the waterbird assemblage in the SPA includes a target to “*reduce the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed [in the non-breeding season]*” (Natural England, 2023a). ‘Significant’ disturbance is defined by the AEWA (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or

- the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
791. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the assemblage.
792. Construction – It is not likely that disturbance from the project alone will be significant during construction, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the SPA waterbird assemblage.
793. Construction disturbance from the Project alone is not likely to cause a changed local distribution of the waterbird assemblage on a continuing basis as this would require: a) birds to be regularly present within the Zol for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds. and c) for the displacement effect to be long-term. To address point a), The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. Similarly, the maximum proportion of the assemblage recorded in the potential FLL area across desk-study data and site-specific surveys to date is 0.05%. It is unlikely the potential FLL area has any importance to the SPA assemblage, and therefore it does not form part of the assemblage’s existing distribution. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if assemblage waterbirds are present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, desk-study data has recorded an assemblage species (greylag goose) using the land in significant numbers (relative to SPA population size) only once despite regular transect surveys and volunteer survey effort in the area, and this comprised a minute proportion (0.05%) of the assemblage total individuals. Species associated with the SPA assemblage are not confirmed to regularly use FLL in vicinity of these proposed activities, and site-specific transect and vantage point surveys to assess the nature and regularity of use of land are on-going to inform assessment for the ES.
794. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as assemblage waterbirds are not confirmed to be regularly present in the FLL area or in significant numbers. They would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
795. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the SPA may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is indicated from desk-study data to be an extremely small proportion of the assemblage total and irregularly occurring, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale. With regard to the conservation objectives of the waterbird assemblage of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the size of the waterbird assemblage will be maintained in the long term.
796. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the waterbird assemblage of the Humber Estuary SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the size of the waterbird assemblage will be maintained in the long term.
797. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. With regard to the conservation objectives of the waterbird assemblage of the Humber Estuary SPA in relation to disturbance and displacement effects in the decommissioning phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the size of the waterbird assemblage will be maintained in the long term.
- 6.4.14.3.2 Long Term and Temporary Loss of Functionally Linked Land
798. Fulfilment of the conservation objectives of the waterbird assemblage in the SPA includes targets to “*restore the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) to an unspecified extent,*” and “*maintain the structure, function and availability of [specific] habitats [including inland areas of wet grassland, rough grassland and agricultural land] which support the assemblage feature for all stages (moulting, roosting, loafing, feeding) of the non-breeding period,*” on a year-round basis.

799. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any SPA birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.

800. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. The maximum proportion of the assemblage recorded in the potential FLL area across desk-study data and site-specific surveys to date is 0.05%. It is unlikely the potential FLL area has any importance to the SPA assemblage in supporting necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding). With regard to the conservation objectives of the waterbird assemblage of the Humber Estuary SPA in relation to loss of Functionally Linked Land from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the size of the waterbird assemblage will be maintained in the long term.

6.4.14.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

801. Fulfilment of the conservation objectives of the waterbird assemblage in the SPA includes a target to “*maintain the structure, function and availability of [specific] habitats which support the assemblage feature for all stages (moulting, roosting, loafing, feeding) of the non-breeding period,*” on a year-round basis.

802. The water column supporting habitat of the Humber Estuary SPA has high sensitivity to nutrient enrichment while other habitats are not sensitive to nutrient enrichment. Some habitats of the Humber Estuary (intertidal mud and intertidal sand/muddy sand) have low to medium sensitivity to introduction of hydrocarbons, PAH and other substances (solid, liquid, gas) while the remainder are classed as not sensitive.

803. On the basis of assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** which conclude there is no significant effect on the Humber Estuary SPA via air quality changes or hydrological linkage, there is no potential for the Project to impact supporting habitats of foraging birds and their food and prey resources within the SPA boundary during construction, operation and maintenance or decommissioning of the Project.

804. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. The maximum proportion of the assemblage recorded in the potential FLL area across desk-study data and site-specific surveys to date is 0.05%, and the activity undertaken by assemblage birds in that instance is unknown. It is unconfirmed but unlikely the potential FLL area has any importance to the SPA assemblage in providing habitat or prey resources. Therefore, any alteration to structure or availability of the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the structure, function and availability of habitats which support the assemblage feature for any stage (moulting, roosting, loafing, feeding) of the non-breeding period. With regard to the conservation objectives of the waterbird assemblage of the Humber Estuary SPA in relation to impacts via habitats and prey from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the size of the waterbird assemblage will be maintained in the long term.

6.4.14.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.4.14.4.1 Disturbance / Displacement

805. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to the waterbird assemblage of the SPA. This is on the basis that the potential FLL is unlikely to act as FLL or support the feature during any stage of the non-breeding period.

806. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the assemblage in the SPA in-combination with other plans and projects.

807. Site-specific transect and vantage point surveys to assess the nature and regularity of use of the potential FLL area by assemblage waterbirds are on-going. Should these surveys identify regular use of the potential FLL area which indicates a supporting habitat status, this will be detailed and considered in assessment for the ES.

6.4.14.4.2 Long Term and Temporary Loss of Functionally Linked Land

808. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for the waterbird assemblage of the SPA. This is on the basis that the potential FLL is unlikely to act as FLL or support the feature during any stage of the non-breeding period.

809. Subsequently, there is no potential for the Project to cause loss of FLL, or act in opposition to the Conservation Objectives of the SPA or the specific target to restore the extent of supporting habitat, in-combination with other plans and projects.
810. Site-specific transect and vantage point surveys to assess the nature and regularity of use of the potential FLL area by assemblage waterbirds are on-going. Should these surveys identify regular use of the potential FLL area which indicates a supporting habitat status, this will be detailed and considered in assessment for the ES.

6.4.14.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

811. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of waterbirds of the SPA. This is on the basis that the potential FLL is unlikely to act as FLL or support the feature during any stage of the non-breeding period.
812. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the structure, function and availability of supporting habitats, in-combination with other plans and projects.
813. Site-specific transect and vantage point surveys to assess the nature and regularity of use of the potential FLL area by assemblage waterbirds are on-going. Should these surveys identify regular use of the potential FLL area which indicates a supporting habitat status, this will be detailed and considered in assessment for the ES.

6.4.15 Summary of Potential Effects on Site Integrity

6.4.15.1 Construction

814. There is in summary no potential for the Project to have an AEoSI for the Humber Estuary SPA through disturbance and displacement, loss of FLL or indirect impacts on habitats or prey during construction, either alone or in-combination with other plans and projects.

6.4.15.2 Operation and Maintenance

815. There is in summary no potential for the Project to have an AEoSI for the Humber Estuary SPA through disturbance and displacement, loss of FLL or indirect impacts on habitats or prey during the operation and maintenance phase, either alone or in-combination with other plans and projects.

6.4.15.3 Decommissioning

816. There is in summary no potential for the Project to have an AEoSI for the Humber Estuary SPA through disturbance and displacement, loss of FLL or indirect impacts on habitats or prey during decommissioning, either alone or in-combination with other plans and projects.

6.5 Humber Estuary Ramsar

6.5.1 Site Description

817. The Humber Estuary Ramsar is located off the east coast of England and extends from the mouth of the river Humber to the limit of saline intrusion on the river Ouse and 2km south to the river Trent. The Humber Estuary Ramsar spatially overlaps the Humber Estuary SPA. The Humber Estuary Ramsar is characterised as a large macro-tidal coastal plain estuary which supports high suspended sediment loads. This dynamic system feeds a range of shifting habitat types including extensive reedbeds, mature and developing saltmarsh, grazing marsh and low sand dunes, marshy slacks and brackish pools. The Ramsar site boundary aligns with that of the Humber Estuary SPA.
818. The Humber Estuary Ramsar regularly supports internationally important populations of passage and wintering waterbirds.

6.5.1.1 Qualifying Features

819. The Humber Estuary Ramsar is designated due to the presence of various qualifying ornithological features:
- Contains the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons;
 - Assemblage of non-breeding waterfowl of international importance, 153,934 individuals (5 year peak mean 1996/97-2000/21);
 - Species/populations occurring at levels of international importance:
 - Bar-tailed godwit (wintering);
 - Black-tailed godwit (passage, wintering);
 - Dunlin (passage, wintering);
 - Golden plover (passage, wintering);
 - Knot (passage, wintering);
 - Redshank (passage, wintering); and

- Shelduck (wintering).

820. In addition, it supports the following, relevant, qualifying habitats:

- Estuarine waters; and
- Intertidal mud and sand flats.

6.5.1.2 Condition Assessment

821. As the Ramsar site boundary aligns with that of the Humber Estuary SPA, condition assessment remarks relating to the Humber Estuary SPA in Section 6.4.1.3 are also expected to be valid for the Ramsar site. Most recent land and water use within the Ramsar site boundary are nature conservation, tourism, recreation, scientific research, small-scale cutting of vegetation, fishing (commercial and recreational/sport), gathering of shellfish and bait collection, permanent pastoral agriculture, industrial water supply, industry, sewage treatment/disposal, harbour/port, flood control, oil/gas exploration, transport routes and military activities (JNCC 2008). Factors most recently reported as potentially affecting the ecological character of the site (JNCC 2008) are:

- Disturbance to (reedbed) vegetation through cutting or clearing;
- Vegetation succession (scrub encroachment on reedbed);
- Water diversion (abstraction for irrigation/domestic/industry) causing reduced freshwater input;
- Overfishing, notably substantial lamprey by-catch in eel nets;
- Domestic sewage and agricultural fertiliser pollution causing reduced dissolved oxygen in the river Ouse leading to a barrier for fish migration; and
- Recreational and tourism disturbance, particularly through illegal access by motorised recreational vehicles and craft.

6.5.2 Bar-tailed godwit (wintering)

6.5.2.1 Status

822. As reported by Natural England (2023a) for the SPA qualifying feature, there has been a recent decline in the bar-tailed godwit population, from a peak of 3,011 individuals in 2006/7 to 2010/11 to 1,395 individuals in 2013/14 to 2017/18. The extent of some supporting habitats (mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently unimpacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) states that population trends for the species in the SPA (and subsequently the Ramsar site) relative to regional and national trends indicate that site-specific pressures are likely to be drivers of the species' decline in the Ramsar site.

6.5.2.2 Connectivity

823. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the Ramsar boundary and constitute land defined by Natural England as potential functionally linked land of the SPA (and subsequently the Ramsar site). Key supporting habitats of bar-tailed godwit are not found within the potential FLL area of the Onshore Development Area. Bar-tailed godwit is not cited in Natural England's (2023b) Annex B list as a species known to use off-site supporting habitat or FLL in the non-breeding season. Bar-tailed godwit has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Bar-tailed godwit was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.5.2.3 Assessment of Potential Effects of the Project Alone

6.5.2.3.1 Disturbance / Displacement

824. On the basis that the main habitats outlined as supporting the non-breeding bar-tailed godwit as a SPA qualifying feature are not found within the potential FLL area, bar-tailed godwit are not known to make regular use of FLL off-site, and bar-tailed godwit has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause disturbance and displacement of the wintering bar-tailed godwit qualifying feature of the Ramsar site.

6.5.2.3.2 Long Term and Temporary Loss of Functionally Linked Land

825. On the basis that the main habitats outlined as supporting the non-breeding bar-tailed godwit qualifying feature are not found within the potential FLL area, bar-tailed godwit are not known to make regular use of FLL off-site, and bar-tailed godwit has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause long-term or temporary loss of FLL for the wintering bar-tailed godwit qualifying feature of the Ramsar site.

6.5.2.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

826. Natural England (2023a) reports that main food sources of bar-tailed godwit as a qualifying feature of the SPA are found within lagoons, with important prey species including *Arenicola marina* and *Nereis* spp.
827. On the basis that the habitats supporting the main food sources of bar-tailed godwit do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no significant effect on the Humber Estuary SAC, SPA or Ramsar site via air quality changes or hydrological linkage, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species of the wintering bar-tailed godwit qualifying feature.

6.5.2.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.5.2.4.1 Disturbance / Displacement

828. On the basis that there is no potential for the Project alone to cause disturbance and displacement of the wintering bar-tailed godwit qualifying feature of the Ramsar site, there is subsequently considered to be no potential for the Project to cause disturbance and displacement in-combination with other projects.

6.5.2.4.2 Long Term and Temporary Loss of Functionally Linked Land

829. On the basis that there is no potential for the Project alone to cause long term or temporary loss of FLL for the wintering bar-tailed godwit qualifying feature of the Ramsar site, there is subsequently considered to be no potential for the Project to cause loss of FLL in-combination with other projects.

6.5.2.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

830. On the basis that the habitats supporting the main food sources of bar-tailed godwit do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no cumulative significant effect from the Project and other projects on the Humber Estuary SAC, SPA or Ramsar site via air quality changes or hydrological linkage, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other projects.

6.5.3 Black-tailed godwit (passage, wintering)

6.5.3.1 Status

831. There has been a significant rise in the black-tailed godwit population since Ramsar site classification in 1994. As reported by Natural England (2023a) for the SPA qualifying feature, the extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and / or currently un-impacted by anthropogenic activities with regard to nutrients. BTO WeBS Alerts (Woodward *et al.*, 2019) reports that the SPA, regional and national population trends for this species indicate that the SPA's – and therefore Ramsar site's – environmental conditions remain relatively favourable for black-tailed godwit.

6.5.3.2 Connectivity

832. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the Ramsar boundary and constitute land defined by Natural England as potential functionally linked land of the SPA (and subsequently the Ramsar site). Key supporting habitats of black-tailed godwit (inland areas of wet grassland and agricultural land) are found within the potential FLL area of the Onshore Development Area. Black-tailed godwit is cited in Natural England's (2023b) Annex B list of SPA assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Black-tailed godwit has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Black-tailed godwit was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.5.3.3 Assessment of Potential Effects of the Project Alone

6.5.3.3.1 Disturbance / Displacement

833. The Project has no pathway to cause direct disturbance impact to birds present within the Ramsar site. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the Ramsar site is via disturbance and displacement of birds originating from the Ramsar site and SPA, present in FLL. The Zol for disturbance of birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **PEIR Volume 2, Appendix 23.1 Consultation Responses for Onshore Ecology and Ornithology**).
834. Black-tailed godwit as a feature of the SPA (and subsequently the Ramsar site) have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). ‘Significant’ disturbance is defined by AEWA (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
835. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.
836. Construction – It is not likely that disturbance from the project alone will be significant during construction. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by black-tailed godwit for roosting, foraging, feeding, moulting and / or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by black-tailed godwit, the nature and regularity of use of the land will be outlined and used in assessment for the ES.
837. Construction disturbance from the Project alone is not likely to cause a changed local distribution of black-tailed godwit on a continuing basis as this would require: a) birds to be regularly present within the Zol for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of black-tailed godwit in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by black-tailed godwit or has any importance to the population. A review of black-tailed godwit use of the Humber Estuary by Percival (2011) demonstrated the vast majority of roosting and feeding occurs within the SPA and Ramsar site boundary. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded black-tailed godwit on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
838. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as black-tailed godwit are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA and Ramsar site population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
839. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the Ramsar site may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale.

840. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during operation and maintenance.

841. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during decommissioning.

6.5.3.3.2 Long Term and Temporary Loss of Functionally Linked Land

842. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any Ramsar site birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.

843. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of black-tailed godwit in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by black-tailed godwit or has any importance to the population in supporting necessary stages of the passage or wintering period (moulting, roosting, loafing, feeding). On this basis, the Project alone has no potential to cause loss of FLL for the black-tailed godwit feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.3.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

844. Natural England (2023a) reports that main food sources of black-tailed godwit as a SPA qualifying feature are held within wet or marshy grassland, lagoons and the intertidal zone. Important prey species of black-tailed godwit are cited to include “*Macoma balthica*, *Cardium spp.* and *Nereis spp.* in intertidal feeding areas and earthworm, leatherjacket and chironomids in terrestrial feeding areas.”

845. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of black-tailed godwit in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by black-tailed godwit or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential black-tailed godwit habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key black-tailed godwit food and prey items at preferred sizes. The Project alone therefore has no potential to cause indirect impacts via habitat or prey on the black-tailed godwit feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.3.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.5.3.4.1 Disturbance / Displacement

846. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to black-tailed godwit of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the passage or wintering period, and there are no records of black-tailed godwit occurring in the potential FLL area or similar habitat in the desk-study data.

847. Subsequently, there is no potential for the Project to cause disturbance and displacement in-combination with other plans and projects.

6.5.3.4.2 Long Term and Temporary Loss of Functionally Linked Land

848. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for black-tailed godwit of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the passage or wintering period, and there are no records of black-tailed godwit occurring in the potential FLL area or similar habitat in the desk-study data.

849. Subsequently, there is no potential for the Project to cause loss of FLL in-combination with other plans and projects.

6.5.3.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

850. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of black-tailed godwit of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the passage or wintering period, and there are no records of black-tailed godwit occurring in the potential FLL area or similar habitat in the desk-study data.
851. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other plans and projects.

6.5.4 Dunlin (passage, wintering)

6.5.4.1 Status

852. There has been a decline of approximately 30% in the dunlin population since Ramsar classification in 1994. As reported by Natural England (2023a) for the SPA qualifying feature, the extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) suggests that the species' decline in the SPA and Ramsar site relates to broad-scale population trends.

6.5.4.2 Connectivity

853. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the Ramsar boundary and constitute land defined by Natural England as potential functionally linked land of the SPA. Key supporting habitats of dunlin (inland areas of wet grassland and agricultural land) are found within the potential FLL area of the Onshore Development Area. Dunlin is cited in Natural England's (2023b) Annex B list of SPA assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Dunlin has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Dunlin was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.5.4.3 Assessment of Potential Effects of the Project Alone

6.5.4.3.1 Disturbance / Displacement

854. The Project has no pathway to cause direct disturbance impact to birds present within the Ramsar site. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the Ramsar site is via disturbance and displacement of birds originating from the Ramsar site and SPA, present in FLL. The Zol for disturbance of birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **PEIR Volume 2, Appendix 23.1 Consultation Responses for Onshore Ecology and Ornithology**).
855. Dunlin as a feature of the SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). 'Significant' disturbance is defined by the AEWA (2016) as follows: "*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young."
856. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.
857. Construction – It is not likely that disturbance from the project alone will be significant during construction. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by dunlin for roosting, foraging, feeding, moulting and/or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by dunlin, the nature and regularity of use of the land will be outlined and used in assessment for the ES.

858. Construction disturbance from the Project alone is not likely to cause a changed local distribution of dunlin on a continuing basis as this would require: a) birds to be regularly present within the Zol for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of dunlin in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by dunlin or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded dunlin on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
859. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as dunlin are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA and Ramsar site population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
860. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the Ramsar site may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale.
861. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during operation and maintenance.
862. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during decommissioning.
- 6.5.4.3.2 Long Term and Temporary Loss of Functionally Linked Land
863. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any Ramsar site birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.
864. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of dunlin in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by dunlin or has any importance to the population in supporting necessary stages of the passage or wintering period (moulting, roosting, loafing, feeding). On this basis, the Project alone has no potential to cause loss of FLL for the dunlin feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.
- 6.5.4.3.3 Indirect Impacts Through Effects on Habitats and Prey Species
865. Natural England (2023a) reports that main food sources of dunlin include *Nereis spp*, *Macoma balthica*, *Peringia ulvae*, *Crangon spp* and *Carcinus spp* in intertidal feeding areas and grassland / marsh invertebrates in terrestrial feeding areas.

866. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of dunlin in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by dunlin or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential dunlin habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key dunlin food and prey items at preferred sizes. The Project alone therefore has no potential to cause indirect impacts via habitat or prey on the dunlin feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.4.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.5.4.4.1 Disturbance / Displacement

867. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to dunlin of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the passage or wintering period, and there are no records of dunlin occurring in the potential FLL area or similar habitat in the desk-study data.
868. Subsequently, there is no potential for the Project to cause disturbance and displacement in-combination with other plans and projects.

6.5.4.4.2 Long Term and Temporary Loss of Functionally Linked Land

869. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for dunlin of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the passage or wintering period, and there are no records of dunlin occurring in the potential FLL area or similar habitat in the desk-study data.
870. Subsequently, there is no potential for the Project to cause loss of FLL in-combination with other plans and projects.

6.5.4.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

871. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of dunlin of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the passage or wintering period, and there are no records of dunlin occurring in the potential FLL area or similar habitat in the desk-study data.
872. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other plans and projects.

6.5.5 Golden plover (passage, wintering)

6.5.5.1 Status

873. There has been an overall increase but more medium-term (c. 10 year) decline in the golden plover population since Ramsar site classification in 1994 (Woodward *et al.*, 2019). As reported by Natural England (2023a) for the SPA qualifying feature, the extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) suggests that the species' decline in the SPA and Ramsar site relates to broad-scale population trends.

6.5.5.2 Connectivity

874. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the Ramsar boundary and constitute land defined by Natural England as potential functionally linked land of the SPA. Key supporting habitats of golden plover (inland areas of wet grassland and agricultural land) are found within the potential FLL area of the Onshore Development Area. Natural England (2023a) report that golden plover as a SPA qualifying feature "primarily feed outside the SPA boundary on inland areas of wet grassland and agricultural land (both arable and permanent pasture)." Golden plover has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Golden plover was recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.5.5.3 Assessment of Potential Effects of the Project Alone

6.5.5.3.1 Disturbance / Displacement

875. The Project has no pathway to cause direct disturbance impact to birds present within the Ramsar site. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the Ramsar site is via disturbance and displacement of birds originating from the Ramsar site and SPA, present in FLL. The Zol for disturbance of birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **PEIR Volume 2, Appendix 23.1 Consultation Responses for Onshore Ecology and Ornithology**).
876. Golden plover as a qualifying feature of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). ‘Significant’ disturbance is defined by the AEWA (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young.”
877. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.
878. Construction – It is not likely that disturbance from the project alone will be significant during construction. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by golden plover for roosting, foraging, feeding, moulting and/or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by golden plover, the nature and regularity of use of the land will be outlined and used in assessment for the ES.
879. Construction disturbance from the Project alone is not likely to cause a changed local distribution of golden plover on a continuing basis as this would require: a) birds to be regularly present within the Zol for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of golden plover in the potential FLL area in desk-based data or surveys to December 2024 (**Section 6.4.2**) it is unlikely the potential FLL area is used by golden plover or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded golden plover in the potential FLL area on any visit in any season (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
880. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as golden plover are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA and Ramsar site population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
881. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the Ramsar site may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale.

882. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during operation and maintenance.
883. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during decommissioning.

6.5.5.3.2 Long Term and Temporary Loss of Functionally Linked Land

884. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any Ramsar site birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.
885. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of golden plover in the potential FLL area in desk-based data or surveys to December 2024 (**Section 6.4.2**) it is unlikely the potential FLL area is used by golden plover or has any importance to the population in supporting necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding). On this basis, the Project alone has no potential to cause loss of FLL for the golden plover feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.5.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

886. Natural England (2023a) reports that main food sources of golden plover include earthworm, leatherjackets, beetles and spiders, and that the species' SPA population's foraging ecology sees the majority of feeding undertaken "outside the SPA boundary on inland areas of wet grassland and agricultural land".

887. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of golden plover in the potential FLL area in desk-based data or surveys to December 2024 (**Section 6.4.2**) it is unlikely the potential FLL area is used by golden plover or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential golden plover habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key golden plover food and prey items at preferred sizes. The Project alone therefore has no potential to cause indirect impacts via habitat or prey on the golden plover feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.5.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.5.5.4.1 Disturbance / Displacement

888. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to golden plover of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the passage or wintering period, and there are no records of golden plover occurring in the potential FLL area in the desk-study data.
889. Subsequently, there is no potential for the Project to cause disturbance and displacement in-combination with other plans and projects.

6.5.5.4.2 Long Term and Temporary Loss of Functionally Linked Land

890. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for golden plover of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the passage or wintering period, and there are no records of golden plover occurring in the potential FLL area in the desk-study data.
891. Subsequently, there is no potential for the Project to cause loss of FLL in-combination with other plans and projects.

6.5.5.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

892. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of golden plover of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the passage or wintering period, and there are no records of golden plover occurring in the potential FLL area in the desk-study data.
893. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other plans and projects.

6.5.6 Knot (passage, wintering)

6.5.6.1 Status

894. Since Ramsar site classification in 1994 the population of knot has remained relatively stable. As reported by Natural England (2023a) for the SPA qualifying feature, the extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and / or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and / or currently un-impacted by anthropogenic activities with regard to nutrients.

6.5.6.2 Connectivity

895. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the Ramsar boundary and constitute land defined by Natural England as potential functionally linked land of the SPA. Key supporting habitats of knot are not found within the potential FLL area of the Onshore Development Area. Knot is not cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Knot has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Knot was not recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.5.6.3 Assessment of Potential Effects of the Project Alone

6.5.6.3.1 Disturbance / Displacement

896. On the basis that the main habitats outlined as supporting the non-breeding knot SPA qualifying feature are not found within the potential FLL area, knot are not known to make regular use of FLL off-site, and knot has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause disturbance and displacement of the passage and wintering knot qualifying feature of the Ramsar site.

6.5.6.3.2 Long Term and Temporary Loss of Functionally Linked Land

897. On the basis that the main habitats outlined as supporting the non-breeding knot SPA qualifying feature are not found within the potential FLL area, knot are not known to make regular use of FLL off-site, and knot has not been recorded in vicinity of the potential FLL area (**Section 6.4.2**), there is no potential for the Project to cause long-term or temporary loss of FLL for the passage and wintering knot qualifying feature of the Ramsar site.

6.5.6.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

898. Natural England (2023a) reports that main food sources of knot as a qualifying feature of the SPA are found in intertidal habitats and include "*Macoma balthica*, *Mytilus edulis* and *Cerastoderma edule* spat and the mud snail *Peringia ulvae*".
899. On the basis that the habitats supporting the main food sources of knot do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no significant effect on the Humber Estuary SAC, SPA and Ramsar site via air quality changes or hydrological linkage, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species of the passage and wintering knot qualifying feature of the Ramsar site.

6.5.6.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.5.6.4.1 Disturbance / Displacement

900. On the basis that there is no potential for the Project alone to cause disturbance and displacement of the passage and wintering knot qualifying feature of the Ramsar site, there is subsequently considered to be no potential for the Project to cause disturbance and displacement in-combination with other projects.

6.5.6.4.2 Long Term and Temporary Loss of Functionally Linked Land

901. On the basis that there is no potential for the Project alone to cause long term or temporary loss of FLL for the passage and wintering knot qualifying feature of the Ramsar site, there is subsequently considered to be no potential for the Project to cause loss of FLL in-combination with other projects.

6.5.6.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

902. On the basis that the habitats supporting the main food sources of knot do not occur within the potential FLL area, and assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** conclude there is no cumulative significant effect from the Project and other projects on the Humber Estuary SAC, SPA and Ramsar site via air quality changes or hydrological linkage, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other projects.

6.5.7 Redshank (passage, wintering)

6.5.7.1 Status

903. Since Ramsar site classification there has been steady decline in the redshank population, both in winter and passage populations (Natural England, 2023a). The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) states that population trends for the species in the SPA relative to regional and national trends indicate that site-specific pressures are likely to be drivers of the species' decline in the SPA and Ramsar site.

6.5.7.2 Connectivity

904. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the Ramsar boundary and constitute land defined by Natural England as potential functionally linked land of the SPA. Key supporting habitats of redshank (inland areas of wet grassland and agricultural land) are found within the potential FLL area of the Onshore Development Area. Redshank is cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Redshank has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Redshank was not recorded in onshore habitats of the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) (see **Section 23.6.3.4.10** in **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) with all records from these surveys occurring in intertidal habitats (see **Section 3.1** in **PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**).

6.5.7.3 Assessment of Potential Effects of the Project Alone

905. Disturbance / Displacement

906. The Project has no pathway to cause direct disturbance impact to birds present within the Ramsar site. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the Ramsar site is via disturbance and displacement of birds originating from the SPA and Ramsar site, present in FLL. The Zol for disturbance of birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **PEIR Volume 2, Appendix 23.1 Consultation Responses for Onshore Ecology and Ornithology**).

907. Redshank as a qualifying feature of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). 'Significant' disturbance is defined by the AEWA (2016) as follows: "*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*

- changed local distribution on a continuing basis; and/or
- changed local abundance on a sustained basis; and/or
- the reduction of ability of any significant group of birds to survive, breed, or rear their young."

908. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.

909. Construction – It is not likely that disturbance from the project alone will be significant during construction. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by redshank for roosting, foraging, feeding, moulting and/or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by redshank, the nature and regularity of use of the land will be outlined and used in assessment for the ES.
910. Construction disturbance from the Project alone is not likely to cause a changed local distribution of redshank on a continuing basis as this would require: a) birds to be regularly present within the ZOI for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of redshank in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by redshank or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded redshank on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
911. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as redshank are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA and Ramsar population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
912. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the Ramsar site may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale.
913. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during operation and maintenance.
914. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during decommissioning.
- 6.5.7.3.1 Long Term and Temporary Loss of Functionally Linked Land
915. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any Ramsar site birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.
916. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of redshank in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by redshank or has any importance to the population in supporting necessary stages of the passage or wintering period (moulting, roosting, loafing, feeding). On this basis, the Project alone has no potential to cause loss of FLL for the redshank feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.7.3.2 Indirect Impacts Through Effects on Habitats and Prey Species

917. Natural England (2023a) reports that main food sources of redshank are found in intertidal substrates, lagoons and wet/marshy grassland. Important prey species include “*Peringia ulvae*, *Macoma balthica*, *Corophium spp.* and *Nereis spp.* in intertidal feeding areas and earthworm, leatherjacket and other grassland/marsh invertebrates in terrestrial feeding areas.”
918. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of redshank in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by redshank or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential redshank habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key redshank food and prey items at preferred sizes. The Project therefore has no potential to cause indirect impacts via habitat or prey on the redshank feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.7.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.5.7.4.1 Disturbance / Displacement

919. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to redshank of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the passage or wintering period, and there are no records of redshank occurring in the potential FLL area or similar habitat in the desk-study data.
920. Subsequently, there is no potential for the Project to cause disturbance and displacement in-combination with other plans and projects.

6.5.7.4.2 Long Term and Temporary Loss of Functionally Linked Land

921. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for redshank of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the passage or wintering period, and there are no records of redshank occurring in the potential FLL area or similar habitat in the desk-study data.
922. Subsequently, there is no potential for the Project to cause loss of FLL in-combination with other plans and projects.

6.5.7.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

923. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of redshank of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the passage or wintering period, and there are no records of redshank occurring in the potential FLL area or similar habitat in the desk-study data.
924. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other plans and projects.

6.5.8 Shelduck (wintering)

6.5.8.1 Status

925. Since Ramsar site classification the shelduck population has fluctuated but shown overall stability (Natural England, 2023a). The extent of some supporting habitats (Humber Estuary SAC mudflat and sand flat, Atlantic saltmeadow) has reduced. The supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to nutrients. The BTO WeBS Alerts for the Humber Estuary SPA (Woodward *et al.*, 2019) states that SPA population as a proportion of regional population indicates that environmental conditions remain relatively favourable and that the SPA and Ramsar site is increasingly important for the species regionally.

6.5.8.2 Connectivity

926. A 3.5km stretch of the onshore ECC and part of OCS Zone 8 lie within 10km of the Ramsar boundary and constitute land defined by Natural England as potential functionally linked land of the SPA. Shelduck use inland areas of wet grassland and agricultural land (both arable land and permanent pasture) for foraging, and this habitat is found within the potential FLL area of the Onshore Development Area. Shelduck is cited in Natural England's (2023b) Annex B list of waterbird assemblage components as a species known to use off-site supporting habitat or FLL in the non-breeding season. Shelduck has not been recorded in vicinity of the potential FLL area across desk-based data sources or site-specific survey data to date (**Section 6.4.2**). Shelduck was recorded in the wider Dogger Bank South survey area (which overlies a similar area and comprises a similar habitat composition to the Dogger Bank D Onshore Development Area) as a flyover species only (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**).

6.5.8.3 Assessment of Potential Effects of the Project Alone

6.5.8.3.1 Disturbance / Displacement

927. The Project has no pathway to cause direct disturbance impact to birds present within the Ramsar site. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the Ramsar site is via disturbance and displacement of birds originating from the SPA and Ramsar site, present in FLL. The ZoI for disturbance of birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **PEIR Volume 2, Appendix 23.1 Consultation Responses for Onshore Ecology and Ornithology**).
928. Shelduck as a qualifying feature of the Humber Estuary SPA have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). 'Significant' disturbance is defined by the AEWA (2016) as follows: "*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either:*
- changed local distribution on a continuing basis; and/or
 - changed local abundance on a sustained basis; and/or
 - the reduction of ability of any significant group of birds to survive, breed, or rear their young."
929. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the population.

930. Construction – It is not likely that disturbance from the project alone will be significant during construction. No field, land parcel, or water body within the potential FLL area is known from desk study data or site-specific surveys to date to be used by shelduck for roosting, foraging, feeding, moulting and/or loafing. Should site-specific transect and vantage point surveys identify use of FLL in or within 300m of the Onshore Development Area by shelduck, the nature and regularity of use of the land will be outlined and used in assessment for the ES.
931. Construction disturbance from the Project alone is not likely to cause a changed local distribution of shelduck on a continuing basis as this would require: a) birds to be regularly present within the ZoI for disturbance and displacement under baseline conditions, and b) the Project to subsequently displace these birds, and c) for the displacement effect to be long-term. To address point a), the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of shelduck in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by shelduck or has any importance to the population. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if the species is present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, surveys to December 2024 and existing survey data from Dogger Bank South baseline characterisation and BTO Birdtrack have not recorded shelduck on any visit in any season (**Section 6.4.2**), therefore the species is indicated not to use FLL in vicinity of these proposed activities.
932. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as shelduck are indicated from desk-study data and site-specific surveys to date to not be present in the FLL area (or present irregularly or infrequently, with numbers unlikely to approach 1% of the SPA and Ramsar site population) (**Section 6.4.2**) and so would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.

933. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the Ramsar site may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is likely to be zero or a very small number of irregularly occurring birds, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale.
934. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during operation and maintenance.
935. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during decommissioning.

6.5.8.3.2 Long Term and Temporary Loss of Functionally Linked Land

936. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any Ramsar site birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.
937. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. In absence of any records of shelduck in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by shelduck or has any importance to the population in supporting necessary stages of the wintering period (moulting, roosting, loafing, feeding). On this basis, the Project alone has no potential to cause loss of FLL for the shelduck feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.8.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

938. Natural England (2023a) reports that main food sources of shelduck are found in lagoons and the intertidal zone. Important prey species are primarily *Hydrobia* (*Peringia ulvae*), plus *Nereis* and *Corophium* species. The above target of maintaining the food resource also relates explicitly to inland or terrestrial areas.
939. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA and in closer proximity to the SPA. In absence of any records of shelduck in similar habitat in desk-based data or surveys to December 2024 (see **Section 23.6.3.4.10 in PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**) it is unlikely the potential FLL area is used by shelduck or has any importance to the population in providing habitat or prey resources. Therefore, any reduction in abundance or accessibility of potential shelduck terrestrial habitat or prey in the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the distribution, abundance or availability of key shelduck food and prey items at preferred sizes. The Project therefore has no potential to cause indirect impacts via habitat or prey on the shelduck feature of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.8.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.5.8.4.1 Disturbance / Displacement

940. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to shelduck of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the wintering period, and there are no non-flyover records of shelduck occurring in the potential FLL area or similar habitat in the desk-study data.
941. Subsequently, there is no potential for the Project to cause disturbance and displacement in-combination with other plans and projects.

6.5.8.4.2 Long Term and Temporary Loss of Functionally Linked Land

942. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for shelduck of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in supporting the feature during any stage of the wintering period, and there are no non-flyover records of shelduck occurring in the potential FLL area or similar habitat in the desk-study data.

943. Subsequently, there is no potential for the Project to cause loss of FLL in-combination with other plans and projects.

6.5.8.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

944. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of shelduck of the Ramsar site. This is on the basis that the potential FLL area shows no signs of holding importance in providing a supporting habitat or food resource during any stage of the wintering period, and there are no records of shelduck occurring in the potential FLL area or similar habitat in the desk-study data.

945. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other plans and projects.

6.5.9 Waterbird assemblage (non-breeding)

6.5.9.1 Status

946. The size of the assemblage has undergone an overall decline since Ramsar site classification (Woodward *et al.*, 2019). Species site trends in comparison to national and regional trends suggest that SPA/Ramsar site populations of redshank, wigeon, ringed plover and lapwing are being driven by site-specific factors. The most recent site total in the BTO WeBS Report is 136,310 individual waterbirds (2018/19 to 2022/23). The diversity of the waterbird assemblage is not indicated to have changed. As reported by Natural England (2023a) for the SPA assemblage feature, the supporting habitat water quality is indicated to be in poor condition and/or currently impacted by anthropogenic activities with regard to contaminants (Benzo(g-h-i)perylene, Benzo(b)fluoranthene, Tributyltin Compounds, Cypermethrin, Benzo(k)fluoranthene, PFOS, Dichlorvos, PBDE and mercury and its compounds). The supporting habitat water quality is indicated to be in good condition and / or currently un-impacted by anthropogenic activities with regard to nutrients.

6.5.9.2 Connectivity

947. A 3.5km stretch of the onshore ECC (the southernmost corridor between Bentley and Creyke Beck Substation, and from Creyke Beck Substation up the east side of Birkhill Wood) and the south corner of OCS Zone 8 lie within 10km of the Ramsar boundary and constitute land defined by Natural England as potential functionally linked land of the SPA and Ramsar site. There is preliminary indication that there is no frequent or even repeated use of the land in or within 300m of the Onshore Development Area within 10km of the SPA boundary by SPA assemblage (and therefore Ramsar site assemblage) species in numbers which would be significant relative to site population (>1%). Site-specific transect and vantage point surveys are ongoing to assess the nature, frequency and regularity of use of the land by greylag geese and other waterbird assemblage species.

6.5.9.3 Assessment of Potential Effects of the Project Alone

6.5.9.3.1 Disturbance / Displacement

948. The Project has no pathway to cause direct disturbance impact to birds present within the Ramsar site. The pathway for the Project to cause disturbance and displacement impacts to one or more features of the Ramsar site is via disturbance and displacement of birds originating from the SPA and Ramsar site, present in FLL. The Zol for disturbance of birds in FLL is agreed in principle via ETG6 meeting 2 (held on 2nd October 2024) to be in or within 300m of the Onshore Development Area (see **PEIR Volume 2, Appendix 23.1 Consultation Responses for Onshore Ecology and Ornithology**).

949. Waterbirds of the Humber Estuary SPA (and subsequently the Ramsar site) have high sensitivity to noise and visual disturbance associated with construction, particularly to impulsive (loud, intermittent or sudden) stimuli (Natural England, 2024a). ‘Significant’ disturbance is defined by the AEWA (2016) as follows: “*Disturbance should be judged as significant if an action (alone or in combination with other effects) impacts on (water)birds in such a way as to be likely to cause impacts on populations of a species through either*

- changed local distribution on a continuing basis; and/or
- changed local abundance on a sustained basis; and/or
- the reduction of ability of any significant group of birds to survive, breed, or rear their young.”

950. For the Project alone to cause significant disturbance, it must be capable of causing one or more of these changes likely to impact the assemblage.

951. Construction – It is not likely that disturbance from the project alone will be significant during construction. Construction disturbance from the Project alone is not likely to cause a changed local distribution of the waterbird assemblage on a continuing basis as this would require a) birds to be regularly present within the ZOI for disturbance and displacement under baseline conditions, b) the Project to subsequently displace these birds and c) for the displacement effect to be long-term. To address point a), The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. Similarly, the maximum proportion of the assemblage recorded in the potential FLL area across desk-study data and site-specific surveys to date is 0.05%. It is unlikely the potential FLL area has any importance to the Ramsar site assemblage, and therefore it does not form part of the assemblage's existing distribution. Further, to address point b), impulsive construction noise or visual imposition will be rare or absent from construction activities, with most noise and visual stimuli continuous in nature, and waterbirds are less sensitive to these stimuli. To address point c), construction within much of the FLL area is cable construction and burial only, and so is expected to take place for short periods at discrete locations along the cable corridor – sequentially rather than simultaneously – as the programme of onshore cable construction proceeds. Therefore, even if assemblage waterbirds are present in FLL and this construction activity is sufficient to cause disturbance and displacement, the duration of disturbance is not sufficient to act on a continuing basis. Where construction in or near the FLL area has a longer duration such as at OCS Zone 4 and 8, desk-study data has recorded an assemblage species (greylag goose) using the land in significant numbers (relative to SPA population size) only once despite regular transect surveys and volunteer survey effort in the area, and this comprised a minute proportion (0.05%) of the assemblage total individuals. Waterbirds originating from the Ramsar site assemblage are not confirmed to regularly use FLL in vicinity of these proposed activities, and site-specific transect and vantage point surveys to assess the nature and regularity of use of land are on-going to inform assessment for the ES.
952. Construction disturbance from the Project alone is not likely to cause reduction of ability of any significant group of birds to survive, breed, or rear their young, as assemblage waterbirds are not confirmed to be regularly present in the FLL area or in significant numbers. They would not be subjected to disturbance from regular foraging or resting areas necessary to affect body condition and subsequently the ability to survive, breed or rear young.
953. Construction disturbance from the Project alone is not likely to cause changed local abundance on a sustained basis, as the assessment above has concluded it is not likely to cause a changed distribution or reduced body condition of birds, which are the mechanisms by which abundance in the Ramsar site may be changed. Local abundance to the Onshore Development Area itself (i.e. within 300m) is indicated from desk-study data to be an extremely small proportion of the assemblage total and irregularly occurring, therefore there is also considered to be no potential for disturbance from the Project alone to change abundance on a sustained basis at this smaller scale.
954. Operation and Maintenance – Activities with potential to cause disturbance to birds present in the FLL area during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during operation and maintenance.
955. Decommissioning – Activities with potential to cause disturbance to birds present in the FLL area during decommissioning of the Project will resemble activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during decommissioning.
- 6.5.9.3.2 Long Term and Temporary Loss of Functionally Linked Land
956. The segment of cable corridor within the potential FLL area would see temporary construction, maintenance and decommissioning activities through the respective construction, operation and maintenance and decommissioning phases, representing temporary loss of FLL to any Ramsar site birds using the potential FLL area. There is the potential that OCS Zone 8 would see permanent construction within the potential FLL area, and permanent or long-term loss of FLL to any SPA birds using the potential FLL area, however this would depend on the layout of the permanent infrastructure within the zone.
957. Critically, the potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. The maximum proportion of the assemblage recorded in the potential FLL area across desk-study data and site-specific surveys to date is 0.05%. It is unlikely the potential FLL area has any importance to the Ramsar site assemblage in supporting necessary stages of the non-breeding period (moulting, roosting, loafing, feeding). On this basis, the Project alone has no potential to cause loss of FLL for the waterbird assemblage of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.9.3.3 Indirect Impacts Through Effects on Habitats and Prey Species

958. Fulfilment of the conservation objectives of the waterbird assemblage in the SPA includes a target to “*maintain the structure, function and availability of [specific] habitats which support the assemblage feature for all stages (moulting, roosting, loafing, feeding) of the non-breeding period,*” on a year-round basis.
959. The water column supporting habitat of the Humber Estuary SPA has high sensitivity to nutrient enrichment while other habitats are not sensitive to nutrient enrichment. Some habitats of the Humber Estuary (intertidal mud and intertidal sand/muddy sand) have low to medium sensitivity to introduction of hydrocarbons, PAH and other substances (solid, liquid, gas) while the remainder are classed as not sensitive.
960. On the basis of assessments in **PEIR Volume 1, Chapter 20 Air Quality and Dust** and **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk** which conclude there is no significant effect on the Humber Estuary SAC, SPA or Ramsar site via air quality changes or hydrological linkage, there is no potential for the Project to impact supporting habitats of foraging birds and their food and prey resources within the Ramsar site boundary during construction, operation and maintenance or decommissioning of the Project.
961. The potential FLL area comprises a relatively small area (approximately 3.5km²) of unremarkable arable farmland which is widely available in the 10km buffer area around the Humber Estuary SPA including in closer proximity to the SPA and Ramsar site. The maximum proportion of the assemblage recorded in the potential FLL area across desk-study data and site-specific surveys to date is 0.05%, and the activity undertaken by assemblage birds in that instance is unknown. It is unlikely the potential FLL area has any importance to the Ramsar site assemblage in providing habitat or prey resources. Therefore, any alteration to structure or availability of the potential FLL area due to construction, operation and maintenance or decommissioning of the Project alone is insufficient to materially change the structure, function and availability of habitats which support the Ramsar site waterbird assemblage for any stage (moulting, roosting, loafing, feeding) of the non-breeding period. The Project therefore has no potential to cause indirect impacts via habitat or prey on the waterbird assemblage of the Ramsar site during the construction, operation and maintenance or decommissioning Project phases.

6.5.9.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.5.9.4.1 Disturbance / Displacement

962. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to the waterbird assemblage of the Ramsar site. This is on the basis that the potential FLL is unlikely to act as FLL or support the assemblage during any stage of the non-breeding period.
963. Subsequently, there is no potential for the Project to cause disturbance and displacement in-combination with other plans and projects.
964. Site-specific transect and vantage point surveys to assess the nature and regularity of use of the potential FLL area by Ramsar assemblage waterbirds are on-going. Should these surveys identify regular use of the potential FLL area which indicates a supporting habitat status, this will be detailed and considered in assessment for the ES.

6.5.9.4.2 Long Term and Temporary Loss of Functionally Linked Land

965. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause loss of FLL for the waterbird assemblage of the Ramsar site. This is on the basis that the potential FLL is unlikely to act as FLL or support the assemblage during any stage of the non-breeding period.
966. Subsequently, there is no potential for the Project to cause loss of FLL in-combination with other plans and projects.
967. Site-specific transect and vantage point surveys to assess the nature and regularity of use of the potential FLL area by Ramsar site assemblage waterbirds are on-going. Should these surveys identify regular use of the potential FLL area which indicates a supporting habitat status, this will be detailed and considered in assessment for the ES.

6.5.9.4.3 Indirect Impacts Through Effects on Habitats and Prey Species

968. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of waterbirds of the Ramsar site. This is on the basis that the potential FLL is unlikely to act as FLL or support the assemblage during any stage of the non-breeding period.
969. Subsequently, there is no potential for the Project to cause indirect impacts through effects on habitats and prey species in-combination with other plans and projects.

970. Site-specific transect and vantage point surveys to assess the nature and regularity of use of the potential FLL area by Ramsar assemblage waterbirds are on-going. Should these surveys identify regular use of the potential FLL area which indicates a supporting habitat status, this will be detailed and considered in assessment for the ES.

6.5.10 Estuarine Habitats

971. The Humber Estuary Ramsar comprises a near-natural estuary with dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes and coastal brackish/saline lagoons (JNCC, 2008). These same habitats overlap with qualifying habitats of the Humber Estuary SAC and are fully assessed in Section 3.6 in relation the Project alone and in-combination.

6.5.11 Summary of Potential Effects on Site Integrity

6.5.11.1 Construction

972. There is in summary no potential for the Project to have an AEoSI for the Humber Estuary Ramsar site through disturbance and displacement, loss of FLL or indirect impacts on habitats or prey during construction, either alone or in-combination with other plans and projects.

6.5.11.2 Operation and Maintenance

973. There is in summary no potential for the Project to have an AEoSI for the Humber Estuary Ramsar site through disturbance and displacement, loss of FLL or indirect impacts on habitats or prey during the operation and maintenance phase, either alone or in-combination with other plans and projects.

6.5.11.3 Decommissioning

974. There is in summary no potential for the Project to have an AEoSI for the Humber Estuary Ramsar site through disturbance and displacement, loss of FLL or indirect impacts on habitats or prey during decommissioning, either alone or in-combination with other plans and projects.

6.6 Humber Estuary SAC

6.6.1 Site Description

975. The Humber Estuary SAC is designated for supporting estuarine, mudflat and sand flat habitats, as detailed in **Table 4-5**. It is a muddy, macro-tidal estuary, fed by the Rivers Ouse, Trent and Hull, Ancholme and Graveney. Suspended sediment concentrations are high, and are derived from a variety of sources, including marine sediments and eroding boulder clay along the Holderness coast (Natural England, 2009). Sheltered muddy shores and salt marsh are present within the main body of the estuary and up into the tidal rivers.

6.6.2 Connectivity

976. Qualifying habitats of the Humber Estuary SAC are at least approximately 7km away from the Onshore Development Area and therefore sufficiently separated such that no direct impacts are anticipated. As detailed within **PEIR Volume 1, Chapter 23 Onshore Ecology and Ornithology**.
977. However, as noted within **PEIR Volume 1, Chapter 20 Air Quality and Dust**, construction road vehicle exhaust emissions, from construction traffic which is moving to and from the Onshore Development Area, has the potential to make use of the Humber Bridge (A15) and A63, both of which are located within 200m of the Humber Estuary SAC.
978. IAQM (2019) recommends the assessment of ecological receptors when:
- Any sensitive qualifying features are located within 200m of a road link projected to experience developmental-generated vehicle movements; and
 - Onshore construction activities are likely to generate either >1,000 (and/ or >200 HDV) AADT movements on a road link within 200m of the ecological receptor, or result in >1% of a Critical Level and/or Critical Load.
979. A desk study review of the Priority Habitat Inventory shows that mudflat and saltmarsh, designated components of the Humber Estuary SAC, are present within 200m of the A15 and A63. As such, assessment is required to determine the potential effects.

6.6.3 Qualifying Features

980. Qualifying habitats relevant to this assessment include for following Annex I habitats:
- Estuaries; and
 - Mudflats and sandflats not covered by seawater at low tide.

6.6.4 Conservation Objectives

981. Natural England (2018b) list the following conservation objectives for the Humber Estuary SAC:
- “Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;
 - The extent and distribution of qualifying natural habitats and habitats of qualifying species
 - The structure and function (including typical species) of qualifying natural habitats
 - The structure and function of the habitats of qualifying species
 - The supporting processes on which qualifying natural habitats and habitats of qualifying species rely
 - The populations of qualifying species, and,
 - The distribution of qualifying species within the site.”

6.6.5 Condition Assessment

982. As of March 2025, the SSSI components which cover the Humber Estuary SAC are in the following condition:
- 6.09% favourable;
 - 86.83% unfavourable recovering;
 - 0.22% unfavourable no change; and
 - 6.86% unfavourable declining.
983. Of the SSSI components within the 200m ZoI for potential air quality and dust impacts from construction traffic, unfavourable recovering, unfavourable no change and unfavourable declining areas have been assessed as such due to declines in aggregations of non-breeding birds. These declines have been observed through WeBS data across the whole estuary.
984. There are no ‘favourable’ condition SSSI components within the 200m ZoI.
985. The Natural England (2015) Site Improvement Plan for the Humber Estuary SAC lists air pollution impacts from nitrogen deposition as a pressure on glasswort (*Salicornia* spp.) and other annuals from colonising mud and sand flats.

6.6.6 Assessment of Potential Effects of the Project Alone

986. Saltmarsh and mudflats are intertidal habitats and therefore these systems are subject to daily flooding with large volumes of flowing, saline water. As such, substantial quantities of any deposited air pollution are likely to be removed from the habitat during each inundation. The Air Pollution Information System (APIS) notes that nitrogen deposition is likely to be of low importance saltmarsh as the airborne inputs are probably significantly below the large nutrient loadings from river and tidal inputs. This is also taken to apply for mudflats which are inherently high in organic nutrients. Upper Critical Levels and Loads are therefore taken to be the most relevant values when assessing potential effects in relation to these habitats.
987. **PEIR Volume 1, Chapter 20 Air Quality and Dust** concludes that, in relation to the Humber Estuary Ramsar site, the Project alone:
- Will not have a significant effect on NO_x concentrations;
 - Will exceed the 1% lower Critical Load of Nitrogen deposition within the closest 40m of saltmarsh habitat at traffic and transport road link 24 along the A63 (**Figure 20.4 in PEIR Volume 1, Chapter 20 Air Quality and Dust**), but does not exceed the upper Critical Load;
 - Will exceed the 1% lower Critical Level of Ammonia (NH₃) within saltmarsh habitats located within 200m of traffic and transport road link 24; and
 - Will exceed the upper Critical Level of Ammonia (NH₃) within saltmarsh and mudflat habitats located within 20m of traffic and transport road link 24.
988. The Critical Load / Level exceedance as a result of Project related transport will be within relatively small areas of the Humber Estuary SAC. These are summarised in **Table 6-4**.
989. **PEIR Volume 1, Chapter 20 Air Quality and Dust** considers direct effects on the mudflats and saltmarsh, qualifying habitats of the SAC which covers a total of 6,401ha and 2,241ha respectively. The assessment identified that in these areas of the Humber Estuary SAC there are already baseline exceedances of the Lower Critical Level for Ammonia and Lower Critical Load for Nitrogen deposition, i.e. without any contribution of air emissions (Ammonia or Nitrogen) from traffic associated with the Project.

Table 6-4 Area of qualifying habitats within the Humber Estuary SAC where the 1% upper Critical Level or Load is exceeded from the Project Alone

Air Pollution Type	Area of Saltmarsh with 1% of upper Critical Level / Load exceeded (ha)	Area of Mudflat with 1% of upper Critical Level / Load exceeded (ha)
NOx	0ha - All receptors point below 1% of the upper Critical Level	0ha - All receptors point below 1% of the upper Critical Level.
Ammonia	0.32ha	0.23ha.
Nitrogen deposition	0ha - All receptors point below 1% of the upper Critical Level	0ha - All receptors point below 1% of the upper Critical Level.
Acid deposition	Saltmarsh and mudflats at Humber Estuary not sensitive to acid deposition	Saltmarsh and mudflats at Humber Estuary not sensitive to acid deposition.

990. As detailed in **PEIR Volume 1, Chapter 20 Air Quality and Dust** potential impacts on air quality at the Humber Estuary SAC are likely to be temporary, with exceedances of the Critical Load for Nitrogen deposition and Critical Level for Ammonia at the Humber Estuary SAC occurring over a short period of the construction process resulting in short-term peak in airborne pollutants from the construction vehicles. Furthermore, impacts arising from potential changes to air quality at the Humber Estuary SAC refer only to a localised area of 0.23ha of mudflats and 0.32ha of saltmarsh along the Humber Estuary adjacent to the A63 trunk road that represents 0.004% and 0.014% of the habitats available within the SAC. Given that the above, the temporary impact of the Project on these habitats via the contribution to vehicular air emissions is considered to be negligible (unmeasurable) if the whole extent of this habitat within the designated site is considered.
991. Finally, it should be considered that the air pollution levels and loads have been modelled at their peak during the construction phase which is anticipated to last for a total of 5 years (as detailed within **PEIR Volume 1, Chapter 20 Air Quality and Dust**).
992. In view of the above, for all construction scenarios, with embedded mitigation listed in **PEIR Volume 1, Chapter 20 Air Quality and Dust**, changes in air quality from the Project alone are not anticipated to have an adverse effect to the integrity of the qualifying habitats of the Humber Estuary SAC.

6.6.7 Assessment of Potential Effects of the Project In-combination

993. **PEIR Volume 1, Chapter 20 Air Quality and Dust** concludes that, in relation to the Humber Estuary Ramsar site, the Project in-combination:

- NOx:
 - Will exceed the 1% Critical Level for saltmarsh within 200m and mudflats within 160m of at road link 24; and
 - Will exceed the 1% Critical Level for mudflats within 100m of road link 26.
- Ammonia:
 - Will exceed the 1% Lower and Upper Critical Level for saltmarshes within 200m of road link 24;
 - Will exceed the 1% Upper Critical Level for mudflats within 170m of road link 24;
 - Will exceed the 1% Upper Critical Level for mudflats within 120m of road link 26; and
 - Will not exceed the 1% Lower or Upper Critical Level within mudflats and saltmarshes at road link 80.
- Nitrogen deposition:
 - Will exceed the 1% Lower Critical Load of saltmarshes within 200m of road link 24;
 - Will exceed the 1% Upper Critical Load of saltmarshes within 15m of road link 24;
 - Will not exceed the 1% Lower or Upper Critical Level within saltmarshes at road link 80; and
 - Had no comparable habitat with established Critical Load estimate available to assess the mudflats at road links 24, 26 and 80.

994. The areas of saltmarsh and mudflat habitats within the Humber Estuary SAC where upper Critical Loads or Levels are anticipated to exceed 1% are summarised within **Table 6-5**.

Table 6-5 Area and percentage of qualifying habitats within the Humber Estuary SAC where the 1% upper Critical Level or Load is exceeded from the Project In-combination

Air Pollution Type	Area of Saltmarsh with 1% of upper Critical Level / Load exceeded (ha)	Area of Mudflat with 1% of upper Critical Level / Load exceeded (ha)
NOx	6.96ha (0.31%)	17.07ha (0.27%)
Ammonia	6.96ha (0.31%)	20.2ha (0.32%)
Nitrogen deposition	0.32ha (0.01%)	No comparable habitat with Critical Load
Acid deposition	Saltmarsh and mudflats at Humber Estuary not sensitive to acid deposition	Saltmarsh and mudflats at Humber Estuary not sensitive to acid deposition

995. In combination, the project will result in greater areas of saltmarsh and mudflat habitats exceeding the upper Critical Level / Load compared to the Project alone. However, as demonstrated within **PEIR Volume 1, Chapter 20 Air Quality and Dust**, these levels are not anticipated to exceed the total Critical Level / Load for NOx, Ammonia or Nitrogen. As a result of this, taken in combination with the following points, the Project in-combination is not anticipated to have an adverse effect to the integrity of the qualifying habitats of the Humber Estuary SAC:
- Saltmarsh and mudflat habitats:
 - Are intertidal and therefore subject to daily flushes which will remove a proportion of any pollution deposition;
 - Are subject to high levels of nutrient loadings from river and tidal inputs;
 - Will have upper Critical Levels / Loads exceeded within relatively small proportions of the habitats present within the SAC (<0.32% of saltmarsh and mudflat habitats);
 - Will be subject to any potential effects from construction related traffic on a temporary basis; and
 - Pollution modelling has been based on peak levels and loads during the construction phase.

6.7 The Greater Wash SPA

6.7.1 Site Description

996. The Greater Wash SPA is located off the east coast of England and its boundary stretches from Bridlington Bay in the north to the Outer Thames Estuary SPA to the south. The Greater Wash SPA supports a variety of habitats including seabed habitats which are primarily comprised of coarse sediments, with occasional areas of sand, mud, and mixed sediments with subtidal sandbanks. There are also extensive areas of subtidal sandbanks offshore. In the inshore waters, sediments are comprised of a mosaic of sand and mixed sediments, as well as muddy sands, coarse sediments, and occasional Annex I reefs.

6.7.1.1 Qualifying Features

997. The Greater Wash SPA is designated for the following qualifying features:
- Common scoter *Melanitta nigra* non-breeding population;
 - Common tern *Sterna hirundo* breeding population;
 - Little gull *Hydrocoloeus minutus* non-breeding population;
 - Little tern *Sternula albifrons* breeding population;
 - Red-throated diver *Gavia stellata* non-breeding population; and
 - Sandwich tern *Thalasseus sandvicensis* breeding population.

6.7.1.2 Conservation Objectives

998. The conservation objectives for the Greater Wash SPA aim to maintain or restore:
- The extent and distribution of the habitats of the qualifying features;
 - The structure and function of the habitats of the qualifying features;
 - The supporting processes on which the habitats of the qualifying features rely;
 - The populations of each of the qualifying features; and
 - The distribution of qualifying features within the site.

6.7.1.3 Condition Assessment

999. The water quality is indicated to be in good condition and/or currently un-impacted by anthropogenic activities with regard to a) dissolved oxygen and b) nutrients. The seven Water Framework Directive (WFD) water bodies that collectively overlap with >17% of the Greater Wash SPA, failed WFD chemical status in the 2019 classification due to measured/assumed elevated levels of polybrominated diphenyl ether (PBDE), and mercury and its compounds, therefore there is a conservation target to reduce aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the WFD (Natural England, 2023c). The Greater Wash SPA contains “*a complex matrix of marine industries which includes offshore wind developments, fisheries, Oil and Gas pipelines, offshore cabling, interconnectors, shipping and aggregate extraction,*” and “*there are currently several windfarms considered to have connectivity to the...SPA.*” Based on knowledge of the sensitivity of some qualifying features to activities that are occurring or have occurred in the SPA, there is potential existing disturbance impact of marine industries on qualifying features. In the absence of site-specific data, fulfilment of the conservation objectives of SPA qualifying features includes a target to “*restrict the frequency, duration and/or intensity of disturbance [caused by human activity] affecting roosting, nesting, foraging, feeding, moulting and/or loafing birds so that they are not significantly disturbed.*” In summary, disturbance to birds is subject to a ‘restrict’ as opposed to a ‘reduce’ target (Natural England, 2023c).

6.7.2 Functionally Linked Land

1000. The Greater Wash SPA is a marine SPA and its qualifying features are supported overwhelmingly in offshore activities and behaviours: Non-breeding red-throated diver and common scoter use the SPA for foraging and resting at sea. Natural England (2023c) reports that red-throated diver do not come ashore during the non-breeding season while little gull are reported to occur most commonly in the middle of the SPA (north-east of The Wash) and typically further from the coast than other species. Breeding little tern, common tern and Sandwich tern qualifying features use the SPA for foraging at sea, and breed at SPA and non-SPA colonies largely distant from the Onshore Development Area. All three Greater Wash SPA tern populations are reported to largely feed in marine waters, with common tern the only species reported to regularly use non-marine habitat to forage (in freshwater habitats chiefly in relation to weather and tide). Utilised areas of freshwater habitat are expected to be within typical foraging range (a maximum of 20-30km) of the colonies linked to the SPA (Blakeney Point, Scolt Head, Breydon Water). Therefore, there is no potential for qualifying features of the SPA to use parts of the Onshore Development Area as Functionally Linked Land, and loss of Functionally Linked Land is screened out as a potential effect pathway for features of the SPA.

6.7.3 Red-throated diver (non-breeding)

6.7.3.1 Status

1001. Natural England (2023c) reports that from 2002/3 to 2005/6 winters the SPA supported a peak mean of 1,407 red-throated diver or 8.3% of the GB wintering population. The population trend of the species in the SPA is unconfirmed and is subject to analysis of results of a follow-up digital aerial survey of the SPA which commenced 2021/22. The population size is subject to a ‘maintain’ conservation objective.

6.7.3.2 Connectivity

1002. The Onshore Development Area (onshore export cable corridor, landfall and associated access routes) borders the MHWS which is also the landward boundary of the SPA. Therefore, the presence of onshore works and plant undertaking installation of the export cable could result in effects on red-throated diver.

6.7.3.3 Assessment of Potential Effects of the Project Alone

1003. The red-throated diver peak count in Dogger Bank South surveys of the landfall area was 27 birds on the sea. The species is recorded in eBird in all months in the locality except March, with a 2019-24 peak of 85 birds of unknown behaviour (on sea or flying past) (see **Section 3.1 in PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**).

6.7.3.3.1 Disturbance / Displacement

1004. Construction – Red-throated diver have high sensitivity to above-water noise or visual disturbance associated with construction at the landfall (Natural England, 2024b). Embedded mitigation therefore includes pre-construction surveys for birds in proximity to planned construction, with provision for additional mitigation measures should birds be identified to be present in vicinity. While peak counts of individuals in or flying over inshore waters at the landfall are significant in the context of the estimated SPA population, many birds within view of the land are likely to be outside the ZoI for disturbance and displacement by onshore works. There is therefore no potential for the Project alone to cause significant disturbance and displacement to red-throated diver of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to restrict disturbance to the species in the SPA, during the construction phase.
1005. Operation – Activities with potential to cause disturbance to birds present in vicinity of onshore works during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration.

1006. Decommissioning – No final decision regarding the final decommissioning policy for the onshore project infrastructure including landfall has yet been made. It is also recognised that legislation and industry best practice change over time. 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. It is anticipated that for the worst-case scenario, the impacts will be no greater than those identified for the construction phase.

6.7.3.3.2 Indirect Impacts Through Effects on Habitats and Prey Species

1007. Supporting habitats of red-throated diver of the Greater Wash SPA are not sensitive to nutrient enrichment and have low to medium sensitivity to introduction of hydrocarbons, PAH and other substances (solid, liquid, gas) (Natural England, 2024b). As assessed in **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology** and **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**, no significant effects are considered to occur on invertebrate or fish species (which form the food supply for birds in the SPA) due to onshore construction, operation and maintenance or decommissioning of the Project alone. As assessed in **PEIR Volume 1, Chapter 20 Air Quality and Dust**, the project alone effect of construction dust and fine particulate matter emissions on the Greater Wash SPA is non-significant. As assessed in **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk**, effects of increased sediment supply and supply of contaminants to surface and groundwater to Barmston Sea Drain (which is a hydrological linkage between the Project and Greater Wash SPA) from the Project alone are non-significant (minor adverse). There is therefore no potential for the Project alone to cause significant effects through habitats and prey species of red-throated diver of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the food supply of the species in the SPA, during the construction, operation and maintenance or decommissioning phase.

6.7.3.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.7.3.4.1 Disturbance / Displacement

1008. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to red-throated diver of the SPA. This is on the basis that the landfall area presents no significant noise or visual imposition on the total area of the SPA, and monitoring prior to the construction period will trigger provision of additional mitigation measures to reduce disturbance should birds be found to be present in vicinity.

1009. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.7.3.4.2 Indirect Impacts Through Effects on Habitats and Prey Species

1010. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of red-throated diver of the SPA. This is on the basis that all assessments relating to prey and supporting habitats have concluded no significant effect on habitats or prey.
1011. Subsequently, there is no potential for the Project to contribute to causing indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.7.4 Common scoter (non-breeding)

6.7.4.1 Status

1012. Natural England (2023c) reports that from 2002/3 to 2007/8 winters the SPA supported a peak mean of 3,449 common scoter or 0.6% of the biogeographic population. The winter distribution of common scoter is indicated to be concentrated to specific areas within the SPA, all south of Spurn Point. The areas are a) east of The Wash SPA boundary and b) a smaller concentration off Skegness (Lawson *et al.*, 2016). The population trend of the species in the SPA is unconfirmed and is subject to analysis of results of a follow-up digital aerial survey of the SPA which commenced 2021/22. The population size is subject to a ‘maintain’ conservation objective.

6.7.4.2 Connectivity

1013. The Onshore Development Area (onshore export cable corridor, landfall and associated access routes) borders the MHWS which is also the landward boundary of the SPA. Therefore, the presence of onshore works and plant undertaking installation of the export cable could result in effects on common scoter.

6.7.4.3 Assessment of Potential Effects of the Project Alone

1014. The peak count of common scoter in site-specific surveys to December 2024 was 65 in the August survey (see **Section 3.2 in PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**), and the peak count in Dogger Bank South surveys in the same area was six in the June breeding bird survey (see **Section 3.1 in PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**). The eBird Basic Dataset (2024) peak in the locality during overwintering and passage months 2019-24 is 520 birds on the sea in August before flying off on migration (see **Section 3.1 in PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**).

6.7.4.3.1 Disturbance / Displacement

1015. Construction – Common scoter have medium sensitivity to above-water noise or visual disturbance associated with construction at the landfall (Natural England, 2024b). Embedded mitigation therefore includes pre-construction surveys for birds in proximity to planned construction, with provision for additional mitigation measures should birds be identified to be present in vicinity. The landfall area presents no significant noise or visual imposition on the total area of the SPA. While peak counts of individuals in or flying over inshore waters at the landfall are significant in the context of the estimated SPA population, many birds within view of the land are likely to be outside the Zol for disturbance and displacement by onshore works. There is no risk of the Project alone causing significant disturbance and displacement to common scoter of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to restrict disturbance to the species in the SPA, during the construction phase.
1016. Operation – Activities with potential to cause disturbance to birds present in vicinity of onshore works during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration.
1017. Decommissioning – No final decision regarding the final decommissioning policy for the onshore project infrastructure including landfall has yet been made. It is also recognised that legislation and industry best practice change over time. 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. It is anticipated that for the worst-case scenario, the impacts will be no greater than those identified for the construction phase.

6.7.4.3.2 Indirect Impacts Through Effects on Habitats and Prey Species

1018. Supporting habitats of common scoter of the Greater Wash SPA are not sensitive to nutrient enrichment and have low to medium sensitivity to introduction of hydrocarbons, PAH and other substances (solid, liquid, gas) (Natural England, 2024b). As assessed in **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology** and **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**, no significant effects are considered to occur on invertebrate or fish species (which form the food supply for birds in the SPA) due to onshore construction, operation and maintenance or decommissioning of the Project alone. As assessed in **PEIR Volume 1, Chapter 20 Air Quality and Dust**, the project alone effect of construction dust and fine particulate matter emissions on the Greater Wash SPA is non-significant. As assessed in **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk**, effects of increased sediment supply and supply of contaminants to surface and groundwater to Barmston Sea Drain (which is a hydrological linkage between the Project and Greater Wash SPA) from the Project alone are non-significant (minor adverse). There is therefore no potential for the Project alone to cause significant effects through habitats and prey species of common scoter of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the food supply of the species in the SPA, during the construction, operation and maintenance or decommissioning phase.

6.7.4.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.7.4.4.1 Disturbance / Displacement

1019. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to red-throated diver of the SPA. This is on the basis that the landfall area presents no significant noise or visual imposition on the total area of the SPA, and monitoring prior to the construction period will trigger provision of additional mitigation measures to reduce disturbance should birds be found to be present in vicinity.
1020. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.7.4.4.2 Indirect Impacts Through Effects on Habitats and Prey Species

1021. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of common scoter of the SPA. This is on the basis that all assessments relating to prey and supporting habitats have concluded no significant effect on habitats or prey.

1022. Subsequently, there is no potential for the Project to contribute to causing indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.7.5 Little gull (non-breeding)

6.7.5.1 Status

1023. Natural England (2023c) reports that from 2004/5 to 2005/6 winters the SPA supported a peak mean of 1,255 little gull in the non-breeding season. However, this figure is calculated from a limited Area of Search (AoS) survey (Lawson *et al.*, 2016) and the true non-breeding population could be at least twice the size reported above. The population trend of the species in the SPA is unknown, and an updated population estimate is subject to analysis of results of a follow-up digital aerial survey of the SPA. The population size is subject to a 'maintain' conservation objective. The species is most abundant on the wider English coastline during spring and autumn passage (Natural England, 2023c).

6.7.5.2 Connectivity

1024. The Onshore Development Area (onshore export cable corridor, landfall and associated access routes) borders the MHWS which is also the landward boundary of the SPA. Therefore, the presence of onshore works and plant undertaking installation of the export cable could result in effects on little gull.

6.7.5.3 Assessment of Potential Effects of the Project Alone

1025. The little gull peak count in the locality recorded in eBird Basic Dataset (2024) is 1000 individuals, in August (see **Section 3.1** in **PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**). Records specifying feeding flocks over or on the sea numbered 120-1000 birds. Records specifying flocks on the beach numbered 500-1000 birds.

6.7.5.3.1 Disturbance / Displacement

1026. Construction – Little gull are assessed as having low sensitivity to above-water noise and as not sensitive to visual disturbance (Natural England, 2024b). When they are present in the SPA and in vicinity of the proposed works they are predominantly undertaking foraging or migration offshore, and surface feeders with manoeuvrability in flight such as little gull are reported to have low sensitivity even to marine vehicle movements in proximity (Natural England, 2024b) such as helicopters and ships (Garthe & Huppopp, 2004; Fliessbach *et al.*, 2019), whereas onshore works will typically be more distant and immobile. Embedded mitigation includes pre-construction surveys for birds in proximity to planned construction, with provision for additional mitigation measures should birds be identified to be present in vicinity. The landfall area presents no significant noise or visual imposition on the total area of the SPA. While peak counts of individuals in or flying over inshore waters at the landfall are significant in the context of the estimated SPA population, little gulls in vicinity are generally not expected to have sensitivity to be disturbed or significantly disturbed. There is no risk of the Project alone causing significant disturbance and displacement to little gull of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to restrict disturbance to the species in the SPA, during the construction phase.
1027. Operation – Activities with potential to cause disturbance to birds present in vicinity of onshore works during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during operation and maintenance, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to restrict disturbance to the species in the SPA.
1028. Decommissioning – No final decision regarding the final decommissioning policy for the onshore project infrastructure including landfall has yet been made. It is also recognised that legislation and industry best practice change over time. 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. It is anticipated that for the worst-case scenario, the impacts will be no greater than those identified for the construction phase. On the basis of the assessment above for construction, disturbance from the project alone is subsequently not likely to be significant during operation and maintenance, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to restrict disturbance to the species in the SPA.

6.7.5.3.2 Indirect Impacts Through Effects on Habitats and Prey Species

1029. Supporting habitats of little gull of the Greater Wash SPA are not sensitive to nutrient enrichment and have low to medium sensitivity to introduction of hydrocarbons, PAH and other substances (solid, liquid, gas) (Natural England, 2024b). As assessed in **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology** and **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**, no significant effects are considered to occur on invertebrate or fish species (which form the food supply for birds in the SPA) due to onshore construction, operation and maintenance or decommissioning of the Project alone. As assessed in **PEIR Volume 1, Chapter 20 Air Quality and Dust**, the project alone effect of construction dust and fine particulate matter emissions on the Greater Wash SPA is non-significant. As assessed in **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk**, effects of increased sediment supply and supply of contaminants to surface and groundwater to Barmston Sea Drain (which is a hydrological linkage between the Project and Greater Wash SPA) from the Project alone are non-significant (minor adverse). There is therefore no potential for the Project alone to cause significant effects through habitats and prey species of little gull of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the food supply of the species in the SPA, during the construction, operation and maintenance or decommissioning phase.

6.7.5.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.7.5.4.1 Disturbance / Displacement

1030. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to little gull of the SPA. This is on the basis that the landfall area presents no significant noise or visual imposition on the total area of the SPA, little gull have low sensitivity to airborne noise and no sensitivity to visual disturbance, and monitoring prior to the construction period will trigger provision of additional mitigation measures to reduce disturbance should birds be found to be present in vicinity.
1031. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.7.5.4.2 Indirect Impacts Through Effects on Habitats and Prey Species

1032. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of little gull of the SPA. This is on the basis that all assessments relating to prey and supporting habitats have concluded no significant effect on habitats or prey.

1033. Subsequently, there is no potential for the Project to contribute to causing indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.7.6 Common tern (breeding)

6.7.6.1 Status

1034. The common tern population of the SPA is present during the breeding season as breeding birds originating from SPA and non-SPA colonies around the Greater Wash SPA undertake marine foraging trips. In advice on the SPA by Natural England (2023c) the specific breeding colonies are named as North Norfolk Coast SPA, Breydon Water SPA and Scroby Sands, and the foraging distribution of common tern in the SPA is, “*predominantly in marine areas within approximately 10km of the colonies at Blakeney Point and Scolt Head Island, and approximately 13km of the colony at Breydon Water SPA*”. The feature is indicated to be in a good condition and currently un-impacted by anthropogenic activities. The SPA supported a five-year mean of 510 breeding pairs between 2010 and 2014, and the population is relatively stable based on a five-year mean of 482 breeding pairs between 2017 and 2021 (peaking at 647 breeding pairs in 2019). The population size is subject to a ‘maintain’ conservation objective.

6.7.6.2 Connectivity

1035. The Onshore Development Area (onshore export cable corridor, landfall and associated access routes) borders the MHWS which is also the landward boundary of the SPA. Therefore, the presence of onshore works and plant undertaking installation of the export cable could result in effects on common tern. (53.97067, -0.19529)

6.7.6.3 Assessment of Potential Effects of the Project Alone

1036. The peak count of common tern in Dogger Bank South surveys in the landfall area is six individuals including three alighted on the intertidal habitat (see Section 3.1 in **PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**). Common tern have not been recorded in Project specific surveys between August and December 2024 (see Section 3.2 in **PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**). The eBird Basic Dataset (2024) peak 2019-24 is 376 but this relates to visible migration passage (all south, in August) (see Section 3.1 in **PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**).

6.7.6.3.1 Disturbance / Displacement

1037. Construction – Common tern are assessed as having high sensitivity to above-water noise and visual disturbance (Natural England, 2024b) but all underlying studies to this assessment relate to nesting terns at colonies. The SPA is designated as it protects foraging waters for terns breeding at colonies in the region, and when they are present in the SPA and in vicinity of the proposed works they are predominantly undertaking foraging or migration offshore. Surface feeders with manoeuvrability in flight such as common tern are reported to have low sensitivity even to marine vehicle movements in proximity (Natural England, 2024b) such as helicopters and ships (Garthe & Huppopp, 2004; Fliessbach *et al.*, 2019), whereas onshore works will typically be more distant and immobile. The landfall area presents no significant noise or visual imposition on the total area of the SPA, or on reported main foraging distributions of breeding common tern within the SPA (Natural England, 2023c). While peak counts of individuals flying over inshore waters at the landfall are significant in the context of the estimated SPA population, high counts are often migratory passage, and due to low sensitivity at sea any common tern in vicinity are generally not expected to have sensitivity to be disturbed. There is no risk of the Project alone causing significant disturbance and displacement to common tern of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to restrict disturbance to the species in the SPA, during the construction phase.
1038. Operation – Activities with potential to cause disturbance to birds present in vicinity of onshore works during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration.
1039. Decommissioning – No final decision regarding the final decommissioning policy for the onshore project infrastructure including landfall has yet been made. It is also recognised that legislation and industry best practice change over time. 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. It is anticipated that for the worst-case scenario, the impacts will be no greater than those identified for the construction phase.

6.7.6.3.2 Indirect Impacts Through Effects on Habitats and Prey Species

1040. Supporting habitats of common tern of the Greater Wash SPA are not sensitive to nutrient enrichment and have low to medium sensitivity to introduction of hydrocarbons, PAH and other substances (solid, liquid, gas) (Natural England, 2024b). As assessed in **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology** and **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**, no significant effects are considered to occur on invertebrate or fish species (which form the food supply for birds in the SPA) due to onshore construction, operation and maintenance or decommissioning of the Project alone. As assessed in **PEIR Volume 1, Chapter 20 Air Quality and Dust**, the project alone effect of construction dust and fine particulate matter emissions on the Greater Wash SPA is non-significant. As assessed in **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk**, effects of increased sediment supply and supply of contaminants to surface and groundwater to Barmston Sea Drain (which is a hydrological linkage between the Project and Greater Wash SPA) from the Project alone are non-significant (minor adverse). There is therefore no potential for the Project alone to cause significant effects through habitats and prey species of common tern of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the food supply of the species in the SPA, during the construction, operation and maintenance or decommissioning phase.

6.7.6.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.7.6.4.1 Disturbance / Displacement

1041. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to common tern of the SPA. This is on the basis that the landfall area presents no significant noise or visual imposition on the total area of the SPA, and common tern have low sensitivity to airborne noise and visual disturbance at sea.
1042. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.7.6.4.2 Indirect Impacts Through Effects on Habitats and Prey Species

1043. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of common tern of the SPA. This is on the basis that all assessments relating to prey and supporting habitats have concluded no significant effect on habitats or prey.

1044. Subsequently, there is no potential for the Project to contribute to causing indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.7.7 Little tern (breeding)

6.7.7.1 Status

1045. The little tern population of the SPA is present during the breeding season as breeding birds originating from SPA and non-SPA colonies around the Greater Wash SPA undertake marine foraging trips. In advice on the SPA by Natural England (2023c) the specific breeding colonies are named as Easington Lagoons within the Humber Estuary SPA, Gibraltar Point SPA, multiple colonies within the North Norfolk Coast SPA, Eccles and Caister North Beach on the Norfolk Coast, Winterton Dunes and Great Yarmouth North Denes within the Great Yarmouth North Denes SPA, and Scroby Sands. The feature is indicated to be in a good condition and currently un-impacted by anthropogenic activities. The SPA supported a five-year mean of 798 breeding pairs between 2009 and 2013, and the population is relatively stable based on a five-year mean of 640 breeding pairs between 2017 and 2021 (peaking at 728 breeding pairs in 2021). The population size is subject to a 'maintain' conservation objective.

6.7.7.2 Connectivity

1046. The Onshore Development Area (onshore export cable corridor, landfall and associated access routes) borders the MHWS which is also the landward boundary of the SPA. Therefore, the presence of onshore works and plant undertaking installation of the export cable could result in effects on little tern.

6.7.7.3 Assessment of Potential Effects of the Project Alone

1047. Little tern were not recorded in Dogger Bank South surveys of the landfall. One bird was recorded in Project-specific surveys between August and December 2024 (in August) (see **Section 3.2 in PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**). The eBird Basic Dataset (2024) peak 2019-24 is eight individuals, in August (see **Section 3.1 in PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**).

6.7.7.3.1 Disturbance / Displacement

1048. Construction – Little tern are assessed as having high sensitivity to above-water noise and visual disturbance (Natural England, 2024b) but most underlying studies to this assessment relate to nesting terns at colonies. The SPA is designated as it protects foraging waters for terns breeding at colonies in the region, and when they are present in the SPA and in vicinity of the proposed works they are predominantly undertaking foraging or migration offshore. Surface feeders with manoeuvrability in flight such as little tern are reported to have low sensitivity even to marine vehicle movements in proximity (Natural England, 2024b) such as helicopters and ships (Garthe & Huppopp, 2004; Cook & Burton, 2010; Fliessbach *et al.*, 2019), whereas onshore works will typically be more distant and immobile. The landfall area presents no significant noise or visual imposition on the total area of the SPA, and any little tern in vicinity are generally not expected to have sensitivity to be disturbed. There is no risk of the Project alone causing significant disturbance and displacement to little tern of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to restrict disturbance to the species in the SPA, during the construction phase.
1049. Operation – Activities with potential to cause disturbance to birds present in vicinity of onshore works during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration.
1050. Decommissioning – No final decision regarding the final decommissioning policy for the onshore project infrastructure including landfall has yet been made. It is also recognised that legislation and industry best practice change over time. 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. It is anticipated that for the worst-case scenario, the impacts will be no greater than those identified for the construction phase.

6.7.7.3.2 Indirect Impacts Through Effects on Habitats and Prey Species

1051. Supporting habitats of little tern of the Greater Wash SPA are not sensitive to nutrient enrichment and have low to medium sensitivity to introduction of hydrocarbons, PAH and other substances (solid, liquid, gas) (Natural England, 2024b). As assessed in PEIR **Volume 1, Chapter 10 Benthic and Intertidal Ecology** and **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**, no significant effects are considered to occur on invertebrate or fish species (which form the food supply for birds in the SPA) due to onshore construction, operation and maintenance or decommissioning of the Project alone. As assessed in v **Chapter 20 Air Quality and Dust**, the project alone effect of construction dust and fine particulate matter emissions on the Greater Wash SPA is non-significant. As assessed in **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk**, effects of increased sediment supply and supply of contaminants to surface and groundwater to Barmston Sea Drain (which is a hydrological linkage between the Project and Greater Wash SPA) from the Project alone are non-significant (minor adverse). There is therefore no potential for the Project alone to cause significant effects through habitats and prey species of little tern of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the food supply of the species in the SPA, during the construction, operation and maintenance or decommissioning phase.

6.7.7.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.7.7.4.1 Disturbance / Displacement

1052. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to little tern of the SPA. This is on the basis that the landfall area presents no significant noise or visual imposition on the total area of the SPA, and little tern have low sensitivity to airborne noise and visual disturbance at sea.
1053. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.7.7.4.2 Indirect Impacts Through Effects on Habitats and Prey Species

1054. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of little tern of the SPA. This is on the basis that all assessments relating to prey and supporting habitats have concluded no significant effect on habitats or prey.

1055. Subsequently, there is no potential for the Project to contribute to causing indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.7.8 Sandwich tern (breeding)

6.7.8.1 Status

1056. The common tern population of the SPA is present during the breeding season as breeding birds originating from SPA and non-SPA colonies around the Greater Wash SPA undertake marine foraging trips. In advice on the SPA by Natural England (2023c) the key breeding colonies are named as Scolt Head Island NNR and Blakeney Point NNR, and the foraging distribution of Sandwich tern from these colonies lies “*predominantly in marine areas within 21km of the colony*”. The feature is indicated to be in a good condition and currently un-impacted by anthropogenic activities. The SPA supported a five-year mean of 3,852 breeding pairs from the two key colonies above between 2010 and 2014, and the population is stable or increasing based on a five-year mean of 5,548 breeding pairs from the same colonies between 2017 and 2021 (peaking at 7,044 breeding pairs in 2021). The population size is subject to a ‘maintain’ conservation objective.

6.7.8.2 Connectivity

1057. The Onshore Development Area (onshore export cable corridor, landfall and associated access routes) borders the MHWS which is also the landward boundary of the SPA. Therefore, the presence of onshore works and plant undertaking installation of the export cable could result in effects on Sandwich tern.

6.7.8.3 Assessment of Potential Effects of the Project Alone

1058. The peak count of Sandwich tern in Dogger Bank South surveys in the landfall area is 15 individuals, in August (see **Section 3.1 in PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**). The peak count in Project-specific surveys August to December 2024 is 27 birds, in August (see **Section 3.2 in PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**). The eBird Basic Dataset (2024) peak 2019-24 is 163 (see **Section 3.1 in PEIR Volume 2, Appendix 13.5 Intertidal Ornithology Baseline Characterisation Report**) but details of whether this is passage or a static aggregation is not reported.

6.7.8.3.1 Disturbance / Displacement

1059. Construction – Sandwich tern are assessed as having high sensitivity to above-water noise and visual disturbance (Natural England, 2024b) but most underlying studies to this assessment relate to nesting terns at colonies. The SPA is designated as it protects foraging waters for terns breeding at colonies in the region, and when they are present in the SPA and in vicinity of the proposed works they are predominantly undertaking foraging or migration offshore. Surface feeders with manoeuvrability in flight such as Sandwich tern are reported to have low sensitivity even to marine vehicle movements in proximity (Natural England, 2024b) such as helicopters and ships (Garthe & Huppopp, 2004; Cook & Burton, 2010; Fliessbach *et al.*, 2019), whereas onshore works will typically be more distant and immobile. The landfall area presents no significant noise or visual imposition on the total area of the SPA, and any Sandwich tern in vicinity are generally not expected to have sensitivity to be disturbed. There is no risk of the Project alone causing significant disturbance and displacement to Sandwich tern of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to restrict disturbance to the species in the SPA, during the construction phase.
1060. Operation – Activities with potential to cause disturbance to birds present in vicinity of onshore works during operation and maintenance of the Project are routine and unscheduled maintenance of Project infrastructure onshore, in the worst-case scenario resembling activities during construction but with expected lower intensity and duration.
1061. Decommissioning – No final decision regarding the final decommissioning policy for the onshore project infrastructure including landfall has yet been made. It is also recognised that legislation and industry best practice change over time. 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. It is anticipated that for the worst-case scenario, the impacts will be no greater than those identified for the construction phase.

6.7.8.3.2 Indirect Impacts Through Effects on Habitats and Prey Species

1062. Supporting habitats of Sandwich tern of the Greater Wash SPA are not sensitive to nutrient enrichment and have low to medium sensitivity to introduction of hydrocarbons, PAH and other substances (solid, liquid, gas) (Natural England, 2024b). As assessed in **PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology** and **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**, no significant effects are considered to occur on invertebrate or fish species (which form the food supply for birds in the SPA) due to onshore construction, operation and maintenance or decommissioning of the Project alone. As assessed in **PEIR Volume 1, Chapter 20 Air Quality and Dust**, the project alone effect of construction dust and fine particulate matter emissions on the Greater Wash SPA is non-significant. As assessed in **PEIR Volume 1, Chapter 21 Water Resources and Flood Risk**, effects of increased sediment supply and supply of contaminants to surface and groundwater to Barmston Sea Drain (which is a hydrological linkage between the Project and Greater Wash SPA) from the Project alone are non-significant (minor adverse). There is therefore no potential for the Project alone to cause significant effects through habitats and prey species of Sandwich tern of the SPA, and it will not act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the food supply of the species in the SPA, during the construction, operation and maintenance or decommissioning phase.

6.7.8.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

6.7.8.4.1 Disturbance / Displacement

1063. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause disturbance and displacement to Sandwich tern of the SPA. This is on the basis that the landfall area presents no significant noise or visual imposition on the total area of the SPA, and Sandwich tern have low sensitivity to airborne noise and visual disturbance at sea.
1064. Subsequently, there is no potential for the Project to cause disturbance and displacement, or act in opposition to the Conservation Objectives of the SPA or the specific target to reduce disturbance to the species in the SPA in-combination with other plans and projects.

6.7.8.4.2 Indirect Impacts Through Effects on Habitats and Prey Species

1065. The assessment of the potential effects of the Project alone has concluded that there is no potential for the Project alone to cause indirect impacts through effects on habitats and prey species of Sandwich tern of the SPA. This is on the basis that all assessments relating to prey and supporting habitats have concluded no significant effect on habitats or prey.

1066. Subsequently, there is no potential for the Project to contribute to causing indirect impacts through effects on habitats and prey species, or act in opposition to the Conservation Objectives of the SPA or the specific target to maintain the distribution, abundance and availability of key food and prey items, in-combination with other plans and projects.

6.7.9 Summary of Potential Effects on Site Integrity

6.7.9.1 Construction

1067. There is in summary no potential for the Project to have an AEoSI for the Greater Wash SPA through disturbance and displacement or indirect impacts on habitats or prey during construction, either alone or in-combination with other plans and projects.

6.7.9.2 Operation and Maintenance

1068. There is in summary no potential for the Project to have an AEoSI for the Greater Wash SPA through disturbance and displacement or indirect impacts on habitats or prey during the operation and maintenance phase, either alone or in-combination with other plans and projects.

6.7.9.3 Decommissioning

1069. There is in summary no potential for the Project to have an AEoSI for the Greater Wash SPA through disturbance and displacement or indirect impacts on habitats or prey during decommissioning, either alone or in-combination with other plans and projects.

7 Stage 2 Assessment of Sites Designated for Annex II Marine and Intertidal Ornithology

7.1 Approach to Assessment

1070. This section provides information to determine whether it is possible to exclude adverse effect from the Project on the qualifying features of designated sites (Special Protection Areas (SPAs)) screened into the AA, or to exclude any compromise to each site's conservation objectives and / or site integrity (**Table 7-4**).
1071. For each designated site screened into the AA, a site description is provided. Depending on the information available, this may include citation data for the site, its conservation objectives, SACO, conservation advice, site condition monitoring or other baseline resources.
1072. In order to reduce repetition of assessments, where appropriate, consideration of qualitative assessments have been presented together as a generic text for all designated sites and features screened in for assessment for potential impact pathways and project phases (as opposed to repeating the assessments in each individual case). This includes consideration of indirect effects via habitat or prey availability and barrier effects (although the 2022 Joint SNCB Interim Displacement Advice Note suggests barrier effects are incorporated within displacement assessment, Natural England requested that they be considered separately in response to the DBD Scoping Report and therefore, they have been screened in separately in the DBD HRA Addendum (RHDHV, 2024a)). Similarly, for more distant sites, where the level of connectivity can be considered relatively weak, as evidenced through the level of predicted impact apportioned to the designated site, assessments have been presented for all relevant designated sites together for one receptor.

7.2 Consultation

1073. Consultation in relation to offshore and intertidal ornithology has been key to the development of the Project. A summary of the key issues raised during consultation, that are specific to sites and qualifying features, are outlined below (**Table 7-1**).

REPORT TO INFORM APPROPRIATE ASSESSMENT

Table 7-1 Technical Consultation Undertaken to Date on Offshore and Intertidal Ornithology

Meeting (date)	Stakeholders	Comment	Where addressed in Report to Inform Appropriate Assessment (RIAA)
Expert Topic Group 2 (ETG2) (23/05/2024)	Natural England Royal Society for the Protection of Birds (RSPB)	Does the ETG agree with the use of the Scottish Natural Heritage (SNH) apportionment tool? Natural England Feedback: <ul style="list-style-type: none"> Use of SNH apportioning tool is okay to use. SNH tool calculations are based on a weighted distance from English perspective and can overestimate the apportionment to larger distant colonies. Need to sense check against tracking studies to ensure site-specific details used. Need to recognise bias towards larger SPAs. 	The SNH apportioning tool has been considered as part of the methodology, with consideration of tracking studies to justify the results. A full methodology of the HRA apportionment process is provided in Appendix A.3 Apportionment Report .
		Does the ETG agree with the use of a proportional approach to age classes? Natural England Feedback: <ul style="list-style-type: none"> Natural England are of the view that unless birds are specifically classified as non-breeders, they are assumed to be adult birds. 	The Project has followed the advice provided by Natural England to inform age classes of species recorded. A full methodology of the HRA apportionment process is provided in the Appendix A.3 Apportionment Report .
		Does the ETG agree with the incorporation of sabbatical breeders in apportionment? Natural England Feedback: <ul style="list-style-type: none"> Natural England do not consider sabbatical rates for apportionment. 	Sabbatical rates have not been considered as part of the apportionment process as per the recommendation of Natural England. A full methodology is provided in Appendix A.3 Apportionment Report .
		Does the ETG agree with the non-breeding apportionment method using Furness (2015) as outlined in the Natural England best practice guidance? Natural England Feedback: <ul style="list-style-type: none"> Natural England agrees with this approach but state that if there is site specific evidence this should be taken forward. 	The approach for non-breeding apportionment using the Furness (2015) approach has been applied as per suggestion from Natural England. A full methodology of the apportionment process is provided in the Appendix A.3 Apportionment Report .
		Does the ETG agree with the inclusion of offshore breeders in the apportionment process? Natural England Feedback: <ul style="list-style-type: none"> Natural England are still considering their response to the Outer Dowsing incorporation of offshore breeders. They request more detailed methodology and to provide a with and without offshore breeder scenario. 	To confirm offshore breeders have not been included within the apportionment undertaken for the Draft RIAA, however the Project is considering the feasibility of inclusion for the Final RIAA. A full methodology of the HRA apportionment process is provided in the Appendix A.3 Apportionment Report .
		Does the ETG agree with the use of Outer Dowsing data on offshore breeders? Natural England Feedback: <ul style="list-style-type: none"> Natural England will be providing feedback on Outer Dowsing data and so use for Dogger Bank D (DBD) will be based upon this response. 	Offshore breeders have not been included within the apportionment undertaken for the Draft RIAA, however the Project is considering the feasibility of inclusion for the Final RIAA. Therefore, the use of Outer Dowsing data will be clarified at this later stage. A full methodology of the HRA apportionment process is provided in the Appendix A.3 Apportionment Report .

REPORT TO INFORM APPROPRIATE ASSESSMENT

Meeting (date)	Stakeholders	Comment	Where addressed in Report to Inform Appropriate Assessment (RIAA)
ETG2 (21/11/2024)	<ul style="list-style-type: none">Natural EnglandRSPBMarine Management Organisation (MMO)	<p>Would Natural England consider a mixture of Digital Aerial Survey (DAS) and other literature to form appropriate age classes? – Furness (2015) or Horswill and Robinson (2015) or latest guidance document on demographic rates (Natural England and Natural Resource Wales (NRW))?</p> <p>Natural England Feedback:</p> <ul style="list-style-type: none">Natural England disagrees with the use of a theoretical generalized stable age structure to apportion impacts to adults from SPA colonies as it is unlikely to represent actual proportions of adults present and may lead to underestimation of impacts. There is currently a lack of research to inform where birds of different ages go, therefore if there is no site-specific evidence regarding ages and data based on tracking, Natural England’s assumption is if it looks like an adult then they must presume it is an adult.	<p>As per the request of Natural England, site-specific data to determine age classes has been used, as derived from the DAS. In addition, where no site-specific information is available, the assumption is that 100% are adults. A full methodology of the HRA apportionment process is provided in Appendix A.3 Apportionment Report.</p>
NatureScot (14/10/2024)	<ul style="list-style-type: none">NatureScot	<p>With the Project being in English waters, the assessment will be following Natural England’s approach. Is this okay with NatureScot?</p> <p>NatureScot Feedback:</p> <ul style="list-style-type: none">NatureScot will not be looking for Scottish assessment methodology for English waters.	<p>As per the agreement with NatureScot, a single assessment approach following Natural England’s preferred methods was appropriate to inform all assessments within the RIAA, including Scottish sites. See Section 7.13.</p>
		<p>NatureScot stated that some of the Scottish sites that have been screened in are unusual and that all sites should be reviewed by assessing tracking studies to understand connectivity.</p>	<p>A review of the Scottish SPAs screened in for assessment was conducted, with details provided in Table 7-3. The connectivity in the non-breeding seasons and the migratory corridors of certain species were considered for this approach. See Section 7.3.</p>
		<p>Effects on Scottish SPAs will be addressed in a stand-alone section for ease of access and review for NatureScot.</p> <ul style="list-style-type: none">NatureScot appreciated and agreed with this approach.	<p>As per agreement and appreciated from NatureScot, the Scottish SPAs have been considered in a stand alone section (Section 7.13). Forth Islands is also considered in Section 7.9.</p>

7.3 Updates to Screening Conclusions

7.3.1 Updates between HRA Screening and HRA Screening Addendum

1074. A HRA Screening Report was submitted in December 2023 and in July 2024 addendum to the HRA screening was submitted with a summary of the revised screening provided in **Section 4.3**. The addendum was based on consultation responses received from Natural England (DAS UDS.A006626 02/02/2024), with the changes made in the addendum outlined in **Table 7-2**.

Table 7-2 Updates to Screening Within the HRA Screening Addendum

Updates made in HRA screening addendum	Justification
All features apart from little tern screened out for all impacts at Humber Estuary.	Final offshore ECC and landfall site agreed which means the Humber Estuary is now located 25km away, and so no effects would extend this distance.
Indirect effects via habitat and prey availability screened in for construction, operation and maintenance and decommissioning phases.	Planning Inspectorate (2023) did not agree with the scoping out of direct habitat loss.
Barrier effects during the operational and maintenance phase are screened in.	Natural England would not support the screening out of barrier effects based on conclusions made in the DBC and Sofia EIA.
Tern species at Greater Wash SPA screened in for direct disturbance and displacement effects from work activities in the DBD Array Area, offshore ECC or landfall. Requires further consideration of potential LSE.	Natural England were not in agreement with the screening out of the tern species.
Vessel movements and other work activities screened in for the operation and maintenance phase.	Natural England advised that this impact be screened in, particularly for the Greater Wash SPA.
Gannet, guillemot, razorbill and puffin have been screened in for displacement impacts during construction and decommissioning.	Natural England advised that displacement impacts for these phases and species should be screened in.

7.3.2 Further Updates Following HRA Screening Addendum

1075. Since the HRA addendum was submitted, a review of the full 24 months of site-specific DAS data was completed as well as further interrogation of available evidence. This has resulted in further updates to the original HRA screening conclusions (**Table 7-3**).

Table 7-3 Updates to HRA Screening Addendum

Updates made since HRA screening addendum	Justification
The closest distance from an SPA to the Project Array Area plus buffer has been considered, rather than the DBD Array Area only.	Within the DBD HRA Screening Addendum Annex 1: Stakeholder Responses to HRA Screening Report (2023) Natural England recommended the approach and so this has been carried forward when assessing distance to SPAs.
Great skua has been screened out of all SPAs and impact pathways	A total of 24 months of site-specific data recorded great skua infrequently and in low numbers. Birds were only present within the DBD Array Area in the non-breeding season (PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology , and PEIR Volume 2, Appendix 13.2 Offshore Ornithology Baseline Characterisation). Migratory corridors for great skua in the non-breeding season suggest a 0km to 40km corridor from the shore for UK (WWT and MacArthur Green, 2014). Based on these pieces of information the potential for likely significant effect (LSE) can be ruled out.
Arctic skua has been screened out of all SPA and impact pathways	A total of 24 months of site-specific data recorded Arctic skua infrequently and in low numbers. Birds were only present within the DBD Array Area in the non-breeding season (PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology , and PEIR Volume 2, Appendix 13.2 Offshore Ornithology Baseline Characterisation). Migratory corridors for Arctic skua in the non-breeding season suggest a 0km to 20km corridor from the shore for UK (WWT and MacArthur Green, 2014). Based on these pieces of information the potential for LSE can be ruled out.
Roseate tern been screened out of for all sites and all impact pathways.	A total of 24 months of site-specific data provided no records of roseate tern in the DBD Array Area. Therefore, no potential for LSE concluded.
Common tern has been screened out of all sites for disturbance and displacement due to presence of wind turbines and other offshore infrastructure as well as for collision risk.	A total of 24 months of site-specific data recorded common tern in a single survey in May 2022 (PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology , and PEIR Volume 2, Appendix 13.2 Offshore Ornithology Baseline Characterisation). Migratory corridors for common tern in the non-breeding season suggest a 0km to 10km corridor from the shore for UK birds (WWT and MacArthur Green, 2014). Therefore, birds migrating from the northerly SPAs will have little to no connectivity with the DBD Array Area due to its large distance offshore. Based on these pieces of information the potential for LSE can be ruled out.

Updates made since HRA screening addendum	Justification
Sandwich tern has been screened out of all sites for disturbance and displacement due to presence of wind turbines and other offshore infrastructure as well as for collision risk.	A total of 24 months of site-specific data recorded Sandwich tern in a single survey in April 2023 (PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology , and PEIR Volume 2, Appendix 13.2 Offshore Ornithology Baseline Characterisation). Migratory corridors for sandwich tern in the non-breeding season suggest a 0km to 10km corridor from the shore for UK birds (WWT and MacArthur Green, 2014). Therefore, birds migrating from the northerly SPAs will have little to no connectivity with the DBD Array Area due to its large distance offshore. Based on these pieces of information the potential for LSE can be ruled out.
Arctic tern has been screened out of all sites and all impact pathways.	Migratory corridors for Arctic tern in the non-breeding season suggest a 0 to 10km corridor from the shore for UK birds (WWT and MacArthur Green, 2014). Therefore, birds migrating from the northerly SPAs will have little to no connectivity with the DBD Array Area due to its large distance offshore. Based on these pieces of information the potential for LSE can be ruled out.
Shag and cormorant have been screened out of all sites and all impact pathways.	No cormorants or shags were recorded within the DBD Array Area or any relevant buffers during 24 months of DAS. When regarding the offshore ECC and landfall, no shag records occurred during the desk study of the intertidal area (PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology , and PEIR Volume 2, Appendix 13.2 Offshore Ornithology Baseline Characterisation). Similarly, the majority of records for cormorant were of birds in passage or a single individual present. A high of 68 birds were present at a site north of the landfall. Cormorants are also determined as not having a high sensitivity to vessel disturbance (Fließbach <i>et al.</i> , 2019). Due to the spatially and temporally limited nature of effects due to work activity in the construction and decommissioning phase, couple with the aforementioned information on each species, the potential for LSE can be ruled out.
The herring gull and kittiwake features of Coquet Island SPA has been screened out for all impact pathways.	Incorrectly screened through as herring gull and kittiwake are neither a qualifying feature, nor named component of the SPA.
The lesser black-backed gull feature of Coquet Island SPA and Forth Islands SPA has been screened out for all impact pathways.	Screen out as there is no impact during the non-breeding season based on lack of records within the 24 months of site-specific data (PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology , and PEIR Volume 2, Appendix 13.2 Offshore Ornithology Baseline Characterisation).

Updates made since HRA screening addendum	Justification
The guillemot feature of Fowlsheugh SPA, Troup, Pennan and Lion’s Head SPA, East Caithness Cliffs SPA, North Caithness Cliffs SPA, Fair Isle SPA, West Westray SPA, Noss SPA and Foula SPA has been screened out for all impact pathways.	No potential for LSE based on regional approach to guillemot assessment within the non-breeding season as per ETG with NatureScot (see Section 7.2 for further details).
The razorbill feature of East Caithness Cliffs SPA has been screened out for all impact pathways.	No potential for LSE based on regional approach to razorbill assessment within the non-breeding season as per ETG with NatureScot (see Section 7.2 for further details).
The puffin feature of Hermaness, Saxa Vord and Valla Field SPA has been screened out for all impact pathways.	No potential for LSE based on non-breeding dispersal behaviour of puffins leading to limited to no connectivity.

7.3.3 Updated Screening Conclusion Summary

1076. Accounting for all updates to the screening detailed above, **Table 7-4** provides the final list of all offshore ornithology sites and features taken through for AA. For reference, the initial HRA screening outcomes are found in the HRA Screening Report (**Appendix A.2**).

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Table 7-4 Screening Summary for all Designated Sites and features for which the Potential for LSE could not be Discounted at Screening and for which Assessment is required

Designated site	Relevant features (Seasons assessed)	Construction	Operation and Maintenance	Decommissioning
Greater Wash SPA	Little tern (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts
	Common tern (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts
	Sandwich tern (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts
	Common scoter (non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts
	Red-throated diver (non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts
Humber Estuary SPA	Little tern (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Indirect effects via habitats or prey availability In-combination impacts

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Designated site	Relevant features (Seasons assessed)	Construction	Operation and Maintenance	Decommissioning
FFC SPA	Kittiwake (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> Indirect effects via habitat or prey availability 	<ul style="list-style-type: none"> Collision risk Indirect effects via habitat or prey availability Barrier Effects In-combination effects 	<ul style="list-style-type: none"> Indirect effects via habitat or prey availability
	Guillemot (non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability Barrier Effects In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts
	Razorbill (non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability Barrier Effects In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts
	Gannet (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitat or prey availability In-combination impacts 	<ul style="list-style-type: none"> Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Collision risk Indirect effects via habitat or prey availability Barrier Effects In-combination effects 	<ul style="list-style-type: none"> Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitat or prey availability In-combination impacts
	Seabird assemblage (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure

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Designated site	Relevant features (Seasons assessed)	Construction	Operation and Maintenance	Decommissioning
		<ul style="list-style-type: none"> Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Indirect effects via habitats or prey availability Barrier Effects Collision risk In-combination impacts 	<ul style="list-style-type: none"> Indirect effects via habitats or prey availability In-combination impacts
	Herring gull (component species) (non-breeding bio-season)	<ul style="list-style-type: none"> Indirect effects via habitat or prey availability 	<ul style="list-style-type: none"> Collision risk Indirect effects via habitats or prey availability Barrier Effects In-combination impacts 	<ul style="list-style-type: none"> Indirect effects via habitat or prey availability
Coquet Island SPA	Seabird assemblage (non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability Barrier Effects In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts
	Puffin (non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability Barrier Effects In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts

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Designated site	Relevant features (Seasons assessed)	Construction	Operation and Maintenance	Decommissioning
Farne Island SPA	Guillemot (non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability Barrier Effects In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts
	Seabird assemblage (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability Barrier Effects Collision risk In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts
	Kittiwake (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> Indirect effects via habitat or prey availability 	<ul style="list-style-type: none"> Collision risk Indirect effects via habitats or prey availability Barrier Effects In-combination impacts 	<ul style="list-style-type: none"> Indirect effects via habitat or prey availability
	Puffin (non-breeding bio-season)	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability Barrier Effects In-combination impacts 	<ul style="list-style-type: none"> Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure Indirect effects via habitats or prey availability In-combination impacts

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Designated site	Relevant features (Seasons assessed)	Construction	Operation and Maintenance	Decommissioning
Forth Islands SPA	Gannet (breeding and non-breeding bio-season)	<ul style="list-style-type: none"> • Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure • Indirect effects via habitats or prey availability • In-combination impacts 	<ul style="list-style-type: none"> • Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure • Indirect effects via habitats or prey availability • Collision risk • Barrier Effects • In-combination impacts 	<ul style="list-style-type: none"> • Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure • Indirect effects via habitats or prey availability • In-combination impacts
	Puffin (non-breeding bio-season)	<ul style="list-style-type: none"> • Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall • Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure • Indirect effects via habitats or prey availability • In-combination impacts 	<ul style="list-style-type: none"> • Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall • Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure • Indirect effects via habitats or prey availability • Barrier Effects • In-combination impacts 	<ul style="list-style-type: none"> • Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall • Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure • Indirect effects via habitats or prey availability • In-combination impacts
Fowlsheugh SPA	Kittiwake (non-breeding bio-season)	<ul style="list-style-type: none"> • Indirect effects via habitats or prey availability 	<ul style="list-style-type: none"> • Collision risk • Indirect effects via habitats or prey availability • Barrier Effects • In-combination impacts 	<ul style="list-style-type: none"> • Indirect effects via habitats or prey availability
East Caithness Cliffs SPA	Herring gull (non-breeding bio-season)	<ul style="list-style-type: none"> • Indirect effects via habitats or prey availability 	<ul style="list-style-type: none"> • Collision risk • Indirect effects via habitats or prey availability • Barrier Effects • In-combination impacts 	<ul style="list-style-type: none"> • Indirect effects via habitats or prey availability
	Kittiwake (non-breeding bio-season)	<ul style="list-style-type: none"> • Indirect effects via habitats or prey availability 	<ul style="list-style-type: none"> • Collision risk • Indirect effects via habitats or prey availability • Barrier Effects • In-combination impacts 	<ul style="list-style-type: none"> • Indirect effects via habitats or prey availability

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Designated site	Relevant features (Seasons assessed)	Construction	Operation and Maintenance	Decommissioning
Noss SPA	Gannet (non-breeding bio-season)	<ul style="list-style-type: none">• Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure• Indirect effects via habitats or prey availability• In-combination impacts	<ul style="list-style-type: none">• Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure• Indirect effects via habitats or prey availability• Collision risk• Barrier Effects• In-combination impacts	<ul style="list-style-type: none">• Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure• Indirect effects via habitats or prey availability• In-combination impacts
Hermaness, Saxa Vord and Valla Field SPA	Gannet (non-breeding bio-season)	<ul style="list-style-type: none">• Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure• Indirect effects via habitats or prey availability• In-combination impacts	<ul style="list-style-type: none">• Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure• Indirect effects via habitats or prey availability• Collision risk• Barrier Effects• In-combination impacts	<ul style="list-style-type: none">• Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure• Indirect effects via habitats or prey availability• In-combination impacts

7.4 Assessment of Potential Effects

7.4.1 Embedded and Standard Mitigation Measures

1077. The embedded and standard mitigation measures considered for offshore and intertidal ornithology are presented in **Table 7-5**.

7.4.2 Worst-Case Scenario

1078. The worst-case scenario of the Project in relation to offshore and intertidal ornithology is outlined in **PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology (Section 13.4.4)**.

7.4.3 Biological Seasons, Populations and Demographics

1079. The bio-seasons taken through for assessment for each of the qualifying features are outlined within **PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology (Section 13.6.2.2)**. These bio-seasons were agreed in principle with Natural England (**PEIR Volume 2, Appendix 13.1 Consultation Responses for Offshore and Intertidal Ornithology**), however, further agreement will be made once they have had receipt of the chapter at PEIR.
1080. Impact assessments are carried out against the citation population and the latest count for the qualifying features screened in for assessment. A further textual breakdown is provided for the assessments considering the latest count as this is the most up-to-date information to assess against for each species.

7.4.4 Apportionment of Potential Impacts

1081. Due to there being multiple colonies with potential connectivity to the Project during both the breeding and non-breeding bio-seasons, an apportionment process has been completed to understand the level of potential impact for each qualifying feature of designated sites screened in for assessment (Royal HaskoningDHV, 2024a; **Table 7-4**). The level of potential connectivity between the Project and the qualifying features of designated sites may vary seasonally, therefore apportionment has been undertaken on a seasonal basis. The approach to apportionment was discussed during consultation with Natural England (**Section 7.2**). However, it is important to note that apportionment rates are based on the proportion of adult birds expected to have connectivity with the Project unless stated otherwise. A detailed breakdown of the apportionment methodology applied for the Project and proportional impact splits for each SPA feature assessed is provided in **Appendix A.3 Apportionment Report**.

1082. In addition, the ‘Qualifying Features’ Section (**Sections 7.6.1.1, Section 7.7.1.1, Section 7.8.1.1 and Section 7.9.1.1**) of each SPA account contains the individual apportioning rates per bio-season for the qualifying features taken through for assessment.

7.4.5 Disturbance and Displacement Due to the Presence of Wind Turbines and Other Offshore Infrastructure

7.4.5.1 Overview

1083. The presence of wind turbines has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea where the Project is proposed to be developed. For those seabirds that currently occur within and around the Project and may be susceptible to displacement from the development, this potentially reduces the area available to forage, loaf and / or moult. Displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could lead to the mortality of individuals.
1084. Seabird species vary in their response to the presence of operational infrastructure associated with Offshore Wind Farms (OWFs), such as wind turbines and shipping activity related to maintenance activities. OWFs are a new feature in the marine environment and as a result there is limited evidence as to the effects of disturbance and displacement by operational infrastructure long term.
1085. Garthe and Hüppop (2004) developed a scoring system for such disturbance factors, which has been widely applied in OWF EIAs. Furness and Wade (2012) used a similar system with disturbance ratings for particular species that was applied alongside scores for habitat flexibility and conservation importance to define an index value that highlights the sensitivity of each species to disturbance and displacement. Bradbury *et al* (2014) provided an update to the Furness and Wade (2012) paper to consider seabirds in English waters.
1086. Natural England and Joint Nature Conservation Committee (JNCC) issued a Joint Interim Displacement Advice Note (Natural England and JNCC 2012), which provides recommendations for presenting information to enable the assessment of displacement effects in relation to OWF developments. This has been superseded more recently by a joint SNCB interim displacement advice note (SNCBs, 2022), which provides the latest advice for UK development applications on how to consider, assess and present information and potential consequences of seabird displacement from OWFs. These guidance notes have shaped the assessments provided in the forthcoming sections.

REPORT TO INFORM APPROPRIATE ASSESSMENT

Table 7-5 Embedded Mitigation Measures Relevant to Offshore and Intertidal Ornithology

Relevance to Offshore and Intertidal Ornithology	Commitment ID	Proposed Commitment	How the Commitment will be Secured
Collision risk	CO13	There will be a minimum blade tip clearance of at least 26m above highest astronomical tide, and 28m above lowest astronomical tide.	DCO Works
Vessel disturbance	CO18	A Vessel Traffic Management Plan (VMP) will be provided as part of the Project Environmental Management Plan (PEMP) and will aim to minimise, as far as reasonably practicable, encounters with marine mammals and common scoter and red-throated diver. The Vessel Management Plan will adhere to latest relevant guidelines for reducing risk of collision with relevant marine species.	DML Condition - Project Environmental Management Plan
Disturbance	CO19	An Ecological Clerk of Works (ECoW) will be present during construction works at the landfall to keep a watching brief for red-throated diver and common scoter. Should high densities of these species be observed during construction, mitigation measures will be adopted to reduce disturbance as needed, such as temporary stoppage of those construction activities causing disturbance.	DML Condition - Project Environmental Management Plan
Underwater noise and disturbance to prey species	CO22	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
Pollution	CO25	A Project Environmental Management Plan (PEMP) will be provided in accordance with the Outline PEMP and will include: <ul style="list-style-type: none"> • A Marine Pollution Contingency Plan (MPCP), which will include plans to address the risks, methods and procedures to deal with any spills and collision incidents in relation to all activities carried out below Mean High Water Springs (MHWS) to safeguard the marine environment; • Best practice measures for the storage, use and disposal of lubricant and chemicals will be undertaken throughout the construction phase; • A Chemical Risk Assessment (CRA) to ensure any chemicals, substances and materials to be used will be suitable for use in the marine environment and in accordance with the Health and Safety Executive and the Environment Agency Pollution Prevention Control Guidelines or latest relevant available guidelines; • A marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised; and • Details of waste management and disposal arrangements. 	DML Condition - Project Environmental Management Plan
Monitoring	CO30	An Ornithological Monitoring Plan (OMP) will be provided in accordance with the Outline OMP. The OMP will set out proposals for ornithological monitoring.	DML Condition - Ornithological Monitoring Plan
Disturbance nearshore	CO92	Where construction works are undertaken within or adjacent to open field, wetland or foreshore habitat between November and January, a pre-construction survey will be undertaken as required by a suitably qualified ecologist to record the distribution and abundance of overwintering waterbird flocks in line with the Outline Ecological Management Plan (EcoMP), and the distribution of suitable habitat likely to be affected during the winter season within which construction works will be undertaken. The findings of these pre-construction surveys will determine whether mitigation measures to reduce disturbance to waterbird flocks would be required. During the construction works, should over-wintering waterbirds be present, a suitably qualified ecologist will be responsible for advising on the appropriate levels of mitigation such as watching briefs and toolbox talks to site personnel.	DCO Requirement - Ecological Management Plan

1087. Some species are more susceptible than others to disturbance from OWF operation, which may lead to subsequent displacement. Dierschke *et al* (2016) noted both displacement and avoidance to varying degrees by some seabird species while others were attracted to OWFs. As presented within **Table 7-4**, a total of four species (guillemot, razorbill, puffin and gannet) were concluded to require quantitative assessments of disturbance and displacement from the Project (the DBD Array Area and 2km buffer).
1088. For each of the four species a review was undertaken of evidence from the literature on potential disturbance levels and displacement effects from OWFs and rates applied in assessments of displacement effects by other OWFs. These reviews have been used to inform the Applicant's approach. Assessments following the SNCB guidance have been provided for each species. In addition, an Applicant's approach is presented based on refinement that incorporates site-specific evidence and any relevant updates to current guidance. This is to provide a more realistic worst-case scenario, taking into account the best available scientific evidence.
1089. The mean peak abundance of the DBD Array Area plus 2km asymmetrical buffer was used for each species being assessed for displacement impacts as recommended in the joint SNCB interim displacement advice note (SNCBs, 2022). Due to Dogger Bank C (DBC) Array Area directly abutting DBD Array Area, asymmetrical buffers were considered to avoid double counting of displacement impacts due to the overlapping buffers. Full details of the asymmetrical buffer are provided in **PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology**, and **PEIR Volume 2, Appendix 13.4 Offshore Displacement Analysis Report**.

7.4.5.2 Auk Species Displacement Rate Evidence Base

1090. Displacement impacts from OWF post-consent monitoring studies were reviewed by Dierschke *et al* (2016). The review concluded that the most common response to the presence of turbines for auks was 'weak displacement' but with a few exceptions such as for the Dutch and Belgium OWFs which suggested displacement rates of 60% to 75%. However, auk abundance within these studies tends to be low and re-analysis of these data using INLA suggested displacement effects could be lower than 50% or shown to be not statistically significant (Zuur, 2018). There have been further displacement studies on auks (APEM, 2017; Webb *et al.*, 2017; Vanermen *et al.*, 2019; Peschko *et al.*, 2020; MacArthur Green, 2021) which have been summarised as part of a more recent comprehensive review on auk displacement responses to OWFs (APEM, 2022b).

1091. This review (APEM, 2022b) provides an extensive analysis of empirical data from multiple OWFs expanding and updating the review by Dierschke *et al* (2016). The review concluded that auk displacement varied considerably between study sites showing attraction, no significant effect or a displacement effect. For example, the studies on guillemot included: one OWF with positive displacement effects, eight OWFs with no significant effects or weak displacement effects, three with inferred displacement effects (but not statistically tested) and eight with negative displacement effects. The displacement effects from those studies which provided a defined displacement rate ranged from +112% to -75%. The number of studies on razorbill are considerably less but show a similar range of displacement responses from three studies suggesting no significant effects and three studies indicating a displacement rate which range from 30% to 80%. For puffin there have been few empirical studies of displacement rates for OWFs, in the review by Dierschke *et al* (2016) a response class for displacement was not allocated to this species due to lack of data. However, disturbance susceptibility for puffin has been estimated to be less than guillemot and razorbill (Bradbury *et al.*, 2014). Therefore in the absence of species -specific displacement rates for puffin, it is considered reasonable to rely on those rates used for guillemot and razorbill. Although displacement rates of 50% or more were concluded for some of these studies, such levels of displacement were only observed in the non-breeding season. Review of the analysis methods and quality of the datasets for these studies, found that some studies have not utilised the most appropriate statistical modelling methods for the data collected. These studies were coincidentally found to have high displacement rates due to low abundance and high numbers of zero counts, making displacement rate prediction highly problematic given natural spatial and temporal variation in auk abundance and distribution. As such, the displacement effects reported in these studies are most likely over precautionary. The conclusion from the APEM (2022b) literature review suggested that a displacement rate of up to 50% for the Array Area and 2km buffer would be the most evidence-based approach for UK OWFs, whilst still being suitably precautionary for assessment. Lamb *et al* (2024) conducted a meta-analysis to assess the likelihood of detecting a response from seabirds to OWFs. The analysis concluded that the presence and rate of distributional change reported in studies was dependent on study design criteria and wind farm characteristics, suggesting displacements rates are likely to be site specific.

1092. Further evidence that an auk displacement rate of 50% is precautionary comes from studies that indicate auk ‘habituation’ to OWFs. This was recently demonstrated at Thanet OWF, where auk displacement was shown to be statistically significant, but only in the short term, with abundances increasing within the wind farm from year two post-construction suggesting some level of ‘habituation’ after one year of operation. Indeed, year two and three displacement rates for auks fell from a range of 75% to 85% in the first year of operation to a low of 31% to 41% within year two and three of operations (Royal Haskoning, 2013). There is also further emerging evidence as additional post-construction monitoring of OWFs continues, with reports of auk numbers increasing and observations of foraging behaviour within the wind farm itself (Leopold & Verdaat 2018). This includes evidence of habituation within OWFs of the Belgium wind farm concession zone which previously concluded displacement rates of over 70% now reporting higher numbers within the wind farm than outside (Degraer *et al.*, 2021). This would suggest that displacement rates are expected to diminish over the operational life of OWFs.
1093. The most recent evidence in relation to auk behavioural responses to OWFs in the UK comes from the post-construction monitoring of Beatrice OWF, which indicated higher abundances of guillemot and razorbill within the Beatrice OWF compared to pre-construction surveys (MacArthur Green, 2021). Specifically, results indicated that there were significant increases in overall auk abundance following post-construction. Results from the second year of post-consent monitoring suggested no indication of avoidance of the OWF or individual turbines and in some cases higher densities of auks were recorded in proximity to turbines (MacArthur Green, 2023). Overall, it was concluded that no displacement effects on auks were detected from the two years of post-construction monitoring for the Beatrice OWF (Trinder *et al.*, 2024).
1094. The only studies that report significant and robust displacement effects are for OWFs in the German North Sea. Peschko *et al.* (2020), reported displacement effects of 44% in the breeding season although with a 95% CI of 8 to 66% suggesting considerable uncertainty. Later studies on displacement effects during the non-breeding season reported that only during the post breeding migration did displacement within the OWF and response radius reach 79%. For the winter period the displacement effect was reported at 51% within the OWF and response radius (Peschko *et al.*, 2024). However, as Lamb *et al.* (2024) concluded, reported displacement responses are likely to be site specific especially between different wind farm designs and distant geographical locations.
1095. Therefore, in conclusion, there is strong evidence to support an Applicant’s approach auk displacement rate of 50% within OWF sites and out to a 2km buffer. This would be considered precautionary as displacement effects of 50% or higher have not been concluded in the breeding season in any study and significant displacement effects of 70% or higher have only been concluded during autumn passage and only within one study area, which is outside UK waters and has particularly large numbers of guillemot pass through this area (Peschko *et al.*, 2024). This does not align with the SNCB guidance approach that suggests the use of up to 70% displacement for all seasons. Both approaches will be provided in the impact assessments for all three auk species.
- #### 7.4.5.3 Effects of Displacement on Auk Mortality
1096. Current evidence suggests that the response of seabirds to OWFs varies depending on the species and life stage of the individual birds. The levels both spatially and temporally to which birds may avoid OWFs are likely to be based on key factors such as competition levels within the wider area and prey abundance within the OWF. The consequence of such avoidance may result in reduced foraging areas being available to individuals. Mortalities are likely to correlate strongly with the quality of the area within the OWF from which some individuals are displaced, but conversely may offer increased foraging efficiency for those still using the OWF area. If the OWF area is considered to be a key foraging area and the area outside the OWF is close to carrying capacity, then higher mortality rates may theoretically occur (Busche and Garthe, 2016; SNCBs, 2017). Conversely, if birds are being displaced into an area of optimal habitat and closer to breeding colonies, then this could result in a positive impact due to the reduction in energy expenditure when foraging (Searle *et al.*, 2020).
1097. For auk species, SNCB current guidance is to present and consider assessing displacement impacts using a mortality rate of up to 10% (SNCBs, 2022), the appropriateness of using mortality rates as high as 10% is unclear given the lack of evidence. Furthermore recent guidance from NatureScot does not advocate mortality rates as high as 10% for displacement assessment (NatureScot, 2023). However, since the interim guidance on displacement (SNCBs, 2022) was published, which was originally drafted in 2017 with the 2022 update only providing further information on red-throated diver, there have been two detailed studies that modelled the predicted consequence of displaced seabirds using IBMs. IBMs incorporate biological parameters such as: wind farm location in relation to relevant seabird colonies; seabird utilisation density maps; energetic requirements and prey distributions to model a more evidence-based fate of displaced birds.

1098. Van Kooten *et al* (2019) determined the cost of birds avoiding areas based on energy-budget models for two scenarios; using habitat utilization maps and using a fixed 10% mortality rate due to habitat loss, previously described by Leopold *et al* (2014). The results demonstrated that an additional 1% mortality for displaced auks is a more appropriate evidenced-based rate in the absence of OWF effects, in comparison to the overly precautionary 10% mortality rate.
1099. Searle *et al* (2014; 2018) assessed the effects displacement and barrier effects have on breeding seabirds. The study was based on time and energy budget models being created to estimate the displacement impacts on the breeding population of seabirds, including auks during the chick rearing period. The models provided evidence that displacement has the potential to impact on future survival prospects of an auk due to changes in time and energy budgets. The model simulations consistently yielded estimated OWF project alone effects that corresponded to additional declines in SPA adult survival of less than 1% for auks.
1100. A key factor determining the effects of displacement is the importance of the array area (such as prey abundance) in the context of the surrounding area. However, OWF site selection process avoids areas of known high density usage by seabirds reducing impacts from potential displacement. This assumes that areas of higher prey availability are available within foraging distance outside the array area for displaced birds. Based on the best available evidence from the IBM simulation studies, it is suggested that mortality rates for displaced birds are considerably less than 10%. Indeed, Searle *et al* (2020) demonstrated that modelled estimates of additional mortality at SPAs to combined OWF footprint displacement can be lower than 1%.
1101. Further anecdotal evidence of negligible additional mortality rates as a consequence of displacement comes from the post consent monitoring of the Helgoland auk colony in the German North Sea. OWFs have been in operation in the area since 2014 and a displacement rate for auks was reported of 44% to 63% (Peschko *et al.*, 2020). The OWFs have therefore been in operation long enough for any correlations between colony demographics and operation of the OWF to be identified. The latest breeding population status on Helgoland shows a continued increase for both razorbill and guillemot over the latest five-year period, with rates of population increase unchanged compared to long-term data (Gerlach *et al.*, 2019), inferring that high mortality rates due to displacement are not occurring at the colony.
1102. Therefore, a matrix approach using a broad range of mortality rates can be refined using estimations based on available evidence from IBM studies (Van Kooten *et al.*, 2019; Searle *et al.*, 2014, 2018, and 2022), which suggest additional mortality rates for displaced seabirds are unlikely to exceed 1% for SPA birds especially at the limit of their foraging range and given that OWF site selection avoids areas preferred and utilised by seabirds. Therefore, based on best available evidence from IBM studies the Applicant's approach considers a mortality rate of 1% to be sufficiently precautionary for assessment of consequential displacement mortality. This is different to the SNCB guidance approach that suggests the use of up to 10% mortality. Both approaches will be provided in the impact assessments for all three auk species.

7.4.5.4 Gannet Displacement Rate Evidence Base and Consequent Mortality

1103. Gannets show a low level of sensitivity to ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012). A study by Krijgsveld *et al* (2011) using radar and visual observations to monitor the post-construction effects of the Offshore Wind farm Egmond aan Zee (OWEZ) established that 64% of gannets, which would otherwise have transited the wind farm site, avoided entering the wind farm (macro-avoidance). The results of the post-consent monitoring surveys for Thanet OWF found that gannet densities reduced within the site in the third year, but the report did not quantify this (Royal HaskoningDHV, 2013). Evidence from a review undertaken by APEM (2022b), which has collated and critically appraised studies from 25 OWFs, suggests that gannet behavioural response to OWFs varies bio-seasonally with data suggesting displacement rates of 40% to 60% during the breeding bio-season and 60% to 80% during the non-breeding bio-season.
1104. More recent studies in relation to gannet responses to OWFs comes from the Beatrice OWF post-construction monitoring data, which suggested displacement rates, although not quantified directly, in the upper range described above for the breeding season (MacArthur Green, 2021 and 2023), as only 12 gannets were recorded within the OWF during 2021.
1105. Therefore, for the purpose of this assessment, a precautionary upper range approach has been taken and the level of displacement considered across all bio-seasons is between 60% to 80%.

1106. Furthermore, in accordance with the joint advice note regarding bird collision risk modelling for offshore wind developments (SNCBs, 2024), it is recommended that CRM for gannet should include consideration of macro-avoidance. This behaviour is similar to displacement but affects only flying birds, reducing the number of birds entering an OWF site compared to what might be expected in the absence of the OWF (SNCBs, 2024). No specific advice is provided within the joint guidance note (SNCBs, 2024) on how to apply macro-avoidance, however, Natural England commissioned a review of gannet macro-avoidance rates which is recommended as guidance (Pavat *et al.*, 2023). Utilising both the evidence gathered within the APEM (2022b) and Natural England commissioned review (Pavat *et al.*, 2023) a macro-avoidance rate of 70% was selected based on the 60% to 80% displacement range identified in the APEM (2022b) review and empirical data analysed from nine literature sources in Pavat *et al.* (2023) which suggested a lower and upper CI for avoidance of 53% to 97%.
1107. SNCB current guidance is to present and consider assessing displacement impacts using a mortality rate of up to 10% (SNCBs, 2022) the appropriateness of using mortality rates as high as 10% is unclear given the lack of evidence. A mortality rate of 1% was selected for this assessment, based on expert judgement supported by the evidence that suggests that gannet have a large mean max (315km) and maximum (709km) foraging range during the breeding season (Woodward *et al.*, 2019) and during the non-breeding season can travel 200 km to 400 km per day (Garthe *et al.*, 2007). Gannet can switch to different prey depending on availability feeding on a variety of different prey items including mackerel (*Scomber scombrus*), sandeels (*Ammodytes* sp.), immature herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) (Forrester *et al.*, 2007; Hamer *et al.*, 2007) which provide sufficient alternative foraging opportunities despite any potential reduced foraging within the Array Area. Therefore, despite the displacement responses likely by gannets to OWFs, it is highlighted that any potential consequences of displacement would likely be minimal for gannet due to their large foraging range, their diverse diet and the low energy costs associated with the additional flight distances incurred.

7.4.5.5 Site Abundance and Consequent Displacement Mortality

1108. For the four species screened in for displacement assessment, a summary of the predicted abundance for both flying and sitting birds for the DBD Array Area plus a 2km asymmetrical buffer is provided in **Table 7-6**. Information provided in **Table 7-6** is based on the mean peak abundance from the site-specific aerial digital surveys, as recommended for consideration of displacement effects in the Joint SNCB (Updated, 2022) guidance note. **Table 7-6** also provides a summary of the Applicant's operational and maintenance phase displacement and mortality rates for the four species based on the evidence detailed above. The recommended operational and maintenance phase displacement and mortality rate ranges recommended in the Joint SNCB (Updated, 2022) guidance note to capture the SNCB's assumed preferred approach is also presented. The focus of the displacement assessments are based on the mean peak abundances (**Table 7-6**) apportioned out to the various SPAs. Confidence intervals around the mean peak abundances have been apportioned out for SPAs and features taken through for displacement assessment and are provided within **Appendix A.3 Apportionment Report**.
1109. The disturbance and displacement effects which are presented as the Applicant's preferred approach, are considered to represent a realistic, yet precautionary, assessment based on SNCB guidance and the latest scientific evidence as described above. Alongside the Applicant's approach, due consideration is also given to the predicted impacts following the SNCB's preferred approach to displacement and mortality rates, as discussed at the ETG meeting held on 25th October 2023 (details provided in **PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology**, and **PEIR Volume 2, Appendix 13.1 Consultation Responses for Offshore and Intertidal Ornithology**). In line with the SNCB recommended matrix approach to disturbance and displacement assessments, matrices are provided for the key assessments on an annual basis (SNCB, 2022).

Table 7-6 Predicted Site Abundance and Consequent Displacement and Mortality Rates Considered for Assessment during the Operational Phase

Species	Bio-season	Mean peak abundance (DBD Array Area plus 2km asymmetrical buffer)	Applicant's approach			SNCBs approach		
			Displacement rate (%)	Mortality rate (%)	Consequent mortality (individuals per annum)	Displacement rate (%)	Mortality rate (%)	Consequent mortality (individuals per annum)
Guillemot	Breeding	6,872	50	1	34.36	30 to 70	1 to 10	20.62 – 481.04
	Non-breeding	7,406			37.03			22.22 – 518.42
Razorbill	Return migration	1,461	50	1	7.31	30 to 70	1 to 10	4.38 – 102.27
	Migration-free breeding	749			3.75			2.25 – 52.43
	Post-breeding migration	282			1.41			0.85 – 19.74
	Migration-free winter	588			2.94			1.76 – 41.16
Puffin	Breeding	111	50	1	0.56	30 to 70	1 to 10	0.33 – 7.77
	Non-breeding	24			0.12			0.07 – 1.68
Gannet	Return migration	85	60 to 80	1	0.51 – 0.68	60 to 80	1 to 10	00.51 – 6.80
	Migration-free breeding	217			1.30 – 1.74			11.30 – 17.36
	Post-breeding migration	813			4.88 – 8.90			4.88 – 65.04

1110. With respect to displacement rates used for the construction and decommissioning phase assessment of direct disturbance and displacement (due to the presence of wind turbines and other offshore infrastructure (DBD Array Area)), as actual rates of displacement during the construction phase are difficult to determine from the available studies, the following methodology has been applied to determine potential impact levels. Given that installation is limited both spatially and temporarily, any potential effects are unlikely to reach the same level as during the operation. Therefore, for the purpose of providing a precautionary approach to assessing the potential impacts on species during the construction and decommissioning phase of the Project Array Area, the level used is half that of the operational phase assessments. This approach has been agreed with Natural England in ETG meetings (see **PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology**, and **PEIR Volume 2, Appendix 13.1 Consultation Responses for Offshore and Intertidal Ornithology**). As previously noted, the level of potential effect in the construction and decommissioning phases are considered unlikely to reach the same level as the operational phase and therefore a conclusion of **no AEol is also appropriately concluded for all construction phase assessments**. Because of this, the assessments for the construction phase are presented in a succinct manner, to reduce repetition with information already captured in the Operation and Maintenance phase assessments.

- For guillemot, razorbill and puffin the Applicant's operational phase displacement rate of 50%, thus equates to a construction phase displacement rate of 25%. The SNCBs operational phase displacement rate of 30% to 70% would equate to a construction phase displacement rate of 15% to 35%.
- For gannet, the operational phase displacement rate of 60 to 80% would equate to a construction phase displacement rate of 30% to 40%.

1111. A summary of the seasonal predicted abundance estimates and associated operational displacement impacts, prior to apportionment for qualifying features screened in for disturbance and displacement assessment, is provided in **Table 7-6**. An apportionment process has subsequently been applied to the predicted impact values presented in **Table 7-6** following the apportionment process described in **Appendix A.3 Apportionment Report**, to allow for assessment of potential impacts from the Project to each designated site and qualifying feature screened in for assessment (**Table 7-4**).

7.4.6 Collision Risk

7.4.6.1 Overview

1112. There is potential risk to birds from OWFs through collision with wind turbines and infrastructure within the OCS Zone resulting in injury or fatality. This may occur when birds fly through the Array Area whilst foraging for food, commuting between breeding sites and foraging areas, or during migration.

1113. Collision Risk Modelling (CRM) has been carried out for the Project, with detailed methods and results presented in **PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology**, and **PEIR Volume 2, Appendix 13.3 Offshore Collision Risk Modelling**, to provide information for seabird species of interest identified as potentially at risk and of interest for impact assessment.

1114. CRM was undertaken using the Caneco version of the stochastic Collision Risk Modelling (sCRM) (Caneco and Humphries, 2022), using the recommended parameters within the joint SNCB advice note (SNCBs, 2024) for each seabird species, to determine the risk of collision when in flight. Parameters were discussed at the ETG meeting held on 25/10/2023 (details provided in **PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology**, and **PEIR Volume 2, Appendix 13.1 Consultation Responses for Offshore and Intertidal Ornithology**).

1115. CRM accounts for several different species-specific behavioural aspects, including the height at which birds fly, their avoidance response to wind turbines generators and how active they are diurnally and nocturnally. Details of these considerations are provided in **PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology**, and **PEIR Volume 2, Appendix 13.3 Offshore Collision Risk Modelling**.

1116. In order to provide a range of values to capture variability for each species, the Applicant has run a variety of wind turbine scenarios, the results of which can be found in the **PEIR Volume 1, Chapter 13 Offshore and Intertidal Ornithology**, and **PEIR Volume 2, Appendix 13.3 Offshore Collision Risk Modelling**. A precautionary approach for this AA means the worst-case scenario has been presented only (see **Section 7.4.2** for details on worst-case scenario).

7.4.6.2 Site Predicted Collision Risk Estimates

1117. A summary of the seasonal predicted PEIR level collision estimates prior to apportionment for qualifying features screened in for collision risk assessment is provided in **Table 7-7**. An apportionment process has subsequently been applied to the PEIR predicted impact values presented in **Table 7-7** following the apportionment process described in **Appendix A.3 Apportionment Report**, to allow for assessment of potential impacts from the Project apportioned to each designated site screened in for assessment (**Table 7-4**). Confidence interval around the mean collision values have also been apportioned out for the different sites and features screened in for collision impact assessment and can be found in the **Appendix A.3 Apportionment Report** for reference.

Table 7-7 Predicted Unapportioned Collision Risk Estimates for Key Species

Species	Collision risk impacts (individuals)			
	Return migration	Migration-free breeding	Post-breeding migration	Migration-free winter
Kittiwake	31.22	67.88	36.80	N/A
Great black-backed gull (<i>Larus marinus</i>)	N/A	0.00	N/A	0.40
Herring gull	N/A	0.00	N/A	1.15
Lesser black-backed gull (<i>Larus fuscus</i>)	0.00	0.86	0.00	0.00
Gannet	0.53	1.96	3.46	N/A

7.4.6.3 Uncertainty and/ or Precaution Within CRM Assessment

1118. It is highly likely that the speed at which a bird flies is highly dependent on both wind speed and the type of flight behaviour exhibited, for example a seabird’s flight speed when commuting or during migratory flights is likely to differ from when it is actively foraging. Within the original Band (2012) CRM model and the sCRM (Donovan, 2018; Caneco and Humphries, 2022) an increase in flight speed leads to a greater flux of birds predicted to pass through the OWF, thus increasing collision risk. Within the guidance document for the Band (2012) CRM, one area of uncertainty identified related to species biometrics, including flight speed due to the parameters being a single fixed value. The author stated within the guidance (Band, 2012) uncertainty relating to species biometrics and flight speed could affect the predicted impact by up to ±20%.
1119. The flight speeds advocated by SNCBs are derived from Pennycuick (1997) for gannet and Alerstam *et al* (2007) for kittiwake. As highlighted in the Crown Estate Round 4 Plan Level HRA collision modelling annex the following points should be noted when using such datasets:
1120. “The flight speed for gannet calculated in Pennycuick (1997) is based on a small sample size with these data having been collected from birds flying at a breeding colony (Foula, Shetland). It is therefore possible that the flight speeds recorded are not representative of the flight speeds of birds foraging offshore. This is therefore likely to over-estimate collision risk estimates and increase the uncertainty associated with these estimates.

1121. The birds observed by Alerstam *et al* (2007) were located either in southern Sweden or within the Arctic circle and no differentiation is provided between migratory or foraging birds from colonies. Indeed, the large range of species included in Alerstam *et al* (2007) suggests that non-breeding and/or migratory flights comprised a significant component of the data set. This is therefore likely to over-estimate collision risk estimates and increase the uncertainty associated with these estimates.”
1122. Flight speeds of seabirds within an operational OWF has been collected at Thanet OWF as part of the Offshore Renewables Joint Industry Programme (ORJIP) avoidance study (Skov *et al.*, 2018). This study used laser rangefinder tracking data to estimate flight speed both inside and outside the Thanet OWF from 284 tracks over a period of approximately two years. Overall, flight speeds for both kittiwake and gannet were calculated to be considerably slower than as currently recommended. This difference could be due to a number of factors such as differing temporal and spatial scales of data collection, limited data collected within Pennycuick (1997) and Alerstam *et al* (2007), behavioural response to the OWF development or methodological differences.
1123. Improvement in flight speed parameters for inclusion within assessment was recently assessed by Cook *et al* (2023) on behalf of the Scottish Government. Cook *et al* (2023) concluded:
1124. “Typical flight speeds may be lower than those reported in these previous studies, which are often collected in areas which may not be representative of conditions experienced offshore (Alerstam *et al.*, 2007; Pennycuick, 1997). Accounting for these differences can result in a substantial reduction in the predicted collision rate.”
1125. These studies suggest that currently advocated flight speeds are likely to be inflating the predicted impact of collision.
1126. The recommended SNCB (2024a) Nocturnal Activity Factors (NAFs) for seabirds are derived from Cook *et al* (2023) for gannet, kittiwake and lesser black-backed gull. For herring gull and great black-backed gull, NAFs are derived from Garthe and Hüppop (2004). Prior to the recent CRM guidance updates (SNCBs, 2024), all NAFs were derived from Garthe and Hüppop (2004), which used a scoring index of expected NAF based on literature review and personal observations. Cook *et al* (2023), provided updated parameters based on GPS tags deployed at colonies around the UK, the results of which recommended reduced NAFs comparative to the Garthe and Hüppop (2004) scoring indices. However, the author did note significant variability in NAF between colonies and years of deployment due to significant variation in day time activity, suggesting that wider environmental conditions should be considered to ensure appropriate transferability within assessment (Cook *et al.*, 2023). Additionally, the results of Cook *et al* (2023) relates to the breeding season only, such rates therefore may not appropriately represent nocturnal activity during the non-breeding season. For herring gull and great black-backed gull, the results from Cook *et al* (2023) suggest that the use of Garthe and Hüppop (2004) may not be appropriate for at least the breeding season.

1127. The Bird Collision Avoidance Study funded by ORJIP, considered the potential avoidance rate of seabirds in response to Thanet OWF (Skov *et al.*, 2018). Over the two-year study period (between 2014 and 2016) over 12,000 bird movements were recorded throughout the day and night (Skov *et al.*, 2018). It was reported that only six birds (all gull species) in total collided with wind turbines suggesting there is still significant levels of precaution within the latest avoidance rates recommended for modelling. Although the avoidance rates determined from the Thanet OWF study (Skov *et al.*, 2018) were considered within the determination of SNCBs latest recommended rates (SNCBs, 2024), the recommended species-specific rates from the study are far higher than those currently recommended in SNCB guidance (SNCBs, 2024).
1128. The most recent empirical study of collision risk to seabirds (AOWFL, 2023) was undertaken over two years off the coast of Aberdeen at an OWF site with 11 wind turbines. This study collected data during the breeding and post-breeding season (covering the months of April to October 2020 and 2021). The overall conclusions from this study were that it is evident that seabirds are exposed to very low risks of collision with wind turbines during daylight hours, which was based upon the fact that no collisions, or even near collisions, were recorded in over 10,000 bird videos during the two years of monitoring. These findings also strongly suggest that current collision risk modelling outputs are likely to overestimate the risk to seabirds.
1129. Within the latest guidance (SNCBs, 2024), the avoidance rates outlined in the Ozsanlav-Harris *et al* (2023) paper, are used. It must be noted that the current recommended values are mainly based on observations from onshore and coastal wind farms, which have significantly different design to offshore developments (such as far smaller air gap resulting in greater overlap of key seabird flight heights) and birds flight behaviour may differ between the onshore and offshore environment, resulting in difference in susceptibility to collision. The study concluded that for gannet and kittiwake a generic 'all gull' rate is recommended, and for lesser black-backed gull, herring gull and great black-backed gull, a generic 'large gull rate' is recommended for use as the avoidance rate. These recommendations are despite the provision of species-specific avoidance rate within the study. Not using species specific avoidance rates, but rather, generic rates, adds precaution to the assessment as it does not account for inter-specific variation in the avoidance behaviour between species.
1130. Therefore, it is considered that the CRM input parameters used in the assessment of collision risk to seabirds for the Project and those from other developments, especially cumulatively, incorporate a high degree of precaution for all species assessed. Examples of the level of sensitivity of CRM to changes in even a single variable have been provided for recent OWF developments (GoBe, 2025; APEM, 2024; APEM, 2022d), resulting in significant reductions in predicted impact.

7.4.7 Combined Displacement and Collision Risk

1131. Due to gannet being screened in for both displacement and collision risk assessment during the operation and maintenance phase, there is a potential for these two potential impacts to adversely affect gannet populations through the combined mortality from both impacts. The combined impact of both collision risk and displacement may be greater than either one acting alone and so further consideration of impacts acting together is required. This has been conducted by summing the estimated mortalities for both impacts together to inform a combined impact. Combined displacement and collision assessments for gannet are within the relevant SPA sections below.

7.4.8 Approach to In-combination Assessment

1132. In-combination effects are the result of the impacts of the Project acting in combination with the impacts of other proposed and reasonably foreseeable developments on receptors. This includes plans and projects that are not inherently considered as part of the current baseline.
1133. The overarching framework used to identify and assess in-combination effects is set out in **PEIR Volume 1, Chapter 6 EIA Methodology**, appropriately adapted for the RIAA. The four-stage approach is based upon the Planning Inspectorate's Nationally Significant Infrastructure Projects: Advice on Cumulative Effect Assessment (CEA) (Planning Inspectorate, 2024) and the Offshore Wind Marine Environmental Assessments: Best Practice Advance for Evidence and Data Standards (Parker *et al.*, 2022). The fourth stage of the process is the assessment stage, which is detailed within the sections below for potential in-combination effects on offshore and intertidal ornithology receptors.

7.4.8.1 Screening for Potential In-combination Effects

1134. Following the HRA screening process, all sites and features screened through for potential effects from the Project alone were generally screened through for potential effects in-combination. This precautionary approach was used due to the lack of available evidence at the time to confidently conclude whether there is potential for an in-combination effect to occur. The sites and features screened through for consideration potential effects in-combination is provided within **Table 7-4**.

7.4.8.2 Screening for Other Plans/ Projects

1135. The second step of the in-combination assessment identifies a short-list of other plans and projects that have the potential to interact with the Project to give rise to significant in-combination effects during the construction and operation phases. The short-list provided in **Table 7-9** has been produced specifically to assess in-combination effects on offshore and intertidal ornithology receptors. The exhaustive list of all offshore plans and projects considered in the development of the Project’s CEA framework is provided in **PEIR Volume 2, Appendix 6.4 Offshore Cumulative Effects** and **PEIR Volume 2, Appendix 6.5 Onshore Cumulative Effects**.
1136. The screening exercise has been undertaken based on available information on each plan or project as of the 9th December 2024. Information has been obtained from the planning Inspectorate website (Planning Inspectorate, 2025), the Marine Government website (MMO, 2025) and individual project reports, with references provided within each individual in-combination assessment section. It is noted that further information regarding the identified plans and projects may become available between the Draft RIAA publication and DCO application submission or may not be available in detail prior to construction. The short list of plans and projects will be updated for the Final RIAA to incorporate anymore recent information at the time of drafting. The assessment presented here is therefore considered to be conservative, with the in-combination effects expected to be reduced compared to those presented here. The in-combination effects are expected to be reduced compared to those presented here as it is possible that the size and scale of plans or projects may reduce, it is also possible that not all plans or projects are built.
1137. Plans and projects identified in **Table 7-9** have been assigned a tier based on their development status, the level of information available to inform the CEA and the degree of confidence. As described further in **PEIR Volume 1, Chapter 6 EIA Methodology** a seven-tier system based on the guidance issued by Natural England has been adopted (Parker *et al.*, 2022) (**Table 7-8**).
1138. Using this tier approach accounts for uncertainty around the projects considered within the in-combination assessment, due to the different data being used and its age (Parker *et al.*, 2022). Projects within tiers four to six could go through design changes or not even get consent and so within the individual in-combination assessments these have been split off, to provide separate in-combination totals for consented and then the consented plus planned projects. When considering this tiering approach, tiers taken through within this cumulative assessment include tiers one to six.

Table 7-8 Description of Tiers of Other Developments Considered for In-Combination Assessment (Adapted from Parker *et al* (2022))

Tier level	Consenting or construction stage	Data availability
Tier 1	Built and operational projects	Pre-construction (and possibly post construction) survey data from built projects and environmental characterisation data (from the ES).
Tier 2	Under construction	As tier 1 but excluding the post-construction data.
Tier 3	Consented (but construction has not commenced)	Environmental characterisation data (from the ES) and possibly pre-construction data.
Tier 4	Application submitted to appropriate regulatory body but not yet determined	Environmental characterisation data (from the ES).
Tier 5	Project has produced PEIR and have characterisation data in public domain	Environmental characterisation data (from PEIR).
Tier 6	Projects listed under the Planning Inspectorate programme of projects	Possible environmental characterisation data.
Tier 7	Projects identified in relevant strategic plans or programme	Historic survey data collected for other purposes/ projects.

1139. It must be noted that there is potential for significant precaution around the impact values taken forward in in-combination assessments. Most projects are assessed against their consented design rather than the actual as-built turbines and layout. In a previous report on ‘headroom’ (MacArthur Green, 2020), this was demonstrated to produce a significant overestimation of collision risk impacts. Additionally, it is assumed that all projects awaiting consent are to be developed according to the worst-case design. This is highly precautionary as some projects may ultimately not receive consent, may reduce the proposed design prior to consent or reduce the project boundary.

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Table 7-9 Short List of Plans/ Projects for the Offshore and Intertidal In-Combination Assessment

Project/ Plan	Development Type	Status	Tier	Construction/ Operation Period	Closest Distance to DBD Array Area (km)	Closest distance to ECC (km)	Potential for in-combination effects	Rationale
Beatrice	Offshore Wind Farm	Operational	1	Construction: 2017 to 2018 Operation: 2018 to 2053*	482.85	411.23	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Blyth Demonstration Site	Offshore Wind Farm	Operational	1	Construction: 2017** Operation: 2017 to 2052*	258.86	145.05	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Dudgeon	Offshore Wind Farm	Operational	1	Construction: 2015 to 2017 Operation: 2017 to 2052*	208.66	111.78	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
East Anglia One	Offshore Wind Farm	Operational	1	Construction: 2018 to 2020 Operation: 2020 to 2055*	291.24	246.46	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
European Offshore Wind Deployment Centre (EOWDC)	Offshore Wind Farm	Operational	1	Construction: 2017 to 2018 Operation: 2018 to 2053*	372.27	295.78	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Galloper	Offshore Wind Farm	Operational	1	Construction: 2016 to 2018 Operation: 2018 to 2053*	332.67	258.11	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Greater Gabbard	Offshore Wind Farm	Operational	1	Construction: 2009 to 2012 Operation: 2012 to 2047*	335.22	258.37	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Gunfleet Sands	Offshore Wind Farm	Operational	1	Construction: 2008 to 2010 Operation: 2010 to 2045*	371.70	264.94	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Hornsea Project One	Offshore Wind Farm	Operational	1	Construction: 2018 to 2019 Operation: 2019 to 2054*	122.09	80.12	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.

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Project/ Plan	Development Type	Status	Tier	Construction/ Operation Period	Closest Distance to DBD Array Area (km)	Closest distance to ECC (km)	Potential for in-combination effects	Rationale
Humber Gateway	Offshore Wind Farm	Operational	1	Construction: 2013 to 2015 Operation: 2015 to 2050*	219.05	41.13	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Hywind Scotland Pilot Park	Offshore Wind Farm	Operational	1	Construction: 2016 to 2017 Operation: 2017 to 2037	362.59	289.67	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Kentish Flats	Offshore Wind Farm	Operational	1	Construction: 2004 to 2005 Operation: 2005 to 2040*	404.49	289.22	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Kentish Flats Extension	Offshore Wind Farm	Operational	1	Construction: 2014 to 2015 Operation: 2015 to 2050*	406.14	289.04	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Kincardine	Offshore Wind Farm	Operational	1	Construction: 2021 Operation: 2021 to 2036	348.73	273.18	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Lincs & LID	Offshore Wind Farm	Operational	1	Construction: 2010 to 2012 Operation: 2012 to 2047*	246.55	89.62	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
London Array	Offshore Wind Farm	Operational	1	Construction: 2011 to 2012 Operation: 2012 to 2047*	372.61	274.29	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Methil	Offshore Wind Farm	Operational	1	Construction: 2013 Operation: 2013 to 2048*	379.06	288.70	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Race Bank	Offshore Wind Farm	Operational	1	Construction: 2016 to 2018 Operation: 2018 to 2053*	88.20	225.76	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.

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Project/ Plan	Development Type	Status	Tier	Construction/ Operation Period	Closest Distance to DBD Array Area (km)	Closest distance to ECC (km)	Potential for in-combination effects	Rationale
Rampion	Offshore Wind Farm	Operational	1	Construction: 2015 to 2017 Operation: 2017 to 2052*	362.04	516.70	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Scroby Sands	Offshore Wind Farm	Operational	1	Construction: 2003 to 2004 Operation: 2004 to 2039*	266.44	189.21	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Sheringham Shoal	Offshore Wind Farm	Operational	1	Construction: 2009 to 2011 Operation: 2011 to 2046*	113.80	229.97	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Teesside	Offshore Wind Farm	Operational	1	Construction: 2011 to 2013 Operation: 2013 to 2048*	89.94	245.57	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Thanet	Offshore Wind Farm	Operational	1	Construction: 2017 to 2018 Operation: 2018 to 2053*	302.33	396.64	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Westermost Rough	Offshore Wind Farm	Operational	1	Construction: 2014 to 2015 Operation: 2015 to 2050*	20.19	214.80	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Hornsea Project Two	Offshore Wind Farm	Operational	1	Construction: 2020 to 2022 Operation: 2022 to 2057*	63	121	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Moray East	Offshore Wind Farm	Operational	1	Construction: 2019 to 2022 Operation: 2022 to 2057*	429.84	356.91	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Triton Knoll	Offshore Wind Farm	Operational	1	Construction: 2020 to 2022 Operation: 2022 to 2057*	67.58	206.37	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.

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Project/ Plan	Development Type	Status	Tier	Construction/ Operation Period	Closest Distance to DBD Array Area (km)	Closest distance to ECC (km)	Potential for in-combination effects	Rationale
Neart na Gaoithe	Offshore Wind Farm	Under construction	2	Construction: 2020 to 2025 Operation: 2020 to 2055*	327.06	241.02	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
DBC	Offshore Wind Farm	Under construction	2	Construction: 2025 to 2026 Operation: 2026 to 2061	3	0	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Sofia	Offshore Wind Farm	Under construction	2	Construction: 2023 to 2026 Operation: 2026 to 2061	17.75	22.79	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Seagreen (Phase 1 and 1A)	Offshore Wind Farm	Under construction	2	Phase 1: Construction: 2020 to 2022 for first 114 turbines Operation: 2023 to 2048 1A: Construction: 2029 – 2023 for additional 36 turbines to Phase 1.	304.22	225.61	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Moray West	Offshore Wind Farm	Under construction	2	Construction: 2023 to 2025 Operation: 2025 to 2050	401.85	473.75	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Dogger Bank A	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2022 to 2025 Operation: 2025 to 2060	31	43	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Dogger Bank B	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2024 to 2026 Operation: 2026 to 2061	9	52	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
East Anglia Three	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2025 to 2026 Operation: 2026 to 2051	240.91	220.34	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Hornsea Three	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2023 to 2027 Operation: 2027 to 2052*	107	106	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.

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Project/ Plan	Development Type	Status	Tier	Construction/ Operation Period	Closest Distance to DBD Array Area (km)	Closest distance to ECC (km)	Potential for in-combination effects	Rationale
Inch Cape	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2024 to 2027 Operation: 2027 to 2052*	247.28	330.78	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Norfolk Vanguard	Offshore Wind Farm	Consented (awaiting commencement)	3	Estimated completion before 2030	204.39 (East) 185.29 (West)	209.74 (East) 212.23 (West)	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Norfolk Boreas	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2025 to 2027 Operation: 2027 to 2062*	192.37	188.68	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
East Anglia ONE North	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: estimated completion in 2027 Operation: 2027 to 2052	229.21	280.15	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
East Anglia TWO	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: estimated completion in 2029 Operation: 2029 to 2054	232.76	295.68	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Hornsea Four	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2025 to 2029 Operation: 2029 to 2064	31	134	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
ForthWind Offshore Wind Demonstration Project - phase 1	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: dates to be determined Operation: 25 years	286.42	375.61	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Green Volt	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: estimated completion in 2029 Operation: 2029 to 2064*	297.36	362.01	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Sheringham Shoal Extension	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2025 to 2029 Operation: 2029 to 2064*	107.65	223.87	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.

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Project/ Plan	Development Type	Status	Tier	Construction/ Operation Period	Closest Distance to DBD Array Area (km)	Closest distance to ECC (km)	Potential for in-combination effects	Rationale
Dudgeon Extension	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2025 to 2029 Operation: 2029 to 2064*	101.25	202.20	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Pentland Floating	Offshore Wind Farm	Consented (awaiting commencement)	3	Construction: 2025 to 2026 Operation: 2026 to 2061*	485.88	557.44	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Berwick Bank	Offshore Wind Farm	Application submitted	4	Construction: estimated completion by 2030 Operation: 2030 to 2065	188.96	272.36	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
West of Orkney	Offshore Wind Farm	Application submitted	4	Construction: estimated completion in 2030 Operation: 2030 to 2065*	508	578	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Salamander	Offshore Wind Farm	Application submitted	4	Construction: 2026 to 2028 Operation: 2028 to 2063	293.52	363.01	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Ossian	Offshore Wind Farm	Application submitted	4	Construction: early 2030s	159.47	230.87	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Outer Dowsing	Offshore Wind Farm	Application submitted	4	Construction: 2027 to 2030 Operation: 2030 to 2065*	76.76	170.14	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Rampion 2	Offshore Wind Farm	Application submitted	4	Construction: 2027 to 2030 Operation: 2030 to 2065*	363	523	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
North Falls	Offshore Wind Farm	Application submitted	4	Construction: estimated completion by 2030 Operation: 2030 to 2065*	254	333	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.

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Project/ Plan	Development Type	Status	Tier	Construction/ Operation Period	Closest Distance to DBD Array Area (km)	Closest distance to ECC (km)	Potential for in-combination effects	Rationale
Five Estuaries	Offshore Wind Farm	Application submitted	4	Construction: 2027 to 2030 Operation: 2030 to 2065*	262.86	329.28	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.
Dogger Bank South	Offshore Wind Farm	Application submitted	4	Construction: 2025 to 2029 Operation: 2030 to 2065*	110	30	Yes	Potential for spatial and temporal overlap during the operational and maintenance phase at the DBD Array Area and associated buffers.

*Table note: These dates are estimates based on the assumption that each wind farm will be operational for 35 years. **Phase One of the Blyth Demonstration Site was commissioned in 2017. Phase Two will be commissioned in spring 2025.

1140. Each plan or project in **Table 7-9** has been considered on a case-by-case basis. Only plans and projects which met the following criteria were included:

- There is potential that a pathway exists whereby an impact could have an in-combination effect on a receptor;
- The impact on a receptor from the Project and the plan or project in consideration have 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 in-combination with the plan or project in consideration.

1141. For offshore and intertidal ornithology, a total of 57 plans and projects where significant in-combination effects could arise in combination have been identified with the Project. A detailed assessment of in-combination projects is provided in the relevant SPA sections.

7.5 The Greater Wash SPA

7.5.1 Site Description

1142. The Greater Wash SPA directly overlaps with the offshore ECC and is 207km (at sea) from the DBD Array Area plus 2km asymmetrical buffer.

1143. The Greater Wash SPA site description is as follows (Natural England, 2018d):

1144. *“The Greater Wash SPA is located in the mid-southern North Sea between Bridlington Bay in the north and the Outer Thames Estuary SPA in the south. To the north, off the Holderness coast in Yorkshire, seabed habitats primarily comprise coarse sediments, with occasional areas of sand, mud and mixed sediments. Subtidal sandbanks occur at the mouth of the Humber Estuary, primarily comprising sand and coarse sediments. Offshore, soft sediments dominate, with extensive areas of subtidal sandbanks off The Wash as well as north and east Norfolk coasts. Closer inshore at The Wash as well as north and east Norfolk coasts. Closer inshore at The Wash and north Norfolk coast, sediments comprise a mosaic of sand, muddy sand, mixed sediments and coarse sediments, as well as occasional Annex I reefs. The area off the Suffolk coast continues the mosaic habitats mostly dominated by soft sediment.”*

7.5.1.1 Qualifying Features

1145. The Greater Wash SPA supports notable populations of the following species:

- Red-throated diver – 1,407 individuals (citation count (Natural England, 2018d));
- Little gull – 1,255 individuals;
- Sandwich tern - 7,704 individuals (citation count (Natural England, 2018d));
- Common tern – 1,020 individuals (citation count (Natural England, 2018d));
- Little tern – 1,596 individuals (citation count (Natural England, 2018d)); and
- Common scoter – 3,449 individuals (citation count (Natural England, 2018d)).

7.5.1.2 Conservation Objectives

1146. With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified and subjected to natural change. Those relevant to assessment are highlighted **bold**, based on consideration of how the identified impact pathways may affect the qualifying features screened in for assessment:

- To ensure that the integrity of the site is maintained or restored as appropriated; and
- To ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:
 - The extent and distribution of the habitats of the qualifying features;
 - The structure and function of the habitats of the qualifying features;
 - The supporting processes on which the habitats of the qualifying features rely;
 - The population of each of the qualifying features; and
 - The distribution on the qualifying features within the site.

7.5.1.3 Condition Assessment

1147. When considering the qualifying features (**Section 7.5.1.1**) and the conservation objectives (**Section 7.5.1.2**) of the Greater Wash SPA an assessment of condition can be made. The latest available population count for the red-throated diver feature of 1,787 individuals (Lawson *et al.*, 2016) is above the citation population, therefore the Greater Wash SPA is considered to be in a favourable condition for the red-throated diver feature.

1148. The latest available population count for the common scoter feature of 3,517 individuals (Lawson *et al.*, 2016) is above the citation population, therefore the Greater Wash SPA is considered to be in a favourable condition for the common scoter feature.

1149. The latest available population count for the Sandwich tern feature of 6,560 individuals (SMP, 2025) is below the citation population, therefore the Greater Wash SPA is considered to be in an unfavourable condition for the Sandwich tern feature.
1150. The latest available population count for the common tern feature of 430 individuals (SMP, 2025) is below the citation population, therefore the Greater Wash SPA is considered to be in an unfavourable condition for the common tern feature.
1151. The latest available population count for the little tern feature of 830 individuals is below the citation population, therefore the Greater Wash SPA is considered to be in an unfavourable condition for the little tern feature.

7.5.2 Assessment of Potential Effects of the Project Alone

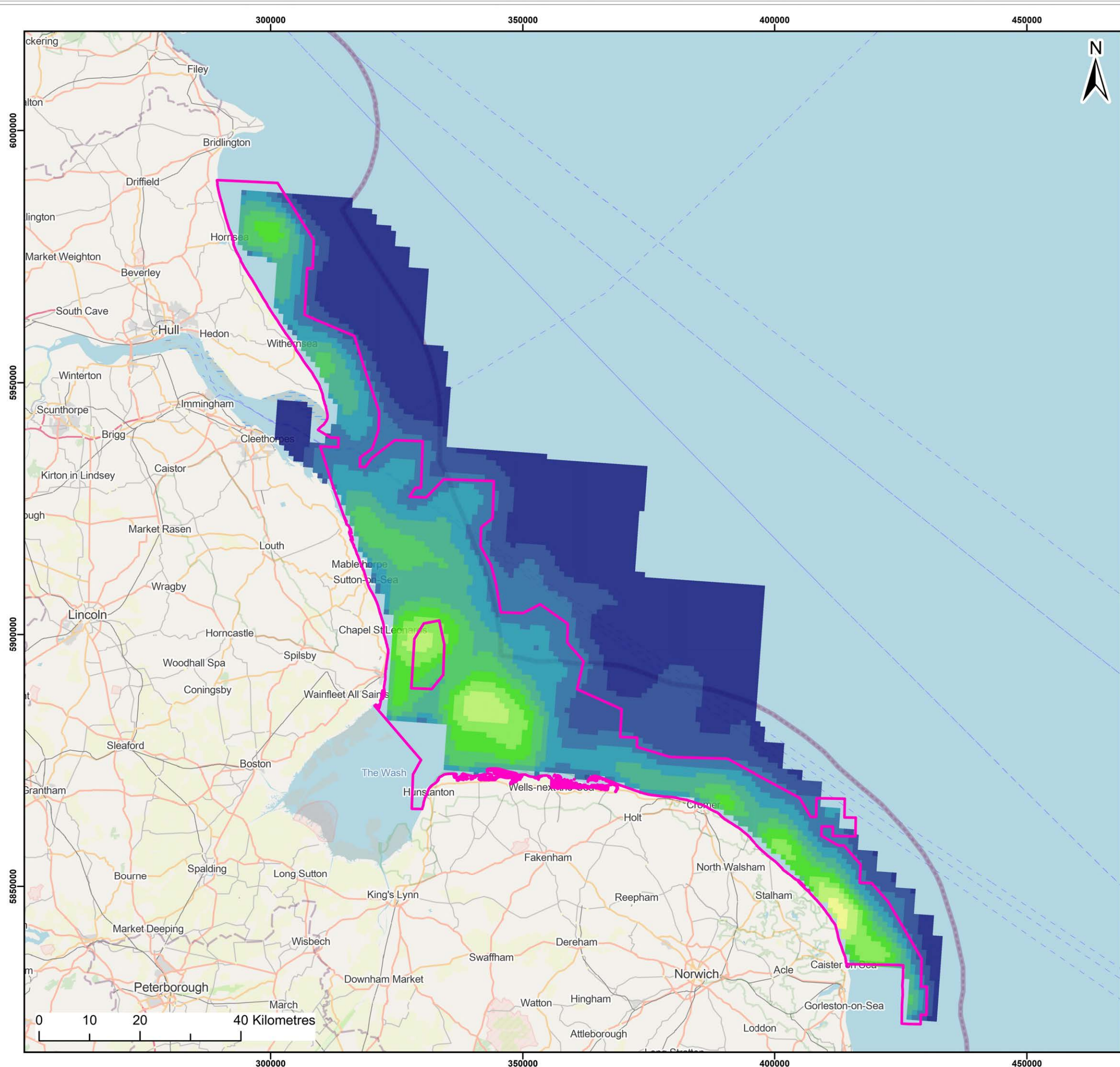
1152. Potential for LSE alone has been identified for the following features of Greater Wash SPA:
- Red-throated diver (see **Section 7.5.2.1** for assessment);
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Common scoter (see **Section 7.5.2.1** for assessment);
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Sandwich tern (see **Section 7.5.2.1** for assessment);
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Common tern (see **Section 7.5.2.1** for assessment);
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall; and
 - Little tern (see **Section 7.5.2.1** for assessment); and
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall.

7.5.2.1 Direct Disturbance and Displacement due to Work Activity in the Dogger Bank D Array Area, ECC or Landfall (Offshore ECC and Landfall)

7.5.2.1.1 Construction

7.5.2.1.1.1 *Red-throated diver*

1153. There is evidence of a concentration of red-throated diver within the area of the Greater Wash SPA (Lawson *et al.*, 2016) that has overlap with the DBD offshore ECC (**Figure 7-1**). A mean density of 0.25 and a maximum density of 0.45 birds perkm² were recorded in the area through which the offshore ECC is planned to run. Full methods of how the densities were derived for red-throated diver within the area of ECC overlap with the Greater Wash SPA are provided within the **PEIR Volume 2, Appendix 13-4: Offshore Displacement Analysis Report**. Abundance estimates for the area of overlap between the DBD ECC and the Greater Wash SPA plus a 2km buffer were estimated by multiplying the density by the area, which gave a mean estimate of 19 individuals (18.9). This estimate has been taken through for impact assessment.
1154. As a note to consider, the use of the Lawson *et al* (2016) data was discussed at the ETG meeting held on the 21st October 2024. The Applicant and Natural England discussed the age of the data, and in the absence of any more recent publicly available data at the time of drafting, this was the only source that could be used.
1155. Red-throated diver have been shown to be sensitive to human activities in marine areas, with the species flushing from approaching vessels at a distance of >1km (Schwemmer *et al.*, 2011; Bradbury *et al.*, 2014). Similarly, a ship-traffic Disturbance Vulnerability Index (DVI) concluded that red-throated diver was the most sensitive, of the seabird species studied, to vessel disturbance. With birds often leaving an area with vessels and leaving an area when the vessel is located at a relatively large distance away (Fliebsbach *et al.*, 2019).
1156. Considering the high sensitivity of red-throated divers to disturbance and displacement, an approach to assessment has been agreed with SNCBs (agreement following ETG held on 21st October 2024) that for this project, the displacement rate to be used should be 90% to 100%.



Legend:

Greater Wash Special Protection Area (SPA)

Red-throated divers/km²

	0 - 0.05
	0.05 - 0.11
	0.11 - 0.19
	0.19 - 0.28
	0.28 - 0.39
	0.39 - 0.51
	0.51 - 0.67
	0.67 - 0.87
	0.87 - 1.35
	1.35 - 3.38

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Project:		
Dogger Bank D Offshore Wind Farm		

Title:

Kernal Density Estimates for Red-throated Diver During the Non-Breeding Season Within the Greater Wash SPA (Taken from Lawson et al. (2016))

Figure: 7-1	Drawing No: PC6250-RHD-XX-ON-DR-GS-0589				
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Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	27/03/2025	AB	PT	A3	1:750,000

Co-ordinate system: WGS 1984 UTM Zone 31N

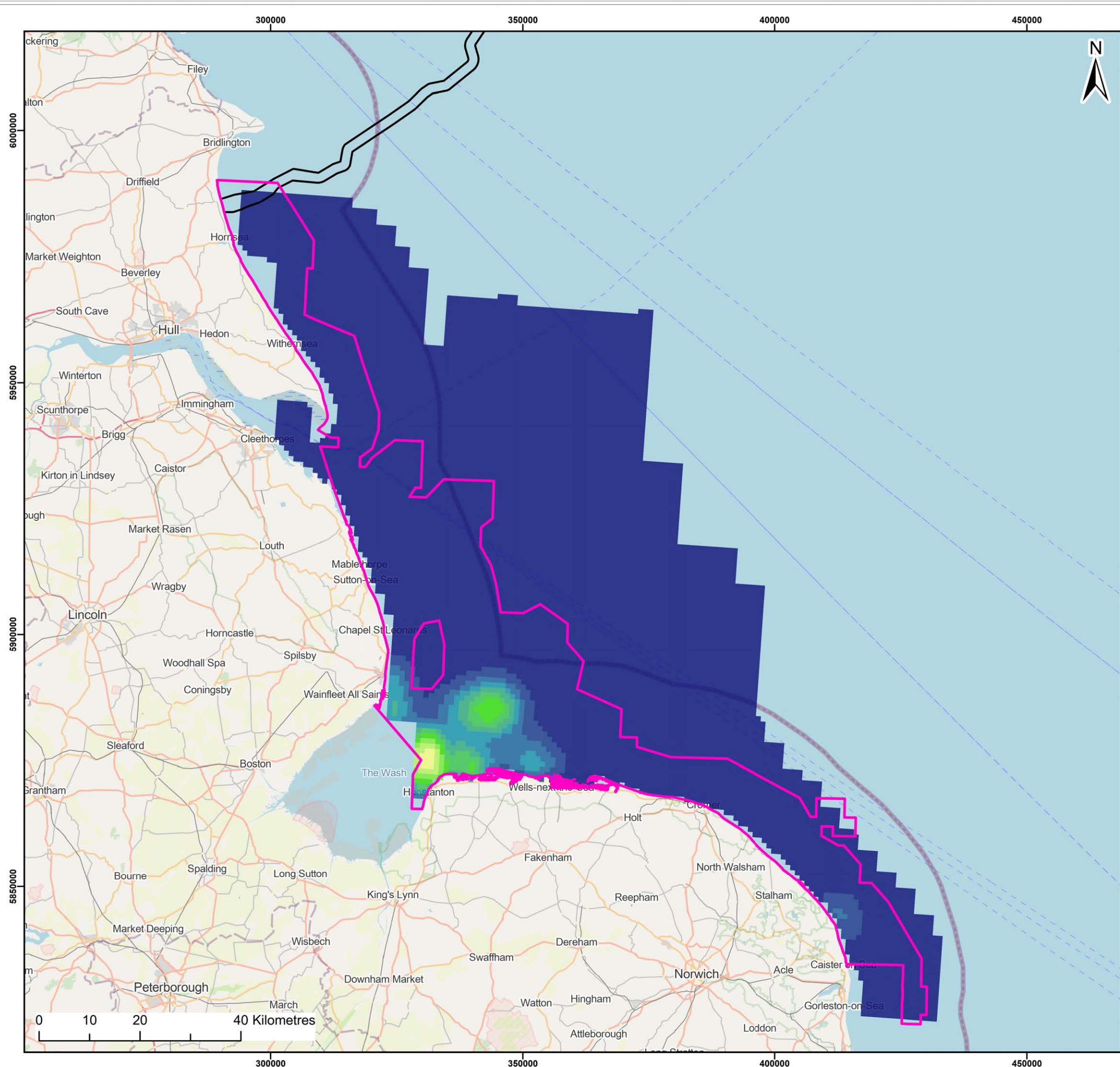
1157. When considering the likely consequence of displacement in relation to an increase in red-throated diver's mortality rate, it is key to consider how displacement will affect their typical foraging behaviour. During the winter bio-season, red-throated divers are known to exhibit two different foraging strategies, individuals tend to either consistently occupy a particular area of optimal foraging habitat each year or remain continually mobile throughout the winter period (Dierschke *et al.*, 2017). As presented in Lawson *et al* (2016), data based on the eight-wintering bio-seasons of monitoring for the Greater Wash SPA, red-throated divers utilise the majority of the surveyed area, though significant congregations occur at the centre and south of the SPA. The areas of high concentrations likely infer the most optimal foraging habitat, in contrast to the remainder of the SPA. The ECC does not overlap with these areas of high concentration and therefore is likely to only interact with more mobile individuals in less optimal habitat, the overall consequence of being temporarily displaced from parts of the ECC is likely to be insignificant.
1158. On the basis of the above information, a mortality rate of 1% has been considered for the Applicant's approach. For comparison, the SNCBs maximum precautionary rate of 10% mortality has been considered.
1159. When considering the Applicant's approach, the annual estimated mortality (when considering a 90% to 100% displacement rate and a 1% mortality rate) for red-throated diver resulting from disturbance and displacement during construction is less than a single (0.19) individual. This is further broken down into relevant bio-seasons in **Table 7-10**.
1160. The presence of red-throated diver within the offshore ECC and 2km buffer is assessed against the non-breeding bio-season only, due to the absence of available data for the breeding bio-season and expected absence of red-throated diver within the breeding bio-season. The absence of red-throated diver during the breeding bio-season is to be expected given that the species breeding distribution within the UK is limited to Northern Scotland (Balmer *et al.*, 2013).
1161. As presented within **Table 7-10**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. Moreover, given the low densities of red-throated divers in areas overlapping with the offshore ECC (Lawson *et al.*, 2016), it is unlikely that any minimal impacts from construction activities would lead to population-level changes in distributions within the SPA, as the highest concentrations of red-throated divers are located around the Wash and the east Norfolk coast. With regard to the conservation objectives of the red-throated diver feature of Greater Wash SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the red-throated diver feature will be maintained in the long term.

Table 7-10 Summary of Construction Phase Disturbance and Displacement Impacts for Red-Throated Diver Apportioned to Greater Wash SPA

Population size (breeding adults)	Bio-seasons	Applicant's approach		SNCB approach	
		90% - 100% Disp; 1% Mort (individuals per annum)	Increase in baseline mortality rate (%)	90% - 100% Disp; 10% Mort (individuals per annum)	Increase in baseline mortality rate (%)
Citation (1,407)	Breeding (March – August)	N/A	N/A	N/A	N/A
	Non-breeding (September – February)	0.17 – 0.19	0.053 - 0.059	1.71 – 1.90	0.534 - 0.593
	Annual	0.17 – 0.19	0.053 - 0.059	1.71 – 1.90	0.534 - 0.593
Latest count (1,787)	Breeding (March – August)	N/A	N/A	N/A	N/A
	Non-breeding (September – February)	0.17 – 0.19	0.042 - 0.047	1.71 – 1.90	0.420 - 0.467
	Annual	0.17 – 0.19	0.042 - 0.047	1.71 – 1.90	0.420 - 0.467

7.5.2.1.1.2 Common scoter

1162. Common scoter has been shown to be sensitive to human activities in marine areas, with the species flushing from approaching vessels at a distance of approximately 1km (Schwemmer *et al.*, 2011; Bradbury *et al.*, 2014). Similarly, a ship-traffic DVI concluded that common scoter was one of the most sensitive, of the seabird species studied, to vessel disturbance. With birds often leaving an area with vessels and leaving an area when the vessel is located at a relatively large distance away (Fliessbach *et al.*, 2019).
1163. However, there is no evidence for concentrations of common scoter within the area of the Greater Wash SPA (Lawson *et al.*, 2016) that have overlap with the DBD offshore ECC, with aggregations of common scoter confined to the outer Wash area and north Norfolk coast (**Figure 7-2**). Therefore, there is no pathway to impact the species or to have any population-level changes in distributions within the SPA. With regard to the conservation objectives of the common scoter feature of the Greater Wash SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the common scoter feature will be maintained in the long term.



Legend:

- Offshore Development Area
- Greater Wash Special Protection Area (SPA)

Common Scoter/km²

- 0 - 0.7
- 0.7 - 2.34
- 2.34- 4.51
- 4.51- 7.22
- 7.22 - 10.51
- 10.51 - 14.83
- 14.83 - 21.34
- 21.34 - 31.05
- 31.05 - 40.72
- 40.72 - 56.58

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Project:

Dogger Bank D
Offshore Wind Farm

Title:

Kernal Density Estimates for Common Scoter During
the Non-Breeding Season Within the Greater Wash SPA
(Taken from Lawson et al. 2016)

Figure:	7-2	Drawing No:	PC6250-RHD-XX-ON-DR-GS-0590								
Revision:	01	Date:	27/03/2025	Drawn:	AB	Checked:	PT	Size:	A3	Scale:	1:750,000

Co-ordinate system: WGS 1984 UTM Zone 31N

7.5.2.1.1.3 *Little tern*

1164. There is limited evidence to suggest that little terns are particularly sensitive to human activities in marine areas (Bradbury *et al.*, 2014; Dierschke *et al.*, 2016; Parsons *et al.*, 2015). The closest breeding colony to the offshore ECC and landfall locations is the Spurn peninsula on the Holderness coast. However, this site lies beyond the 5km Mean Max Foraging Range (MMFR) for the species from the offshore ECC and landfall (Woodward *et al.*, 2019). Given that other little tern breeding colonies within the Greater Wash SPA are further south, there is no evidence for overlap between the DBD offshore ECC and little tern foraging areas. Therefore, there is no pathway to impact the species or to have any population-level changes in distributions within the SPA. With regard to the conservation objectives of the little tern feature of the Greater Wash SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the little tern feature will be maintained in the long term.

7.5.2.1.1.3.1 *Consideration of the little tern qualifying feature of the Humber Estuary SPA*

1165. Due to the overlap of little terns utilising areas within the Greater Wash SPA and the Humber Estuary SPA, specifically around the Spurn peninsula, the little tern qualifying feature of the Humber Estuary is also considered within this assessment. As the Humber Estuary SPA lies outside of the foraging range for the species (from the offshore ECC and landfall), the same conclusion as above is made. With regard to the conservation objectives of the little tern feature of the Humber Estuary SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the little tern feature will be maintained in the long term.

7.5.2.1.1.4 *Common tern*

1166. There is limited evidence to suggest common terns are sensitive to human activities in marine areas (Bradbury *et al.*, 2014; Dierschke *et al.*, 2016). There are no common tern breeding colonies within foraging range of the offshore ECC and landfall locations. However, the Holderness coastline has records of post-breeding aggregations of terns, including common terns. These occur typically between late July and August which may result in overlap between foraging terns and the offshore ECC and landfall. Although, given common terns known low sensitivity to disturbance and displacement effects from construction activities and the temporally restrictive nature of these aggregations impacts to the species or any population-level changes in distributions within the SPA are likely to be very limited. Therefore, with regard to the conservation objectives of the common tern feature of the Greater Wash SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the common tern feature will be maintained in the long term.

7.5.2.1.1.5 *Sandwich tern*

1167. There is limited evidence to suggest Sandwich terns are sensitive to human activities within marine areas (Bradbury *et al.*, 2014; Dierschke *et al.*, 2016). There are no Sandwich tern breeding colonies within foraging range of the offshore ECC and landfall locations. However, the Holderness coastline has records of post-breeding aggregations of terns, including Sandwich terns. These occur typically between late July and August which may result in overlap between foraging terns and the offshore ECC and landfall locations. Although, given sandwich terns known low sensitivity to disturbance and displacement effects from construction activities and the temporally restrictive nature of these aggregations impacts to the species or any population-level changes in distributions within the SPA are likely to be very limited.
1168. Therefore, with regard to the conservation objectives of the Sandwich tern feature of the Greater Wash SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the Sandwich tern feature will be maintained in the long term.

7.5.2.1.2 *Operation and Maintenance*

1169. During the operational phase of the Project the export cable will be submerged with only infrequent vessel activity for maintenance when required. Considering this it would be expected that any impacts from maintenance activities would be less than during impacts concluded during the construction phase. Therefore, with regard to the conservation objectives of the qualifying features of the Greater Wash SPA in relation to disturbance and displacement effects at the ECC during the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**.

7.5.2.1.3 *Decommissioning*

1170. Impacts from decommissioning activities within the offshore ECC and landfall are considered to be equal to or less than those concluded for the construction phase for all features of the Greater Wash SPA. Therefore, for the purposes of this assessment it is assumed that the impacts are likely to be similar. Closer to the time of decommissioning, it may be decided that removal would lead to a greater environmental impact than leaving some components in situ, in which case certain components may be cut off at or below seabed level or left buried (e.g. in the case of sub-sea cables). This may reduce the amount of decommissioning activity required.
1171. As described in **Section 7.5.2.1.1**, the potential for an **AEol in the construction phase can be confidently ruled out** for all ornithological features, therefore **the same conclusion is considered appropriate for the decommissioning phase**.

7.5.2.2 Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure

1172. No features of Greater Wash SPA were screened in for the assessment of direct displacement due to the presence of wind turbines and other offshore infrastructure.

7.5.2.3 Barrier Effect due to Presence of Wind Turbines and Other Offshore Infrastructure

1173. Assessments for barrier effects due to the presence of wind turbines and other offshore infrastructure are considered in **Section 7.12**.

7.5.2.4 Indirect Effects via Habitats or Prey Availability

1174. Assessments for indirect effects via habitat or prey availability are considered in **Section 7.11**.

7.5.2.5 Collision Risk with Wind Turbine Blades

1175. No features of Greater Wash SPA were screened in for the assessment of collision risk.

7.5.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

7.5.3.1 Direct Disturbance and Displacement due to Work Activity in the Dogger Bank D Array Area, ECC or Landfall (Offshore ECC and Landfall)

1176. Given the minimal level of predicted impact when considering the most likely scenarios, and lack of temporal and spatial overlap with other developments, there is currently no potential for in-combination impacts to occur. As the Project progresses this will be reviewed and monitored, however, currently LSE can confidently be ruled out for in-combination effects.

7.5.4 Summary of Potential Effects on Site Integrity

7.5.4.1 Construction

7.5.4.1.1 Direct Disturbance and Displacement due to Work Activity in the Dogger Bank D Array Area, ECC or Landfall (Offshore ECC and Landfall)

1177. There is **no potential for AEol for any of the qualifying features of Greater Wash SPA assessed for disturbance and displacement** during the construction phase.

7.5.4.2 Operation and maintenance

7.5.4.2.1 Direct Disturbance and Displacement due to Work Activity in the Dogger Bank D Array Area, ECC or Landfall (Offshore ECC and Landfall)

1178. There is **no potential for AEol for any of the qualifying features of Greater Wash SPA assessed for disturbance and displacement** during the operation and maintenance phase.

7.5.4.3 Decommissioning

7.5.4.3.1 Direct Disturbance and Displacement due to Work Activity in the Dogger Bank D Array Area, ECC or Landfall (Offshore ECC and Landfall)

1179. There is **no potential for AEol for any of the qualifying features of Greater Wash SPA assessed for disturbance and displacement** during the decommissioning phase.

7.6 Flamborough and Filey Coast SPA

7.6.1 Site Description

1180. FFC SPA is 7km (at sea) from the offshore ECC and 207km (at sea) from the DBD Array Area plus 2km asymmetrical buffer. Given the distance from the SPA, the Project does not directly overlap with the SPA boundary.

1181. The FFC SPA site description is as follows (Natural England, 2018a):

1182. *“The Flamborough and Filey Coast SPA is located on the Yorkshire coast between Bridlington and Scarborough. It includes the RSPB reserve at Bempton Cliffs, the Yorkshire Wildlife Trust Flamborough Cliffs nature reserve and the East Riding of Yorkshire Council Flamborough Head local nature reserve. The cliffs of Flamborough head rise to 135 metres and are composed of chalk and other sedimentary rocks. These soft cliffs have been eroded into a series of bays, arches, pinnacles and gullies with an extensive system of caves at sea-level. The cliffs from Filey Brigg to Cunstone Nab comprise maritime grassland vegetation growing alongside species more typical of chalk grassland. The intertidal area below the cliffs is predominantly rocky and part of a series of reefs that extend into the subtidal area. The adjacent sea out to 2km off Flamborough Head as well as Filey Brigg to Cunstone Nab is characterised by reefs supporting kelp forest communities in the shallow subtidal and faunal turf communities below 2 m water depths. The southern side of Filey Brigg shelves off gently from the rocks to the sandy bottom of Filey Bay.”*

7.6.1.1 Qualifying Features

1183. The qualifying features taken through for assessment for FFC SPA (FFC SPA) are outlined in **Table 7-11**. FFC SPA supports over 1% of the biogeographic population of these species. The citation count, latest count mortality rate and baseline mortality are provided for reference. An assessment for the seabird assemblage is also provided in **Section 7.10**.

Table 7-11 Designated Features of FFC SPA and the Citation Population, Latest Count, Mortality Rate and Baseline Mortality

Designated feature	Citation count (breeding adults) (Natural England, 2018a)	Latest count (breeding adults) (SMP, 2025)	Adult Mortality rate (Horswill & Robinson, 2015)	Baseline mortality per year (number of breeding adults)	
				Citation count	Latest count
Kittiwake	89,040	89,148 (2022)*	14.6%	13,000	13,016
Guillemot	83,214	149,980 (2022)*	6.1%	5,076	9,149
Razorbill	21,140	61,345 (2022)*	10.5%	2,220	6,441
Gannet	16,938	26,250 (2022)*	8.1%	1,372	2,126
Seabird Assemblage	216,730	Sum of latest count of all named features and components.	N/A	Sum of all named features and components.	Sum of all named features and components
Puffin (component species)**	N/A	3,080	9.4%	N/A	290
Herring gull (component species)**	N/A	566	16.0%	N/A	91

1184. Table note: *Count taken from Clarkson *et al* (2022) **No citation count as only a component of the seabird assemblage.

1185. The apportionment rate for each of the qualifying features taken through for assessment are provided in **Table 7-12**.

Table 7-12 Breeding Adult Apportioning Rates for Qualifying Features of FFC SPA Taken Through for Assessment

Species	Apportioning rate (%)				
	Return migration	Breeding	Post-breeding migration	Migration-free winter	Non-breeding
Kittiwake	7.19	71.35	5.44	N/A	N/A
Herring gull	N/A	N/A	N/A	N/A	0.21
Guillemot	N/A	N/A	N/A	N/A	4.41
Razorbill	3.38	N/A	3.38	2.74	N/A
Puffin	N/A	100.00	N/A	N/A	0.41
Gannet	6.23	93.00	4.85	N/A	N/A

7.6.1.1.1 Population Trends for Qualifying Features Subject to Assessment

7.6.1.1.1.1 Guillemot

1186. The colony counts for guillemot presented in Table 7-13 and Figure 7-3 are exclusively from the former Flamborough Head and Bempton Cliffs SPA area. Including the FFC SPA population, designated in 2018, would artificially inflate the population trend as it would account for additional guillemots breeding on the Filey coast, which would not have been included in the population census prior to 2017.

Table 7-13 Historic Colony Counts for Guillemot Feature of the FFC SPA Between 1969 - 2022

Colony count						
Year	1969	1987	2000	2008	2017	2022
Population (breeding adults)	12,570	32,578	47,215	59,817	84,647	105,832

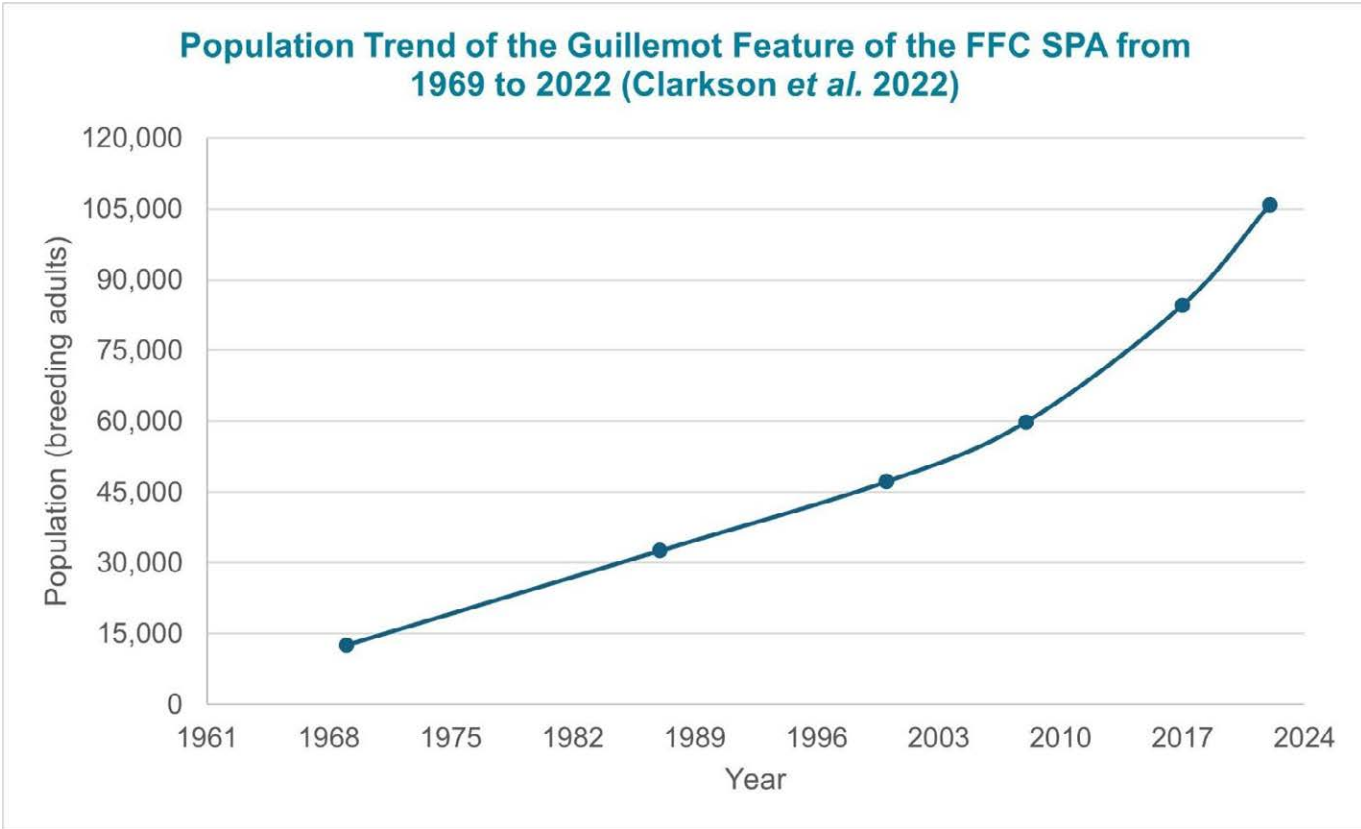


Figure 7-3 Population Trend of the Guillemot Feature of the FFC SPA from 1969 to 2022 (Clarkson et al., 2022)

1187. Colony-specific population growth trends are derived from information provided within the 2022 FFC SPA seabird monitoring report (Clarkson *et al.*, 2022). Overall, the population has grown consistently since the late 1960s at an average of 4.10% per annum (Table 7-14). The guillemot population increased more rapidly from 2000 onwards, peaking at 4.58% growth per annum from 2008. Although there is an increasing concern at some other UK colonies that gannets may be displacing guillemots from traditional nest ledges, this does not appear to have an impact at this SPA (Clarkson *et al.*, 2022).

Table 7-14 Annual Colony Compound Growth Rates for Guillemot Feature of the FFC SPA Between 1969 - 2022

Colony annual compound growth rate (%)					
Year	1969 - 2022	1987 - 2022	2000 - 2022	2008 - 2022	2017 - 2022
Population growth rate (%)	4.21	3.59	4.00	4.58	4.26

7.6.1.1.1.2 Razorbill

1188. The colony counts presented in Table 7-15 and Figure 7-4 for razorbill are from the Flamborough Head and Bempton Cliffs SPA area only as inclusion of the FFC SPA population, which was designated in 2018, would artificially inflate the population trend as it would account for additional razorbill breeding on the Filey coast, which would not have been included in the population census prior to 2017.

Table 7-15 Historic Colony Counts for Razorbill Feature of the FFC SPA Between 1969 - 2022

Colony count						
Year	1969	1987	2000	2008	2017	2022
Population (breeding adults)	1,724	7,688	8,463	14,956	27,967	44,071

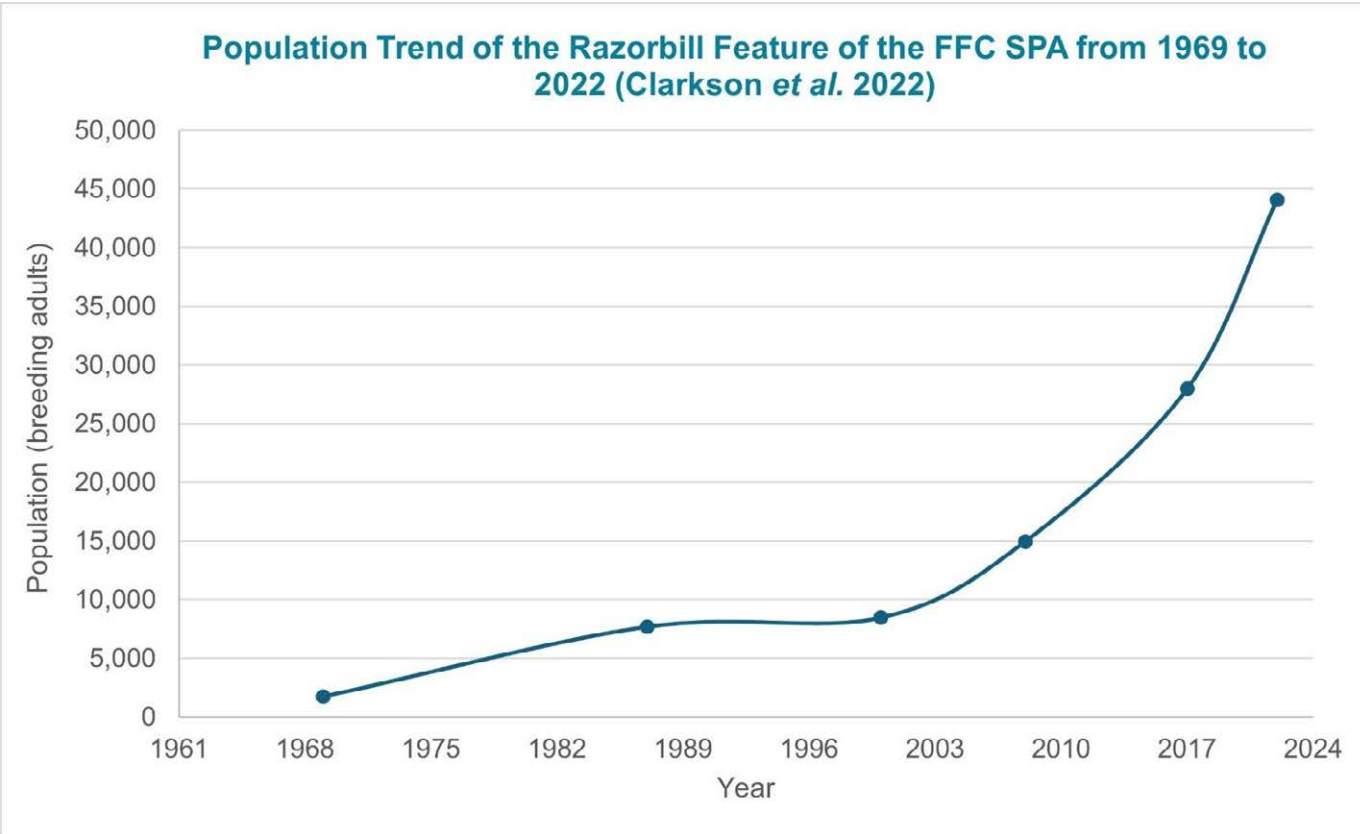


Figure 7-4 Population Trend of the Razorbill Feature of the FFC SPA from 1969 to 2022 (Clarkson et al., 2022)

1189. Colony-specific population growth trends are derived from information provided within the 2022 FFC SPA seabird monitoring report (Clarkson *et al.*, 2022). The colony counts show an ongoing and strong increase in the breeding razorbill population within the FFC SPA, with a mean annual population growth of 6.38% since 1969 (Table 7-16). The population increase has been most significant since 2000, with an increase of 230% up to 2022, with a mean annual growth rate of approximately 8%. The FFC SPA now supports one of the largest razorbill colonies in the UK (Clarkson *et al.*, 2022).

Table 7-16 Annual Colony Compound Growth Rates for Razorbill Feature of the FFC SPA Between 1969 - 2022

Colony annual compound growth rate (%)					
Year	1969 - 2022	1987 - 2022	2000 - 2022	2008 - 2022	2017 - 2022
Population growth rate (%)	6.38	5.23	7.98	8.32	8.66

7.6.1.1.1.3 Puffin

1190. Colony-specific population growth trends are derived from information provided within the 2022 FFC SPA seabird monitoring report (Clarkson *et al.*, 2022). The puffin counts are derived from pre-breeding season rafting of returning individuals. This method was conducted following the expertise of puffin researcher Professor Mike Harris (Babcock *et al.*, 2018). Counts are presented from 2017 and show a slight population increase of 1.36% per annum up to 2022 (Table 7-17; Figure 7-5). The 2018 count was notably higher than the years either side although reasons for this are unclear (Clarkson *et al.*, 2022). The 2018 count was completed later in the year than the 2017 and 2022 counts due to poor weather conditions delaying puffin arrival. This may help explain the higher count as the concentration of puffin could have been channelled into a more focussed period of time (Babcock *et al.*, 2018). It must also be noted that for the 2017 count, only individuals at sea were properly surveyed, however, it was noted that other individuals were already on cliff ledges but were not considered as part of the main count. Therefore, when considering the population trend of puffin at FFC SPA, it is worth considering the areas of potential error when concluding colony health.

Table 7-17 Historic Colony Counts for Puffin Feature of the FFC SPA Between 2017 - 2022

Colony count			
Year	2017	2018	2022
Population (breeding adults)	2,879	4,279	3,080

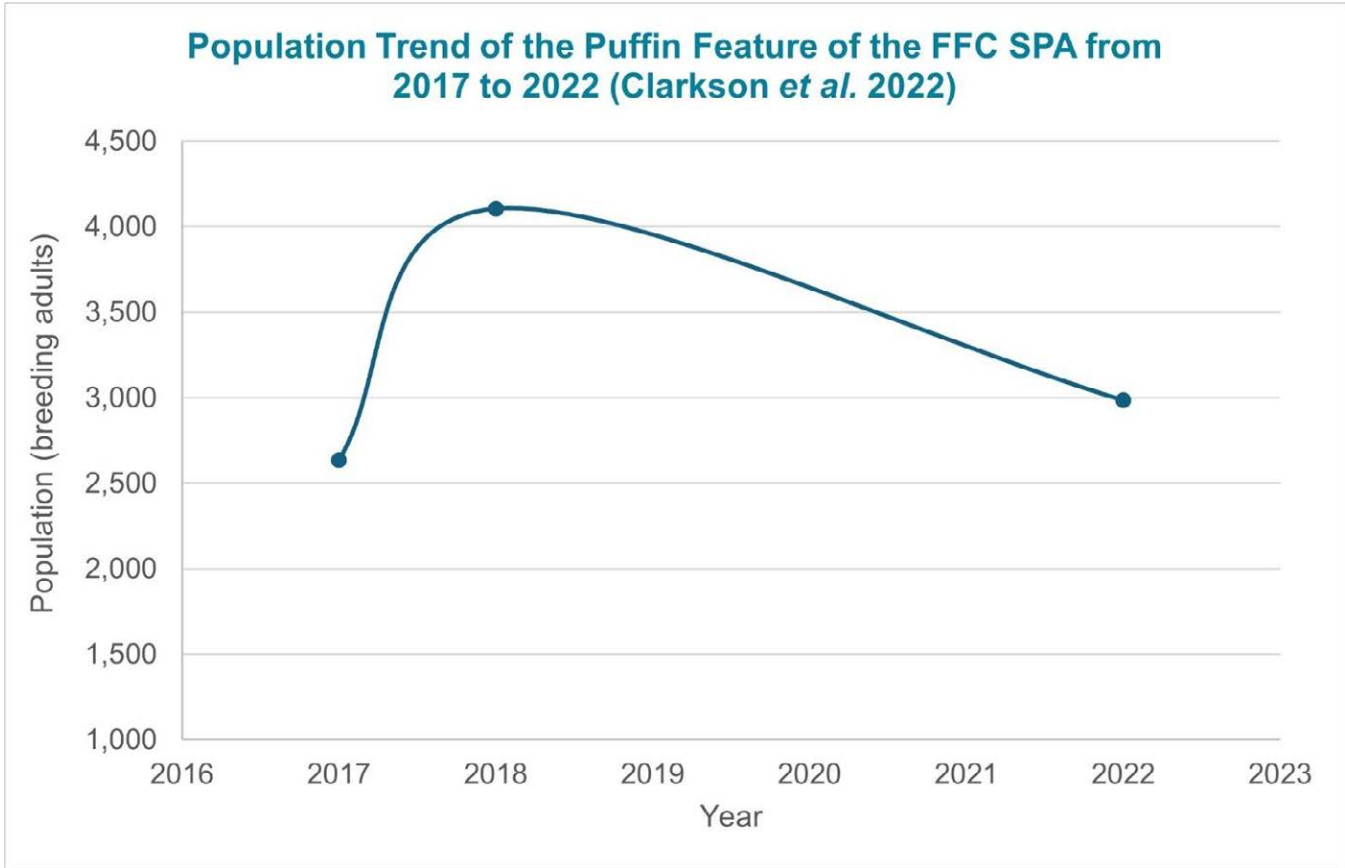


Figure 7-5 Population Trend of the Puffin Feature of the FFC SPA from 2017 to 2022 (Clarkson *et al.*, 2022)

7.6.1.1.1.4 Gannet

1191. The Flamborough and Bempton Cliffs gannet colony was initially established in the late 1930s (Cramp *et al.*, 1974) and so has been in existence for nearly 90 years. Colony-specific population growth trends for the colony are based on the information provided within the 2022 FFC SPA seabird monitoring report (Clarkson *et al.*, 2022) and the SMP database (2025). Overall, the gannet population at the FFC SPA has grown by 13% since the late 1960s (Table 7-18; Figure 7-6). The mean annual growth rate peaked between 1969 and 1987 at 22% but has since decreased to an 8% growth rate per annum since 2000 and 6% growth rate per annum since 2008 (Table 7-19; Clarkson *et al.*, 2022). The colony census in 2022 recorded a 0.4% contraction in population since the last count in 2017 due to the impacts from Highly Pathogenic Avian Influenza (HPAI). Although not as severely impacted as other UK gannet colonies (e.g. Forth Islands) this marked the first time the gannet colony had experienced a decline since its establishment. In 2023 a follow up census was completed which showed a recovery of the population from the previous year with a population growth rate of 16% between 2022 and 2023.

Table 7-18 Historic Colony Counts for Gannet Feature of the FFC SPA between 1969 - 2023

Colony count							
Year	1969	1987	2000	2008	2017	2022	2023
Population (breeding adults)	42	1,560	5,104	12,772	26,784	26,250	30,466

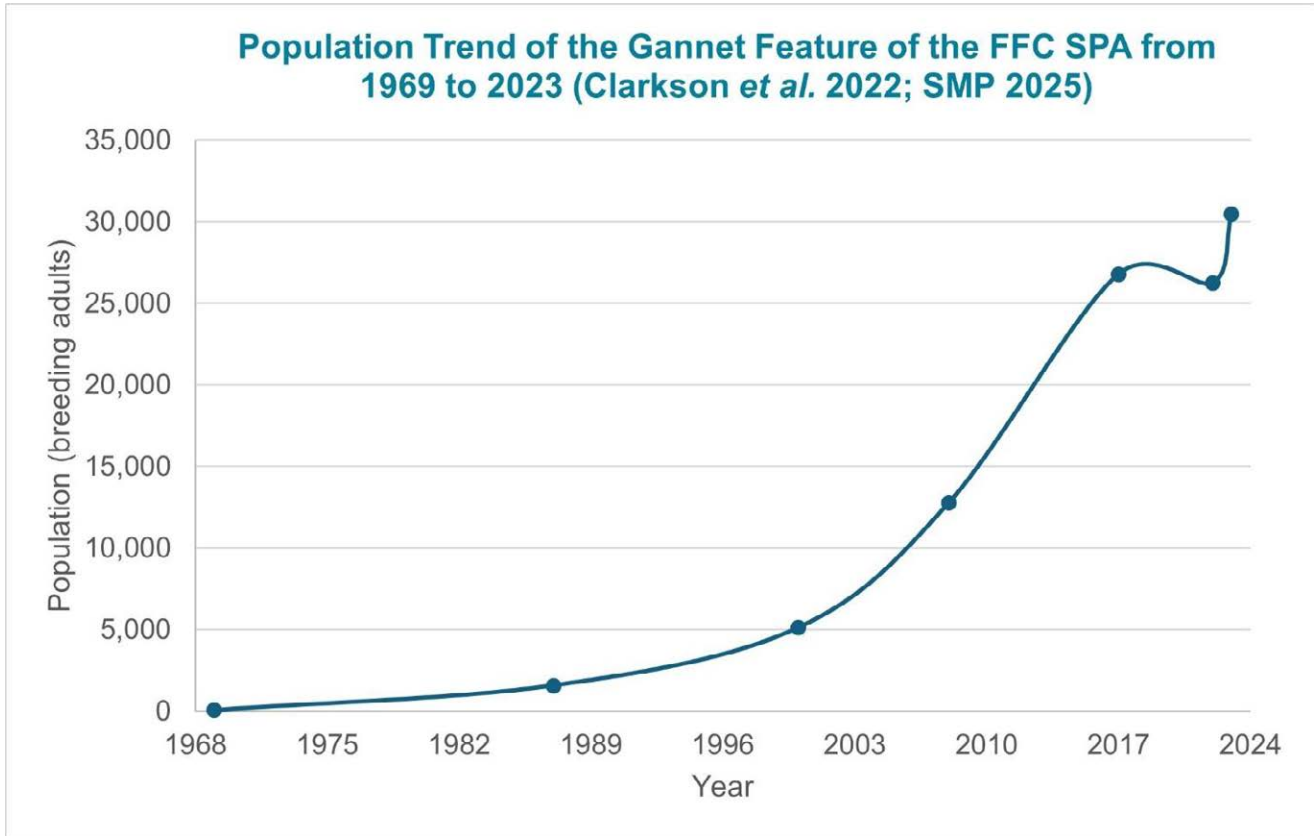


Figure 7-6 Population Trend of the Gannet Feature of the FFC SPA from 1969 to 2023 (Clarkson et al., 2022; SMP, 2025)

Table 7-19 Annual Colony Compound Growth Rates for Gannet Feature of the FFC SPA between 1969 - 2023

Colony annual compound growth rate (%)							
Year	1969 - 2023	1987 - 2023	2000 - 2023	2008 - 2023	2017 - 2022	2017 - 2023	2022 - 2023
Population growth rate (%)	12.97	8.61	8.08	5.97	-0.40	2.17	16.06

1192. The cliff area occupied by the colony has continued to expand in line with the population growth with significant expansion to the southern and northern boundaries of the colony. Population growth is widespread across the colony with new pairs infilling alongside existing territories or establishing in ‘clubs’ of previously non-breeding birds (Clarkson *et al.*, 2022).

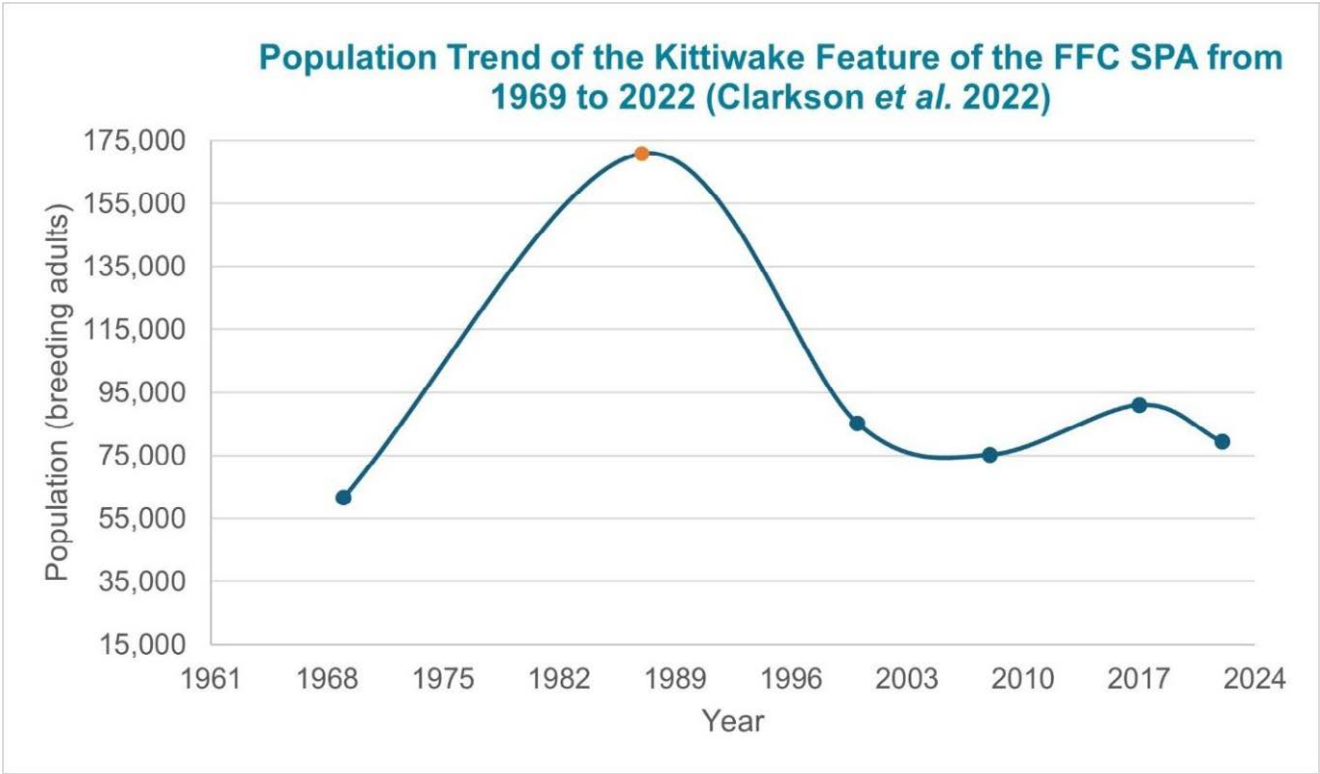
7.6.1.1.1.5 Kittiwake

1193. The colony counts presented in Table 7-20 and Figure 7-7 for kittiwake are from the Flamborough Head and Bempton Cliffs SPA area only as inclusion of the FFC SPA population, which was designated in 2018, would artificially inflate the population trend as it would account for additional kittiwakes breeding on the Filey coast, which would not have been included in the population census prior to 2017. The average annual growth rates presented are derived from the colony counts in the 2022 FFC SPA seabird monitoring report (Clarkson *et al.*, 2022).

Table 7-20 Historic Colony Counts for Kittiwake Feature of the FFC SPA between 1969 - 2022

Colony count						
Year	1969	1987	2000	2008	2017	2022
Population (breeding adults)	61,594	170,790	85,164	75,234	91,008	79,306

1194. The FFC SPA kittiwake colony seemingly increased in size from 30,800 to 85,395 pairs, or by 169.5%, between 1969 and 1987, respectively. However, this increase is widely disputed by seabird experts, including Coulson (Coulson, 2011 and 2017) and MacArthur Green (2015) who suggest there is a likely error in the colony counts that were undertaken in 1987. Recorders at that time were considered to have recorded the number of individual birds present (85,395 individual breeding kittiwakes) as being the number of breeding pairs, which would artificially inflate the colony population to double the value (to 170,790 individual breeding kittiwakes). No accurate counts were made of the colony in the years between 1969 and 1987. The 1987 count forms the basis of the designated SPA citation population value which underpins the conservation objectives of the FFC SPA.



*Orange datapoint indicates the disputed colony count at the FFC SPA as discussed above.
Figure 7-7 Population Trend for the Kittiwake Feature of FFC SPA from 1969 to 2022 (Clarkson *et al.*, 2022)

1195. A more accurate colony count undertaken in 2000, as part of the national Seabird 2000 census (Mitchell *et al.*, 2004), was conducted. This represents a decrease in the colony size from 83,700 to 42,582 pairs, or by 50%, between 1987 and 2000. Such a dramatic population change would have to be linked to changes from other factors such as changes in available food resources, such as the biomass of sandeels, which are the main food source of kittiwakes. Shortages of this food source for kittiwakes are recognised as being a likely direct cause of declines in kittiwake breeding success at other colonies, as waters within their natural foraging range contain a lack of alternative prey species to substitute such losses when sandeels have years of low abundance (Coulson, 2017; Frederiksen *et al.*, 2004; Wanless *et al.*, 2007). A further study conducted by Carroll *et al* (2017) further highlights this relationship, at the FFC SPA in particular, with modelling results showing increases in sandeels biomass at the Dogger Bank area having a positive association with the FFC SPA kittiwake colony productivity rates.

1196. Following more regular monitoring work at the kittiwake colony since 2000, it is apparent that in the last 20 years the kittiwake population has increased by 0.21% per annum. A further increase of 2.14% per annum is evident in the 10 years since 2008 to achieve a population of 45,504 pairs in 2017 (51,535 pairs within the FFC SPA), despite multiple OWFs being operational within the North Sea over that period, providing evidence of the FFC SPA kittiwake colony being stable and maintaining a population of the long-term mean of between 40,000 to 50,000 breeding pairs.
1197. Reference to the potential 170% increase between 1969 and 1979 and then 50% decrease between 1987 and 2000 are considered a contentious subject (Coulson, 2011; MacArthur Green, 2015), as explained above. Considering these data as erroneous would better fit with the long-term colony trend of maintaining a steady increase from approximately 30,000 breeding pairs in the 1960s to approximately 50,000 breeding pairs in the 2020s, therefore providing evidence that this colony has a continuously increasing trend. Therefore, when considering the overall long-term population trend from 1969 of 30,800 pairs until the most recent accurate counts in 2022 of 44,574 pairs, the population shows a steady increase in the growth rate of 0.70% per annum (Table 7-21). However, colony counts between 2017 and 2022 indicate a slight population decline of approximately 3% per annum over this period. Clarkson *et al* (2022) suggest the reasons behind this are unclear but may reflect a cumulative impact of poor breeding output since 2010, although this breeding success improved in 2022. Other causes for the population decline at this time could be due to the outbreak of HPAI amongst UK seabirds between 2021 and 2022 (Tremlett *et al.*, 2024).

Table 7-21 Annual Colony Compound Growth Rates for Kittiwake Feature of the FFC SPA between 1969 - 2022

Colony annual compound growth rate (%)					
Year	1969 - 2022	1987 - 2022	2000 - 2022	2008 - 2022	2017 - 2022
Population growth rate (%)	0.70	-2.17	0.21	1.22	-2.86

7.6.1.2 Conservation Objectives

1198. The overarching conservation objectives for the SPA are listed below. Those relevant to assessment are highlighted **bold**, based on consideration of how the identified impact pathways may affect the qualifying features screened in for assessment:
- To ensure that the integrity of the site is maintained or restored as appropriate;
 - To ensure the site contributes in achieving the aims set out in the Wild Birds Directive by maintaining or restoring the following:
 - The extent and distribution of habitats of the qualifying features;

- The structure and function of the habitats of the qualifying features;
- Supporting the processes on which the habitats of the qualifying features rely;
- **The population of the different qualifying features;** and
- The distribution of the qualifying features within the designated site.

7.6.1.3 Condition Assessment

1199. A condition assessment has not been completed for the qualifying features of the FFC SPA or for the site as a whole (Natural England, 2025b).
1200. When considering the qualifying features (**Section 7.6.1.1**) and the conservation objectives (**Section 7.6.1.2**) of the FFC SPA an assessment of condition can be made. The latest available population count for the guillemot feature of 149,980 breeding adults (SMP, 2025; Clarkson *et al.*, 2022) is above the citation population, therefore suggesting that the conservation objectives in relation to population size have been maintained. The guillemot feature of the FFC SPA is considered to be in favourable condition.
1201. The latest available population count for the razorbill feature of 61,345 breeding adults (SMP, 2025; Clarkson *et al.*, 2022) is above the citation population, therefore suggesting that the conservation objectives in relation to population size have been maintained. The razorbill feature of the FFC SPA is considered to be in favourable condition.
1202. There is no citation population count to compare against for the puffin feature of FFC SPA but considering the population trends presented in **Section 7.6.1.1.1** which show an overall stable population trend, suggests the conservation objectives in relation to population size have been maintained. The puffin feature of the FFC SPA is considered to be in favourable condition.
1203. The latest available population count for the kittiwake feature of 89,149 breeding adults (SMP, 2025; Clarkson *et al.*, 2022) is slightly above the citation population, therefore suggesting that the conservation objectives in relation to population size have been maintained. The kittiwake feature of the FFC SPA is considered to be in favourable condition.
1204. The latest available population count for the gannet feature of 30,466 breeding adults (SMP, 2025; Clarkson *et al.*, 2022) is above the citation population, therefore suggesting that the conservation objectives in relation to population size have been maintained. The gannet feature of the FFC SPA is considered to be in favourable condition.

7.6.2 Assessment of Potential Effects of the Project Alone

1205. Potential for LSE alone has been identified for the following features of FFC SPA:

- Guillemot (see **Section 7.6.2** and **Section 7.6.3** for assessment);
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Disturbance and displacement due to presence of wind turbines and other offshore infrastructure (non-breeding bio-season);
 - In-combination effects (operation and maintenance phase) for the non-breeding bio-season;
- Razorbill (see **Section 7.6.2** and **Section 7.6.3** for assessment);
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Disturbance and displacement due to presence of wind turbines and other offshore infrastructure (for non-breeding bio-season);
 - In-combination effects (operation and maintenance phase) for the non-breeding bio-season;
- Puffin (see **Section 7.6.2** and **Section 7.6.3** for assessment);
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Disturbance and displacement due to presence of wind turbines and other offshore infrastructure (for breeding and non-breeding bio-seasons);
 - In-combination effects (operation and maintenance phase) for the breeding and non-breeding bio-season;
- Kittiwake (see **Section 7.6.2** and **Section 7.6.3** for assessment);
 - Collision risk (operation and maintenance phase) for the breeding and non-breeding bio-season; and
 - In-combination effects (operation and maintenance phase) for the breeding and non-breeding bio-season;
- Herring gull (see **Section 7.6.2** and **Section 7.6.3** for assessment);
 - Collision risk (operation and maintenance phase) for the non-breeding bio-season;
 - In-combination effects (operation and maintenance phase) for the breeding and non-breeding bio-season;
- Gannet (see **Section 7.6.2** and **Section 7.6.3** for assessment);

- Displacement due to presence of wind turbines and other offshore infrastructure (for breeding and non-breeding bio-seasons);
- Collision risk (operation and maintenance phase) for the breeding and non-breeding season; and
- In-combination effects (operation and maintenance phase) for the breeding and non-breeding seasons.

7.6.2.1 Direct Disturbance and Displacement due to Work Activity in the Dogger Bank D Array Area, ECC or Landfall

1206. Assessment of impacts of direct disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall have been assessed together with direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure. This is because there is no differentiation between displacement impacts due to work activity or the presence of turbines when assessing for the DBD Array Area. The assessment of apportioned displacement impacts for designated features of FFC SPA are outlined in **Section 7.6.2.2**.

7.6.2.2 Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

7.6.2.2.1 Construction

7.6.2.2.1.1 Guillemot

1207. During the construction phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-22**, when considering both the Applicant's and SNCB preferred approach.
1208. As presented within **Table 7-22**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the guillemot feature of FFC SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the guillemot feature will be maintained in the long term.

7.6.2.2.1.2 Razorbill

1209. During the construction phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-23** when considering both the Applicant's and SNCB approach.

1210. As presented within **Table 7-23**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the razorbill feature of FFC SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the razorbill feature will be maintained in the long term.

7.6.2.2.1.3 Puffin

1211. During the construction phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-24** when considering both the Applicant's and SNCB approach.
1212. As presented within **Table 7-23**, the level of predicted impact from the Applicant's and SNCB lower range approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. The increase in baseline mortality only exceeds a 1% increase when considering the upper range of the SNCB approach. However, a 10% mortality rate is the upper extreme of the mortality range that Natural England require to be considered and, in view of the evidence detailed in **Section 7.4.5.3**, it is considered to be unrealistic and overly precautionary. Furthermore, the estimated increases in baseline mortality presented above are also based on the premise that all puffin recorded within the DBD Array Area and 2km buffer during the breeding bio-season are breeding adults from the FFC SPA, which (as detailed in **Appendix A.3 Apportionment Report**) is highly unlikely to be the case. Therefore, with regard to the conservation objectives of the puffin feature of FFC SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. As such, subject to natural change, the puffin population will be maintained as a feature in the long term.

Table 7-22 Summary of Construction Phase Disturbance and Displacement Impacts for Guillemot Apportioned to FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-seasons	Guillemot apportioned to the FFC SPA (breeding adults)*	Applicant’s approach		SNCB approach	
			25% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	15% – 35% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (83,214)	Breeding (March – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – February)	327	0.82	0.016	0.49 - 11.43	0.010 - 0.225
	Annual	327	0.82	0.016	0.49 - 11.43	0.010 - 0.225
Latest count (149,980)	Breeding (March – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – February)	327	0.82	0.009	0.49 - 11.43	0.005 - 0.125
	Annual	327	0.82	0.009	0.49 - 11.43	0.005 - 0.125

Table note: *Calculated as the mean peak abundance (Table 7-6) x the FFC SPA apportioning rate (Table 7-12).

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Table 7-23 Summary of Construction Phase Disturbance and Displacement Impacts for Razorbill Apportioned to FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-seasons	Razorbill apportioned to the FFC SPA (breeding adults)*	Applicant's approach		SNCB approach	
			25% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	15% – 35% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (21,140)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Post-breeding migration (August – October)	10	0.02	0.001	0.01 – 0.33	0.001 – 0.015
	Migration-free winter (November – December)	16	0.04	0.002	0.02 – 0.56	0.001 - 0.025
	Return migration (January – March)	49	0.12	0.006	0.07 – 1.73	0.003 – 0.078
	Annual	75	0.19	0.008	0.11 – 2.63	0.005 – 0.118
Latest count (61,345)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Post-breeding migration (August – October)	10	0.02	<0.001	0.01 – 0.33	<0.001 – 0.005
	Migration-free winter (November – December)	16	0.04	0.001	0.02 – 0.56	<0.001 – 0.009
	Return migration (January – March)	49	0.12	0.002	0.07 – 1.73	0.001 – 0.027
	Annual	75	0.19	0.003%	0.11 – 2.63	0.002 – 0.041%

Table note: *Calculated as the mean peak abundance (Table 7-6) x the FFC SPA apportioning rate (Table 7-12).

7.6.2.2.1.4 Gannet

1213. During the construction phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-25** when considering both the Applicant's and SNCB approach.
1214. As presented within **Table 7-25**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the gannet feature of FFC SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term.

7.6.2.2.2 Operation and Maintenance

7.6.2.2.2.1 Guillemot

1215. During the operation and maintenance phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-26** when considering both the Applicant's and SNCB approach.
1216. A displacement matrix is also presented for the annual apportioned abundance for the DBD Array Area plus 2km asymmetrical buffer to FFC SPA (**Table 7-27**).

7.6.2.2.2.1.1 Breeding Bio-season

1217. The Project is outside of guillemots Mean Max Foraging Range (MMFR) + 1 Standard Deviation (SD) foraging range from the FFC SPA. Therefore, no potential for connectivity concluded during the breeding bio-season.

7.6.2.2.2.1.2 Non-breeding Bio-season

1218. When considering the Applicant's approach, the consequent potential mortality is predicted at two (1.63) breeding adults during the non-breeding bio-season. This would result in a baseline mortality increase of 0.018% against the latest population count (**Table 7-26**).

7.6.2.2.2.1.3 Annual Total

1219. When considering the Applicant's approach, the consequent potential mortality for breeding adult guillemots from FFC SPA annually is predicted at two (1.63) breeding adults per annum. This would result in an increase in the baseline mortality of 0.018% against the latest population count (**Table 7-26**).
1220. When considering the SNCB approach the consequent potential mortality for breeding adult guillemots from FFC SPA annually is predicted at one to 23 (0.98 – 22.86) breeding adults per annum. This would result in an increase in the baseline mortality of 0.011% to 0.250% against the latest population count (**Table 7-26**).
1221. These levels of impact from either the Applicant's or SNCB approach would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the guillemot feature of FFC SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can confidently be ruled out**. Therefore, subject to natural change, the population of the guillemot feature will be maintained in the long term.

7.6.2.2.2.2 Razorbill

1222. During the operation and maintenance phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-28** when considering both the Applicant's and SNCB approach.
1223. A displacement matrix is also presented for the annual apportioned abundance for the DBD Array Area plus 2km asymmetrical buffer to FFC SPA (**Table 7-29**).

Table 7-24 Summary of Construction Phase Disturbance and Displacement Impacts for Puffin Apportioned to FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-seasons	Puffin apportioned to the FFC SPA (breeding adults)*	Applicant’s approach		SNCB approach	
			25% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	15% – 35% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Latest count (3,080)	Breeding (April – July)	111	0.28	0.096	0.17 - 3.89	0.058 - 1.342
	Non-breeding (August – March)	<1	<0.01	<0.001	<0.01	<0.001 - 0.001
	Annual	111	0.28	0.096	0.17 - 3.89	0.058 - 1.343

Table note: *Calculated as the mean peak abundance (Table 7-6) x the FFC SPA apportioning rate (Table 7-12).

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Table 7-25 Summary of Construction Phase Disturbance and Displacement Impacts for Gannet Apportioned to FFC SPA using the breeding adult apportioning rates within **Table 7-12**

Population size (breeding adults)	Bio-season	Gannet apportioned to the FFC SPA (breeding adults)*	Applicant's approach		SNCB approach	
			30% - 40% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	30% - 40% Disp; 1% - 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (16,938)	Breeding (March – September)	202	0.61 - 0.81	0.044 - 0.059	0.61 – 8.07	0.044 - 0.588
	Return migration (December – February)	5	0.02 – 0.02	0.001 - 0.002	0.02- 0.21	0.001 - 0.015
	Post-breeding migration (October – November)	39	0.12 - 0.16	0.009 - 0.011	0.12 - 1.58	0.009 - 0.115
	Annual	247	0.74 - 0.99	0.054 - 0.072	0.74 – 9.86	0.054 - 0.719
Latest Count (26,250)	Breeding (March – September)	202	0.61 - 0.81	0.028 - 0.038	0.61 – 8.07	0.028 - 0.380
	Return migration (December – February)	5	0.02 – 0.02	0.001 - 0.001	0.02- 0.21	0.001 - 0.010
	Post-breeding migration (October – November)	39	0.12 - 0.16	0.006 - 0.007	0.12 - 1.58	0.006 - 0.074
	Annual	247	0.74 - 0.99	0.035 - 0.046	0.74 – 9.86	0.035 - 0.464

Table note: *Calculated as the mean peak abundance (**Table 7-6**) x the FFC SPA apportioning rate (**Table 7-12**).

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Table 7-26 Summary of Operation and Maintenance Phase Disturbance and Displacement Impacts for Guillemot Apportioned to FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-season	Guillemot apportioned to the FFC SPA (breeding adults)*	Applicant's approach		SNCB approach	
			50% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	30% – 70% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (83,214)	Breeding (March – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – February)	327	1.63	0.032	0.98 – 22.86	0.019 – 0.450
	Annual	327	1.63	0.032	0.98 – 22.86	0.019 – 0.450
Latest count (149,980)	Breeding (March – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – February)	327	1.63	0.018	0.98 – 22.86	0.011 – 0.250
	Annual	327	1.63	0.018	0.98 – 22.86	0.011 – 0.250

Table note: *Calculated as the mean peak abundance (Table 7-6) x the FFC SPA apportioning rate (Table 7-12).

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Table 7-27 Guillemot Operation and Maintenance Phase Annual Displacement Matrix for Impacts Apportioned to the FFC SPA

Guillemot annual displacement matrix (based on 327 breeding adults apportioned to the FFC SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	1	1	2	2	2	3	3	3
10	0	0	1	1	1	2	3	7	10	13	16	20	23	26	29	33
20	0	1	1	2	3	3	7	13	20	26	33	39	46	52	59	65
30	0	1	2	3	4	5	10	20	29	39	49	59	69	78	88	98
40	0	1	3	4	5	7	13	26	39	52	65	78	91	105	118	131
50	0	2	3	5	7	8	16	33	49	65	82	98	114	131	147	163
60	0	2	4	6	8	10	20	39	59	78	98	118	137	157	176	196
70	0	2	5	7	9	11	23	46	69	91	114	137	160	183	206	229
80	0	3	5	8	10	13	26	52	78	105	131	157	183	209	235	261
90	0	3	6	9	12	15	29	59	88	118	147	176	206	235	265	294
100	0	3	7	10	13	16	33	65	98	131	163	196	229	261	294	327
				>1% increase in baseline mortality rate against latest count						>1% increase in baseline mortality rate against citation population						

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Table 7-28 Summary of Operation and Maintenance Phase Disturbance and Displacement Impacts for Razorbill Apportioned to FFC SPA using the breeding adult apportioning rates within **Table 7-12**

Population size (breeding adults)	Bio-season	Razorbill apportioned to the FFC SPA (breeding adults)*	Applicant's approach		SNCB approach	
			50% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	30% – 70% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (21,140)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Post-breeding migration (August – October)	10	0.05	0.002	0.03 – 0.67	0.001 – 0.030
	Migration-free winter (November – December)	16	0.08	0.004	0.05 – 1.13	0.002 – 0.051
	Return migration (January – March)	49	0.25	0.011	0.15 – 3.46	0.007 – 0.156
	Annual	75	0.38	0.017	0.23 – 5.25	0.010 – 0.237
Latest count (61,345)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Post-breeding migration (August – October)	10	0.05	0.001	0.03 – 0.67	<0.001 – 0.010
	Migration-free winter (November – December)	16	0.08	0.001	0.05 – 1.13	0.001 – 0.018
	Return migration (January – March)	49	0.25	0.004	0.15 – 3.46	0.002 – 0.054
	Annual	75	0.38	0.006	0.23 – 5.25	0.003 – 0.082

Table note: *Calculated as mean peak abundance (**Table 7-6**) x the FFC SPA apportioning rate (**Table 7-12**).

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Table 7-29 Razorbill Operation and Maintenance Phase Annual Displacement Matrix for Impacts Apportioned to the FFC SPA

Razorbill annual displacement matrix (based on 75 breeding adults apportioned to the FFC SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
10	0	0	0	0	0	0	1	2	2	3	4	5	5	6	7	8
20	0	0	0	0	1	1	2	3	5	6	8	9	11	12	14	15
30	0	0	0	1	1	1	2	5	7	9	11	14	16	18	20	23
40	0	0	1	1	1	2	3	6	9	12	15	18	21	24	27	30
50	0	0	1	1	2	2	4	8	11	15	19	23	26	30	34	38
60	0	0	1	1	2	2	5	9	14	18	23	27	32	36	41	45
70	0	1	1	2	2	3	5	11	16	21	26	32	37	42	47	53
80	0	1	1	2	2	3	6	12	18	24	30	36	42	48	54	60
90	0	1	1	2	3	3	7	14	20	27	34	41	47	54	61	68
100	0	1	2	2	3	4	8	15	23	30	38	45	53	60	68	75
				>1% increase in baseline mortality rate against latest count						>1% increase in baseline mortality rate against citation population						

7.6.2.2.2.1 Breeding Bio-season

1224. The Project Array Area plus 2km buffer is outside the MMFR + one SD foraging range for razorbill from the FFC SPA. Therefore, no potential for connectivity concluded during the breeding bio-season.

7.6.2.2.2.2 Return Migration Bio-season

1225. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.25) breeding adult during the return migration bio-season. This would result in a baseline mortality increase of 0.004% against the latest population count (**Table 7-28**).

7.6.2.2.2.3 Migration-free Winter Bio-season

1226. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.08) breeding adult during the migration-free winter bio-season. This would result in a baseline mortality increase of 0.001% against the latest population count (**Table 7-28**).

7.6.2.2.2.4 Post-breeding Migration Bio-season

1227. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.05) breeding adult during the post-breeding migration bio-season. This would result in a baseline mortality increase of 0.001% against the latest population count (**Table 7-28**).

7.6.2.2.2.5 Annual Total

1228. When considering the Applicant's approach, the consequent potential mortality for breeding adult razorbills from FFC SPA annually is predicted at less than one (0.38) breeding adult per annum. This would result in a baseline mortality increase of 0.006% against the latest population count (**Table 7-28**).
1229. When considering the SNCB approach the consequent potential mortality for breeding adult razorbills from FFC SPA annually is predicted at less than one to six (0.23 – 5.25) breeding adults per annum. This would result in a baseline mortality increase of 0.003% to 0.082% against the latest population count (**Table 7-28**).
1230. These levels of impact from either the Applicant's or SNCB approach would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the razorbill feature of FFC SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the razorbill feature will be maintained in the long term.

7.6.2.2.2.3 Puffin

1231. During the operation and maintenance phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-30** when considering both the Applicant's and SNCB approach.
1232. A displacement matrix is also presented for the annual apportioned abundance for the DBD Array Area plus 2km asymmetrical buffer to FFC SPA (**Table 7-31**).

7.6.2.2.3.1 Breeding Bio-season

1233. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.56) breeding adult during the breeding bio-season. This would result in a baseline mortality increase of 0.192% against the latest population count (**Table 7-30**).

7.6.2.2.3.2 Non-breeding Bio-season

1234. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (<0.01) breeding adult during the non-breeding bio-season. This would result in a baseline mortality increase of less than 0.001% against the latest population count (**Table 7-30**).

7.6.2.2.3.3 Annual Total

1235. When considering the Applicant's approach, the consequent potential mortality for breeding adult puffins from FFC SPA annually is predicted at less than one (0.56) breeding adult per annum. This would result in a baseline mortality increase of 0.192% against the latest population count (**Table 7-30**).
1236. When considering the SNCB approach the consequent potential mortality for breeding adult puffins from FFC SPA annually is predicted at less than one to eight (0.33 – 7.78) breeding adults per annum. This would result in a baseline mortality increase of 0.115% to 2.686% against the latest population count (**Table 7-30**).

Table 7-30 Summary of Operation and Maintenance Phase Disturbance and Displacement Impacts for Puffin Apportioned to FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-season	Puffin apportioned to the FFC SPA (breeding adults)*	Applicant's approach		SNCB approach	
			50% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	30% – 70% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Latest count (3,080)	Breeding (April – July)	111	0.56	0.192	0.33 – 7.78	0.115 – 2.684
	Non-breeding (August – March)	<1	<0.01	<0.001	<0.01 – 0.01	<0.001 – 0.002
	Annual	111	0.56	0.192	0.33 – 7.78	0.115 – 2.686

Table note: *Calculated as the mean peak abundance (Table 7-6) x the FFC SPA apportioning rate (Table 7-12).

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Table 7-31 Puffin Operation and Maintenance Phase Annual Displacement Matrix for Impacts Apportioned to the FFC SPA

Puffin annual displacement matrix (based on 111 breeding adults apportioned to the FFC SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
10	0	0	0	0	0	1	1	2	3	4	6	7	8	9	10	11
20	0	0	0	1	1	1	2	4	7	9	11	13	16	18	20	22
30	0	0	1	1	1	2	3	7	10	13	17	20	23	27	30	33
40	0	0	1	1	2	2	4	9	13	18	22	27	31	36	40	44
50	0	1	1	2	2	3	6	11	17	22	28	33	39	44	50	56
60	0	1	1	2	3	3	7	13	20	27	33	40	47	53	60	67
70	0	1	2	2	3	4	8	16	23	31	39	47	54	62	70	78
80	0	1	2	3	4	4	9	18	27	36	44	53	62	71	80	89
90	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
100	0	1	2	3	4	6	11	22	33	44	56	67	78	89	100	111
				>1% increase in baseline mortality rate against latest count						>1% increase in baseline mortality rate against citation population						

1237. As presented within **Table 7-30**, the level of predicted impact from the Applicant's and SNCB lower range approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. The increase in baseline mortality only exceeds a 1% increase when considering the upper range of the SNCB approach. However, a 10% mortality rate is the upper extreme of the mortality range that Natural England require to be considered and in view of the evidence detailed in **Section 7.4.5.3**, is considered to be unrealistic and overly precautionary. Furthermore, the estimated increases in baseline mortality presented above are also based on the premise that all puffin recorded within the DBD Array Area and 2km buffer during the breeding bio-season are breeding adults from the FFC SPA, which (as detailed in **Appendix A.3 Apportionment Report**) is highly unlikely to be the case. Therefore, with regard to the conservation objectives of the puffin feature of FFC SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for **an AEol can be confidently ruled out**. As such, subject to natural change, the puffin population will be maintained as a feature in the long term.

7.6.2.2.4 Gannet

1238. During the operation and maintenance phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-32** when considering both the Applicant's and SNCB approach.
1239. A displacement matrix is also presented for the annual apportioned abundance for the DBD Array Area plus 2km asymmetrical buffer to FFC SPA (**Table 7-33**).

7.6.2.2.4.1 Breeding Bio-season

1240. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.50 – 0.67) breeding adult during the breeding bio-season. This would result in a baseline mortality increase of 0.024% to 0.032% against the latest population count (**Table 7-32**).

7.6.2.2.4.2 Return Migration Bio-season

1241. When considering the Applicant's approach, the consequent potential mortality is predicted to be one to two (1.21 – 1.61) breeding adult during the return migration bio-season. This would result in a baseline mortality increase of 0.057% to 0.076% against the latest population count (**Table 7-32**).

7.6.2.2.4.3 Post-breeding Migration Bio-season

1242. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.24 – 0.32) breeding adult during the post-breeding migration bio-season. This would result in a baseline mortality increase of 0.011% to 0.015% against the latest population count (**Table 7-32**).

7.6.2.2.4.4 Annual Total

1243. When considering the Applicant's approach, the consequent potential mortality for breeding adult gannets from FFC SPA annually is predicted at approximately two (1.48 – 1.97) breeding adult per annum. This would result in a baseline mortality increase of 0.070% to 0.093% against the latest population count (**Table 7-32**).
1244. When considering the SNCB approach the consequent potential mortality for breeding adult gannets from FFC SPA annually is predicted at two to 20 (1.48 – 19.72) breeding adults per annum. This would result in a baseline mortality increase of 0.070% to 0.928% against the latest population count (**Table 7-32**).
1245. These levels of impact from either the Applicant's or SNCB approach would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the gannet feature of FFC SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for **an AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term.

7.6.2.2.3 Decommissioning

1246. The worst-case scenario for decommissioning activities within the DBD Array Area is considered to be equal to or less than the worst-case scenario for the construction phase. Therefore, for the purposes of this assessment it is assumed that the impacts are likely to be similar. Closer to the time of decommissioning, it may be decided that removal would lead to a greater environmental impact than leaving some components in situ, in which case certain components may be cut off at or below seabed level (e.g. in the case of piled foundations) or left buried (e.g. in the case of sub-sea cables). This may reduce the amount of decommissioning activity required.
1247. As described in **Section 7.6.2.2.1**, the potential for **an AEol in the construction phase can be confidently ruled out**, therefore **the same conclusion is considered appropriate for the decommissioning phase**.

7.6.2.3 Barrier Effect due to Presence of Wind Turbines and Other Offshore Infrastructure

1248. Assessments for barrier effects due to the presence of wind turbines and other offshore infrastructure are considered in **Section 7.12**.

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Table 7-32 Summary of Operation and Maintenance Phase Disturbance and Displacement Impacts for Gannet Apportioned to FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-season	Gannet apportioned to the FFC SPA (breeding adults)*	Applicant's approach		SNCB approach	
			60% - 80% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	60% – 80% Disp; 1% - 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (16,938)	Breeding (March – September)	202	1.21 – 1.61	0.088 – 0.118	1.21 – 16.14	0.088 – 1.177
	Post-breeding migration (October – November)	39	0.24 – 0.32	0.017 – 0.023	0.24 – 3.15	0.017 – 0.230
	Return migration (December – February)	5	0.03 – 0.04	0.002 – 0.003	0.03 – 0.42	0.002 – 0.031
	Annual	247	1.48 – 1.97	0.108 – 0.144	1.48 – 19.72	0.108 – 1.437
Latest Count (26,250)	Breeding (March – September)	202	1.21 – 1.61	0.057 – 0.076	1.21 – 16.14	0.057 – 0.759
	Post-breeding migration (October – November)	39	0.24 – 0.32	0.011 – 0.015	0.24 – 3.15	0.011 – 0.148
	Return migration (December – February)	5	0.03 – 0.04	0.001 – 0.002	0.03 – 0.42	0.001 – 0.020
	Annual	247	1.48 – 1.97	0.070 – 0.093	1.48 – 19.72	0.070 – 0.928

Table note: *Calculated as the mean peak abundance (Table 7-6) x the FFC SPA apportioning rate (Table 7-12).

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Table 7-33 Gannet Operation and Maintenance Phase Annual Displacement Matrix for Impacts Apportioned to the FFC SPA

Gannet annual displacement matrix (based on 247 breeding adults apportioned to the FFC SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
10	0	0	0	1	1	1	2	5	7	10	12	15	17	20	22	25
20	0	0	1	1	2	2	5	10	15	20	25	30	35	40	44	49
30	0	1	1	2	3	4	7	15	22	30	37	44	52	59	67	74
40	0	1	2	3	4	5	10	20	30	40	49	59	69	79	89	99
50	0	1	2	4	5	6	12	25	37	49	62	74	86	99	111	124
60	0	1	3	4	6	7	15	30	44	59	74	89	104	119	133	148
70	0	2	3	5	7	9	17	35	52	69	86	104	121	138	156	173
80	0	2	4	6	8	10	20	40	59	79	99	119	138	158	178	198
90	0	2	4	7	9	11	22	44	67	89	111	133	156	178	200	222
100	0	2	5	7	10	12	25	49	74	99	124	148	173	198	222	247
				>1% increase in baseline mortality rate against latest count						>1% increase in baseline mortality rate against citation population						

7.6.2.4 Indirect Effects via Habitats or Prey Availability

1249. Assessments for indirect effects via habitat or prey availability are considered in **Section 7.11**.

7.6.2.5 Collision Risk with Wind Turbine Blades (Dogger Bank D Array Area)

7.6.2.5.1 Operation and Maintenance

7.6.2.5.1.1 Kittiwake

1250. During the operation and maintenance phase, the potential of impact from collision risk apportioned to the FFC SPA seasonally is summarised in **Table 7-34**.

Table 7-34 Kittiwake Predicted Collision Risk Mortalities During the Operation and Maintenance Phase Apportioned to the FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-seasons	Collision risk impact	
		Breeding adults per annum	Increase in baseline mortality (%)
Citation (89,040)	Breeding (March - August)	48.43	0.373
	Return migration (January - February)	2.24	0.017
	Post-breeding migration (September - December)	2.00	0.015
	Annual total	52.68	0.405
Latest Count (89,148)	Breeding (March - August)	48.43	0.372
	Return migration (January - February)	2.24	0.017
	Post-breeding migration (September - December)	2.00	0.015
	Annual total	52.68	0.405

7.6.2.5.1.1.1 Breeding Bio-season

1251. The predicted breeding bio-season adult mortalities attributed to FFC SPA is 48 (48.43) breeding adults per annum (**Table 7-34**). This would result in a baseline mortality increase of 0.372% against the latest population count (**Table 7-34**).

7.6.2.5.1.1.2 Return Migration Bio-season

1252. The predicted return-migration bio-season adult mortalities attributed to FFC SPA is two (2.24) breeding adults per annum (**Table 7-34**). This would result in an increase in the baseline mortality rate of 0.017% against the latest population count (**Table 7-34**).

7.6.2.5.1.1.3 Post-breeding Migration Bio-season

1253. The predicted post-breeding migration bio-season adult mortalities attributed to FFC SPA is two (2.00) breeding adults per annum (**Table 7-34**). This would result in an increase in the baseline mortality rate of 0.015% against the latest population count (**Table 7-34**).

7.6.2.5.1.1.4 Annual Total

1254. The predicted resultant mortality across all defined bio-seasons from the Project attributed to FFC SPA is 53 (52.68) breeding adult kittiwakes per annum. The addition of 53 predicted mortalities per annum would result in an increase to the baseline mortality rate of 0.405%.

1255. This level of impact would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the kittiwake feature of FFC SPA in relation to collision risk in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the kittiwake feature will be maintained in the long term.

7.6.2.5.1.2 Herring gull

1256. During the operation and maintenance phase, the potential of impact from collision risk apportioned to the FFC SPA seasonally is summarised in **Table 7-35**.

Table 7-35 Herring Gull Predicted Collision Risk Mortalities During the Operation and Maintenance Phase Apportioned to the FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-seasons	Collision risk impact	
		Breeding adults per annum	Increase in baseline mortality (%)
Latest Count (566)	Breeding (March - August)	N/A	N/A
	Non-breeding (September - February)	<0.01	0.003
	Annual total	<0.01	0.003

7.6.2.5.1.2.1 Breeding Bio-season

1257. Herring gull do not have connectivity to the FFC SPA in the breeding bio-season and so this is not considered further in the assessment.

7.6.2.5.1.2.2 Non-breeding Migration Bio-season

1258. The predicted non-breeding bio-season adult mortalities attributed to FFC SPA is less than one (<0.01) breeding adult per annum (**Table 7-35**). This would result in an increase in the baseline mortality rate of 0.003% against the latest population count (**Table 7-35**).

7.6.2.5.1.2.3 Annual Total

1259. The predicted resultant mortality across all defined bio-seasons from the Project attributed to FFC SPA, is less than one (<0.01) breeding adult herring gull per annum. The addition of less than one predicted mortalities per annum would result in an increase to the baseline mortality rate of 0.003%.
1260. This level of impact would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the herring gull feature of FFC SPA in relation to collision risk in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the herring gull feature will be maintained in the long term.

7.6.2.5.1.3 Gannet

1261. During the operation and maintenance phase, the potential of impact from collision risk apportioned to the FFC SPA seasonally is summarised in **Table 7-36**.

Table 7-36 Gannet Predicted Collision Risk Mortalities During the Operation and Maintenance Phase Apportioned to the FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-seasons	Collision risk impact	
		Breeding adults per annum	Increase in baseline mortality (%)
Citation (16,938)	Breeding (March - September)	1.83	0.133
	Return migration (December - February)	0.03	0.002
	Post-breeding migration (October - November)	0.17	0.012
	Annual total	2.03	0.148

Population size (breeding adults)	Bio-seasons	Collision risk impact	
		Breeding adults per annum	Increase in baseline mortality (%)
Latest Count (26,250)	Breeding (March - September)	1.83	0.086
	Return migration (December - February)	0.03	0.002
	Post-breeding migration (October - November)	0.17	0.008
	Annual total	2.03	0.095

7.6.2.5.1.3.1 Breeding Bio-season

1262. The predicted breeding bio-season adult mortalities attributed to FFC SPA is two (1.83) breeding adults per annum (**Table 7-36**). This would result in an increase in the baseline mortality rate of 0.086% against the latest population count (**Table 7-11**).

7.6.2.5.1.3.2 Return Migration Bio-season

1263. The predicted return-migration bio-season adult mortalities attributed to FFC SPA is less than one (0.03) breeding adult per annum (**Table 7-36**). This would result in an increase in the baseline mortality rate of 0.002% against the latest population count (**Table 7-11**).

7.6.2.5.1.3.3 Post-breeding Migration Bio-season

1264. The predicted post-breeding migration bio-season adult mortalities attributed to FFC SPA is less than one (0.17) breeding adult per annum (**Table 7-36**). This would result in an increase in the baseline mortality rate of 0.008% against the latest population count (**Table 7-11**).

7.6.2.5.1.3.4 Annual Total

1265. The predicted resultant mortality across all defined bio-seasons from the Project attributed to FFC SPA is two (2.03) breeding adult gannets per annum. The addition of two predicted mortalities per annum would result in an increase to the baseline mortality rate of 0.095%.

1266. This level of impact would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the gannet feature of FFC SPA in relation to collision risk in the operation and maintenance phase from the Project alone, **the potential for an AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term.

7.6.2.6 Combined Operational Phase Collision and Displacement Effects

1267. For species screened in for both displacement and collision risk assessment, during the O&M phase, there is the potential that the two impacts can adversely impact species populations of SPA features cumulatively. Therefore, combined impacts have been conducted for the following species:

- Gannet.

7.6.2.6.1 Gannet

1268. Due to gannet being screened in for both displacement and collision risk assessment during the O&M phase, there is a potential for these two potential impacts to adversely affect gannet populations cumulatively. Previous sections have ruled out AEol when assessing collision risk or displacement acting alone. However, the combined impact of both collision risk and displacement may be greater than either one acting alone. Further consideration of both impacts acting together is therefore required.

1269. When considering the Applicant's approach, the consequent potential mortality for breeding adult gannets from FFC SPA annually is predicted at approximately four (3.51 to 4.00) breeding adults per annum. This would result in an increase in the baseline mortality of 0.165% to 0.188% against the latest population count (**Table 7-37**).

1270. When considering the SNCB approach the consequent potential mortality for breeding adult gannets from FFC SPA annually is predicted at four to 22 (3.51 to 21.75) breeding adults per annum. This would result in an increase in the baseline mortality of 0.165% to 1.023% against the latest population count (**Table 7-37**).

1271. As presented in **Table 7-37**, the level of predicted impact from the Applicant's and SNCB lower range approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. The increase in baseline mortality only exceeds a 1% increase when considering the upper range of the SNCB approach. However, a 10% mortality rate is the upper extreme of the mortality range that Natural England require to be considered and in view of the evidence detailed in **Section 7.4.5.4**, is considered to be unrealistic and overly precautionary. Therefore, with regard to the conservation objectives of the gannet feature of FFC SPA in relation to combined collision risk and disturbance and displacement effects in the operation and maintenance phase from the Project alone, **the potential for an AEol can be ruled out**. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term.

7.6.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

7.6.3.1 Construction and Decommissioning

1272. The potential for an in-combination effect to occur during the construction and decommissioning phases can be confidently ruled out for all features of the FFC SPA. This is due to the Project having no proposed overlap of construction / decommissioning activities with other reasonably foreseeable projects for an in-combination effect to materialise, based on expert judgement. Additionally, the assessment for the Project alone concluded a non-material level of effect which would be indistinguishable from natural fluctuations in the population, and certainly wouldn't tangibly contribute to an in-combination effect.

7.6.3.2 Operation and Maintenance

7.6.3.2.1 Collision Risk with Wind Turbine Blades (Dogger Bank D Array Area)

7.6.3.2.1.1 Kittiwake

1273. The projects identified for in-combination collision risk for the kittiwake feature of FFC SPA and details on the reference sources are provided in **Table 7-38**. The predicted in-combination mortality is provided in **Table 7-39**.

1274. To ensure the in-combination assessment for the kittiwake feature of the FFC SPA adheres to the recent update to recommended avoidance rates (SNCBs, 2024), where applicable, the collision estimates which rely on previously recommended avoidance rates have been corrected in the same way as undertaken for the Sheringham Shoal Extension Project (SEP) & Dudgeon Extension Project (DEP) (Royal HaskoningDHV, 2023b).

Table 7-37 Summary of Predicted Operation and Maintenance Phase Combined Collision Risk and Displacement Mortalities for Gannet Apportioned to FFC SPA using the breeding adult apportioning rates within Table 7-12

Population size (breeding adults)	Bio-season	Applicant’s approach		SNCB approach	
		60% - 80% Disp; 1% Mort plus CRM (breeding adults per annum)	Increase in baseline mortality rate (%)	60% – 80% Disp; 1% - 10% Mort plus CRM (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (16,938)	Breeding (March - September)	3.04 – 3.44	0.222 - 0.251	3.04 – 17.97	0.222 – 1.310
	Return migration (December - February)	0.06 - 0.07	0.005 – 0.005	0.06 - 0.45	0.005 - 0.033
	Post-breeding migration (October - November)	0.41 - 0.49	0.030 - 0.035	0.41 - 3.32	0.030 - 0.242
	Annual total	3.51 – 4.00	0.256 - 0.292	3.51 – 21.75	0.256 – 1.585
Latest Count (26,250)	Breeding (March - September)	3.04 – 3.44	0.143 - 0.162	3.04 – 17.97	0.143 - 0.845
	Return migration (December - February)	0.06 - 0.07	0.003 - 0.003	0.06 - 0.45	0.003 - 0.021
	Post-breeding migration (October - November)	0.41 - 0.49	0.019 - 0.023	0.41 - 3.32	0.019 - 0.156
	Annual total	3.51 – 4.00	0.165 - 0.188	3.51 – 21.75	0.165 – 1.023

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Table 7-38 In-Combination Predicted Collision Mortality Apportioned to FFC SPA Kittiwake Feature

Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate
	Breeding	Post-breeding migration	Return migration	Annual					
Beatrice	0.0	0.4	2.0	2.5	1	APEM (2022c)	Deterministic	0.989	0.9923
Beatrice Demonstrator	0.0	0.1	0.1	0.1	1	APEM (2022c)	Deterministic	0.989	0.9923
Blyth Demonstration Project	0.0	0.1	0.1	0.1	1	APEM (2022c)	Deterministic	0.989	0.9923
Dudgeon	-	-	-	-	1	APEM (2022c)	Deterministic	0.989	0.9923
East Anglia ONE	0.0	6.1	2.4	8.5	1	APEM (2022c)	Deterministic	0.989	0.9923
EOWDC	0.0	0.2	0.1	0.3	1	APEM (2022c)	Deterministic	0.989	0.9923
Galloper	0.0	1.1	1.6	2.7	1	APEM (2022c)	Deterministic	0.989	0.9923
Greater Gabbard	0.0	0.6	0.6	1.1	1	APEM (2022c)	Deterministic	0.989	0.9923
Gunfleet Sands	-	-	-	-	1	APEM (2022c)	Deterministic	0.989	0.9923
Hornsea Project One	25.6	2.1	1.1	28.7	1	APEM (2022c)	Deterministic	0.989	0.9923
Hornsea Project Two	9.3	0.4	0.1	9.8	1	APEM (2022c)	Deterministic	0.989	0.9923
Humber Gateway	1.3	0.1	0.1	1.5	1	APEM (2022c)	Deterministic	0.989	0.9923
Hywind Scotland Pilot Park	0.0	0.1	0.1	0.1	1	APEM (2022c)	Deterministic	0.989	0.9923
Kentish Flats	0.0	0.1	0.1	0.1	1	APEM (2022c)	Deterministic	0.989	0.9923
Kentish Flats Extension	0.0	0.0	0.1	0.1	1	APEM (2022c)	Deterministic	0.989	0.9923
Kincardine	0.0	0.4	0.1	0.4	1	APEM (2022c)	Deterministic	0.989	0.9923
Lincs	0.5	0.1	0.1	0.6	1	APEM (2022c)	Deterministic	0.989	0.9923
London Array	0.0	0.1	0.1	0.1	1	APEM (2022c)	Deterministic	0.989	0.9923
Lynn and Inner Dowsing	-	-	-	-	1	APEM (2022c)	Deterministic	0.989	0.9923

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Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate
	Breeding	Post-breeding migration	Return migration	Annual					
Methil	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923
Moray East	0.0	0.1	1.0	1.1	1	APEM (2022c)	Deterministic	0.989	0.9923
Race Bank	1.3	0.9	0.3	2.5	1	APEM (2022c)	Deterministic	0.989	0.9923
Rampion	0.0	1.4	1.5	2.9	1	APEM (2022c)	Deterministic	0.989	0.9923
Scroby Sands	-	-	-	-	1	APEM (2022c)	Deterministic	0.989	0.9923
Sheringham Shoal	-	-	-	-	1	APEM (2022c)	Deterministic	0.989	0.9923
Teesside	0.0	0.9	0.1	1.1	1	APEM (2022c)	Deterministic	0.989	0.9923
Thanet	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923
Triton Knoll	17.2	5.3	2.3	24.8	1	APEM (2022c)	Deterministic	0.989	0.9923
Westermost Rough	0.1	0.0	0.0	0.1	1	APEM (2022c)	Deterministic	0.989	0.9923
DBC and Sofia	18.5	3.4	10.9	32.8	2	APEM (2022c)	Deterministic	0.989	0.9923
Seagreen (Phase 1 and 1A)	0.0	5.4	1.7	7.1	2	Royal HaskoningDHV (2024b)	Deterministic	0.989	0.9923
Moray West	0.0	0.9	0.4	1.3	2	APEM (2022c)	Deterministic	0.989	0.9923
Neart na Gaoithe	0.0	0.6	0.1	0.7	2	Royal HaskoningDHV (2024b)	Deterministic	0.989	0.9923
Dogger Bank A and B	39.1	5.1	14.9	59.1	3	APEM (2022c)	Deterministic	0.989	0.9923
DEP and SEP*	0.0	0.0	0.0	0.0	3	Royal HaskoningDHV (2024c)	Deterministic	0.992	0.9923
East Anglia ONE North*	0.0	0.0	0.0	0.0	3	(MacArthur Green & Royal HaskoningDHV, 2021)	Deterministic	0.989	0.9923

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Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate
	Breeding	Post-breeding migration	Return migration	Annual					
East Anglia TWO*	0.0	0.0	0.0	0.0	3	(MacArthur Green & Royal HaskoningDHV, 2021)	Deterministic	0.989	0.9923
East Anglia THREE	0.0	2.6	1.9	4.5	3	(MacArthur Green & Royal HaskoningDHV, 2021)	Deterministic	0.989	0.9923
ForthWind Offshore Wind Demonstration Project - phase 1	0.0	0.0	0.0	0.0	3	ForthWind (2022)	Deterministic	0.989	0.9923
Green Volt	0.0	0.2	0.2	0.4	3	APEM (2023)	Stochastic	0.993	0.9929
Hornsea Project Three*	0.0	0.0	0.0	0.0	3	APEM (2022c)	Deterministic	0.989	0.9923
Hornsea Four*	0.0	0.0	0.0	0.0	3	APEM (2022c)	Stochastic	0.989	0.9929
Inch Cape	0.0	1.0	0.3	1.3	3	Royal HaskoningDHV (2024b)	Deterministic	0.989	0.9923
Norfolk Boreas*	0.0	0.0	0.0	0.0	3	APEM (2022c)	Deterministic	0.989	0.9923
Norfolk Vanguard*	0.0	0.0	0.0	0.0	3	APEM (2022c)	Deterministic	0.989	0.9923
Pentland Floating OWF	-	-	-	-	3	Xodus Group Ltd (2022)	Deterministic	0.989	0.9923
Total consented	112.8	39.5	44.1	196.4					
Berwick Bank	0.4	6.8	9.6	16.7	4	Royal HaskoningDHV (2022)	Deterministic	0.989	0.9923
Dogger Bank South	175.8	4.3	2.1	182.2	4	Royal HaskoningDHV (2024d)	Stochastic	0.993	0.9929
Five Estuaries	0.0	0.4	0.4	0.8	4	GoBe (2024a)	Stochastic	0.993	0.9929

Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate
	Breeding	Post-breeding migration	Return migration	Annual					
North Falls	0.0	0.2	0.6	0.8	4	Royal HaskoningDHV (2024c)	Stochastic	0.993	0.9929
Ossian	2.7	0.3	0.4	3.4	4	NIRAS and RPS (2024)	Stochastic	0.993	0.9929
Outer Dowsing	14.2	0.2	0.2	14.6	4	GoBe (2024b)	Stochastic	0.993	0.9929
Rampion 2	0.0	0.2	0.6	0.7	4	GoBe (2023)	Stochastic	0.993	0.9929
Salamander	-	-	-	-	4	NIRAS Group (UK) Ltd (2024)	Stochastic	0.993	0.9929
West of Orkney	0.0	0.9	1.6	2.5	4	MacArthur Green (2024)	Stochastic	0.993	0.9929
Dogger Bank D	48.4	2.0	2.2	52.7	4	-	Stochastic	0.9929	0.9929
Total all projects	354.3	54.8	61.7	470.8					

Table Note: *Projects have committed to delivery of compensation for the kittiwake feature of the FFC SPA as part of their DCO. Therefore, impact contributions have been zeroed to account for the Project’s compensation contribution.

Table 7-39 FFC SPA Kittiwake Feature In-Combination Predicted Collision Mortality and Increase in Baseline Mortality

Population size (breeding adults)	Bio-season	Projects included	Mean collisions (breeding adults per annum)	Increase in baseline mortality (%)
Citation (89,040)	Breeding (March – August)	DBD plus all consented	112.8	1.240
		All projects	354.3	2.725
	Return migration (January – February_	DBD plus all consented	44.1	0.356
		All projects	61.7	0.475
	Post-breeding migration (September – December)	DBD plus all consented	39.5	0.319
		All projects	54.8	0.422
	Annual	DBD plus all consented	196.4	1.916
		All projects	470.8	3.622
Latest count (89,148)	Breeding (March – August)	DBD plus all consented	112.8	1.239
		All projects	354.3	2.722
	Return migration (January – February)	DBD plus all consented	44.1	0.356
		All projects	61.7	0.474
	Post-breeding migration (September – December)	DBD plus all consented	39.5	0.319
		All projects	54.8	0.421
	Annual	DBD plus all consented	196.4	1.914
		All projects	470.8	3.617

7.6.3.2.1.1.1 Breeding Bio-season

1275. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the breeding bio-season is 354 (354.3) breeding adults. This would result in an increase in baseline mortality of 2.722% (**Table 7-39**) against the latest population count (**Table 7-11**).

7.6.3.2.1.1.2 Return Migration Bio-season

1276. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the return migration bio-season is 62 (61.7) breeding adults. This would result in an increase in baseline mortality of 0.474% (**Table 7-39**) against the latest population count (**Table 7-11**).

7.6.3.2.1.1.3 Post-breeding Migration Bio-season

1277. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the post-breeding migration bio-season is 55 (54.8) breeding adults. This would result in an increase in baseline mortality of 0.421% (**Table 7-39**) against the latest population count (**Table 7-11**).

7.6.3.2.1.1.4 Annual Total

1278. The predicted resultant mortality across all defined bio-seasons from all projects in-combination, attributed to FFC SPA, is 471 (470.8) breeding adult kittiwakes. This would result in an increase in baseline mortality of 3.617% (**Table 7-39**) against the latest population count (**Table 7-11**).

1279. Although the kittiwake feature of FFC SPA is currently considered to be in a favourable condition (**Section 7.6.1.3**), there is a risk that the addition of 471 additional mortalities per annum may compromise the integrity of the feature, even when considering the over precaution surrounding the parameters used within the CRM (**Section 1110**). the potential for an **AEol therefore cannot be ruled out** at this stage. Further consideration of population consequences such a level of predicted impact poses will be determined using Population Viability Analysis (PVA) for the final RIAA, alongside further engagement with Natural England regarding impact conclusions.

7.6.3.2.1.2 Herring Gull

1280. For the Project alone impact, the increase in baseline mortality is predicted to be significantly less than 0.1% per annum. Such a level of effect alone would certainly be indistinguishable from natural fluctuations in the population and is unlikely to materially contribute to any in-combination effect, especially given connectivity is temporally restricted to the non-breeding bio-season. Therefore, the potential for an **AEol in-combination due to mortality as a result of collision can confidently be ruled out** for the herring gull feature of the FFC SPA. Subject to natural change, herring gull will be maintained as a feature in the long-term.

7.6.3.2.1.3 Gannet

1281. Although the project alone impact from collision risk only is unlikely to materially contribute to any in-combination collision impact, an im-combination assessment is presented for context, due to the potential for a combined in-combination effect from collision risk and displacement.
1282. The projects identified for in-combination collision risk for the gannet feature of FFC SPA and details on the reference sources are provided in **Table 7-40**. The predicted in-combination mortality is provided in **Table 7-41**.
1283. To ensure the in-combination assessment for the gannet feature of the FFC SPA adheres to the recent update to recommended avoidance rates (SNCBs, 2024), where applicable the collision estimates which rely on previously recommended avoidance rates have been corrected in the same way as undertaken for DEP & SEP (Royal HaskoningDHV, 2023b). Additionally, macro avoidance has been applied to the estimates from those projects for which this was not already included, in accordance with relevant statutory bodies advice (SNCBs, 2024). In the case of Scottish projects, macro-avoidance was only applied during the non-breeding bio-seasons as per NatureScot advice (NatureScot, 2025).

7.6.3.2.1.3.1 Breeding Bio-season

1284. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the breeding bio-season is 90 (90.2) breeding adults. This would result in an increase in baseline mortality of 4.242% (**Table 7-41**) against the latest population count (**Table 7-11**).

7.6.3.2.1.3.2 Return Migration Bio-season

1285. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the return migration bio-season is five (5.1) breeding adults. This would result in an increase in baseline mortality of 0.240% (**Table 7-41**) against the latest population count (**Table 7-11**).

7.6.3.2.1.3.3 Post-breeding Migration Bio-season

1286. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the post-breeding migration bio-season is ten (10.2) breeding adults. This would result in an increase in baseline mortality of 0.480% (**Table 7-41**) against the latest population count (**Table 7-11**).

7.6.3.2.1.3.4 Annual Total

1287. The predicted resultant mortality across all defined bio-seasons from all projects in-combination, attributed to FFC SPA, is 105 (105.4) breeding adult gannets. This would result in an increase in baseline mortality of 4.957% (**Table 7-41**) against the latest population count (**Table 7-11**).
1288. Although the increase in baseline mortality for the Project in-combination is over 1%, the gannet feature of FFC SPA is considered to be in favourable condition, with steady continual long term population increases recorded (**Section 7.6.1**), even despite any potential impact on the feature due to HPAI. The gannet feature is therefore considered resilient enough to withstand the potential in-combination impact predicted. Such a conclusion is bolstered by the PVA recently completed by Dogger Bank South (Royal HaskoningDHV, 2024d), the results of which predicted a reduction in the population growth rate of 0.22% for an in-combination collision impact of 79 breeding adult mortalities per annum. The compound annual growth trend of the gannet feature of the FFC SPA varies from 2.17% (short-term average) to 12.97% (long-term average) per annum. A reduction of approximately 0.22% in the colony growth rate is highly unlikely to lead to a population decline when considering the consistent increasing growth trend of the feature.
1289. The favourable condition status and expected stable long term future growth trend of the gannet feature has also been previously suggested by Natural England as summarised within the advice provided to Norfolk Boreas (Natural England, 2020). Natural England advised Norfolk Boreas that based on their literature review of UK gannetry growth trends, they expect a future plausible growth rate for the gannet feature of FFC SPA to be between 1% and 5%. Even when considering a conservative 1% long term, a reduction of 0.22% would not compromise the overall continued growth of the colony.
1290. It is acknowledged that the impact predicted for all projects is slightly higher than that modelled by Dogger Bank South (79 vs 105 mortalities per annum). However, the difference between the two impact totals is not expected to significantly increase the reduction in growth rate predicted.
1291. Additionally, the contribution from the Project is predicted to two (2.0) breeding adult per annum. Such a level of predicted impact is highly unlikely to materially contribute to any in-combination effect.

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Table 7-40 In-Combination Predicted Collision Mortality Apportioned to FFC SPA Gannet Feature

Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate	Macro avoidance included
	Breeding	Post-breeding migration	Return migration	Annual						
Beatrice	0.0	0.5	0.1	0.6	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Beatrice Demonstrator	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Blyth Demonstration Site	0.0	0.0	0.0	0.1	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Dudgeon	4.7	0.4	0.2	5.3	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
East Anglia One	0.7	1.3	0.1	2.1	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
EOWDC	0.0	0.1	0.0	0.1	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Galloper	0.0	0.3	0.2	0.5	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Greater Gabbard	0.0	0.1	0.1	0.2	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Gunfleet Sands	-	-	-	-	1	APEM (2022c)	Deterministic	N/A	0.9923	Yes – 70% all seasons
Hornsea Project One	2.4	0.3	0.3	3.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Humber Gateway	0.4	0.0	0.0	0.4	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Hywind Scotland Pilot Park	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Kentish Flats	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Kentish Flats Extension	-	-	-	-	1	APEM (2022c)	Deterministic	N/A	0.9923	Yes – 70% all seasons

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Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate	Macro avoidance included
	Breeding	Post-breeding migration	Return migration	Annual						
Kincardine	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Lincs, Lynn & Inner Dowsing	0.5	0.0	0.0	0.5	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
London Array	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Methil	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Race Bank	23.6	0.1	0.1	23.8	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Rampion	0.0	0.6	0.0	0.7	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Scroby Sands	-	-	-	-	1	APEM (2022c)	Deterministic	N/A	0.9923	Yes – 70% all seasons
Sheringham Shoal	3.0	0.0	0.0	3.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Teesside	0.5	0.0	0.0	0.5	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Thanet	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Westermest Rough	0.0	0.0	0.0	0.0	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Hornsea Project Two	1.5	0.1	0.1	1.7	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Moray East	0.0	0.4	0.1	0.5	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Triton Knoll	5.6	0.6	0.4	6.7	1	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Neart na Gaoithe	0.0	0.5	0.3	0.8	2	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season

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Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate	Macro avoidance included
	Breeding	Post-breeding migration	Return migration	Annual						
DBC and Sofia	1.6	0.1	0.1	1.8	2	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Seagreen (Phase 1 and 1A)	0.0	0.5	0.9	1.4	2	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Moray West	0.0	0.0	0.0	0.0	2	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Dogger Bank A and B	8.5	0.8	0.7	10.1	3	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
East Anglia Three	1.3	0.3	0.1	1.7	3	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Hornsea Three	1.3	0.0	0.1	1.4	3	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Inch Cape	0.0	0.3	0.1	0.4	3	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
East Anglia ONE North	2.6	0.1	0.0	2.7	3	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
East Anglia TWO	2.6	0.2	0.0	2.9	3	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Norfolk Boreas	3.0	0.1	0.1	3.2	3	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Norfolk Vanguard	1.7	0.2	0.1	2.0	3	APEM (2022c)	Deterministic	0.989	0.9923	Yes – 70% all seasons
Hornsea Four	9.2	0.2	0.1	9.4	3	APEM (2022c)	Stochastic	0.989	0.9929	No - 70% all seasons already included
Pentland Floating OWF	-	-	-	-	3	Xodus Group Ltd (2022)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Green Volt	0.3	0.0	0.1	0.4	3	APEM (2023)	Stochastic	0.993	0.9929	Yes – 70% non-breeding season

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Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate	Macro avoidance included
	Breeding	Post-breeding migration	Return migration	Annual						
ForthWind Offshore Wind Demonstration Project - phase 1	0.0	0.0	0.0	0.0	3	ForthWind (2022)	Deterministic	0.98	0.9923	Yes – 70% non-breeding season
DEP and SEP	0.1	0.0	0.0	0.1	3	Royal HaskoningDHV (2024c)	Deterministic	0.992	0.9923	Yes – 70% all seasons
Total consented	75.1	8.5	4.4	88.0						
Rampion 2	0.0	0.1	0.0	0.1	4	GoBe (2023)	Stochastic	0.993	0.9929	No - 70% all seasons already included
Berwick Bank	1.4	0.1	0.0	1.5	4	Royal HaskoningDHV (2022)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Salamander	-	-	-	-	4	NIRAS Group (UK) Ltd (2024)	Stochastic	0.993	0.9929	Yes – 70% non-breeding season
Ossian	1.2	0.1	0.0	1.3	4	NIRAS & RPS (2024)	Stochastic	0.993	0.9929	Yes – 70% non-breeding season
North Falls	0.6	0.9	0.6	2.1	4	Royal HaskoningDHV (2024b)	Stochastic	0.993	0.9929	No - 70% all seasons already included
Dogger Bank South	8.2	0.2	0.0	8.4	4	Royal HaskoningDHV (2024d)	Stochastic	0.998	0.9929	No - 70% all seasons already included
West of Orkney	0.0	0.1	0.0	0.2	4	MacArthur Green (2024)	Stochastic	0.9928	0.9929	Yes – 70% non-breeding season
Outer Dowsing	1.0	0.1	0.0	1.1	4	GoBe (2024b)	Stochastic	0.993	0.9929	No - 70% all seasons already included
Five Estuaries	0.8	0.1	0.0	0.9	4	GoBe (2024a)	Stochastic	0.9979	0.9929	No – already incorporated within the avoidance rate

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Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate	Macro avoidance included
	Breeding	Post-breeding migration	Return migration	Annual						
Dogger Bank D	1.8	0.2	0.0	2.0	4		Stochastic	0.9929	0.9929	No - 70% all seasons already included
Total all projects	90.2	10.2	5.1	105.4						

Table 7-41 FFC SPA Gannet Feature In-Combination Predicted Collision Mortality and Increase in Baseline Mortality

Population size (breeding adults)	Bio-season	Projects included	Mean collisions (breeding adults per annum)	Increase in baseline mortality (%)
Citation (16,938)	Breeding (March - September)	DBD plus all consented	77.0	5.605
		All projects	90.2	6.574
	Return migration (December - February)	DBD plus all consented	4.3	0.313
		All projects	5.1	0.372
	Post-breeding migration (October - November)	DBD plus all consented	8.6	0.627
		All projects	10.2	0.743
	Annual	DBD plus all consented	89.9	6.553
		All projects	105.4	7.682
Latest count (26,250)	Breeding (March - September)	DBD plus all consented	77.0	3.619
		All projects	90.2	4.242
	Return migration (December - February)	DBD plus all consented	4.3	0.202
		All projects	5.1	0.240
	Post-breeding migration (October - November)	DBD plus all consented	8.6	0.404
		All projects	10.2	0.480
	Annual	DBD plus all consented	89.9	4.228
		All projects	105.4	4.957

1292. The potential for an **AEol in-combination due to collision risk can confidently be ruled out** for the gannet feature of the FFC SPA. Subject to natural change, gannet will be maintained as a feature in the long-term.

7.6.3.2.2 Direct Disturbance and Displacement Due to Presence of Wind Turbines and Other Offshore Infrastructure

7.6.3.2.2.1 Guillemot

1293. The projects identified for in-combination displacement effects for the guillemot feature of FFC SPA and details on the reference sources are provided in **Table 7-42**. The predicted in-combination mortality is provided in **Table 7-43** and an annual displacement matrix for all projects annually is presented in **Table 7-44**.

7.6.3.2.2.1.1 Breeding Bio-season

1294. The Project is outside of guillemots MMFR + one SD foraging range from the FFC SPA. Therefore, no potential for an in-combination effect to occur concluded during the breeding bio-season.

7.6.3.2.2.1.2 Non-breeding Bio-season

1295. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the non-breeding bio-season is 103 (103.1) breeding adults when considering the Applicant's preferred approach (50% displacement rate and 1% mortality rate). This would result in an increase in baseline mortality of 1.127% (**Table 7-43**) against the latest population count (**Table 7-11**).

7.6.3.2.2.1.3 Annual Total

1296. For the Applicant's approach, the predicted resultant mortality across all defined bio-seasons from all projects in-combination, attributed to FFC SPA, is 307 (307.0) breeding adult guillemots. This would result in an increase in baseline mortality of 3.355% (**Table 7-43**) against the latest population count (**Table 7-11**).

1297. When considering the SNCB approach, the predicted resultant mortality across all defined bio-seasons from all projects in-combination, attributed to FFC SPA is 184 to 4,298 (307.0 – 4,297.7) breeding adult guillemots. This would result in an increase in baseline mortality of 2.013% to 46.975% (**Table 7-43**) against the latest population count (**Table 7-11**).

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Table 7-42 In-Combination Mean Peak Abundance Apportioned to FFC SPA Guillemot Feature

Project	Apportioned mean peak abundance			Tier	Source
	Breeding	Non-breeding	Annual		
Beatrice	0	121	121	1	APEM (2024)
Blyth Demonstration Site	0	58	58	1	APEM (2024)
Dudgeon	0	24	24	1	APEM (2024)
EOWDC	0	10	10	1	APEM (2024)
Galloper	0	26	26	1	APEM (2024)
Greater Gabbard	0	24	24	1	APEM (2024)
Gunfleet Sands	0	16	16	1	APEM (2024)
Humber Gateway	99	6	105	1	APEM (2024)
Hywind Scotland Pilot Park	0	94	94	1	APEM (2024)
Kentish Flats Extension	0	0	0	1	APEM (2024)
Kentish Flats	0	0	0	1	APEM (2024)
Lincs, Lynn & Inner Dowsing	0	36	36	1	APEM (2024)
London Array	0	17	17	1	APEM (2024)
Methil	0	0	0	1	APEM (2024)
Race Bank	0	31	31	1	APEM (2024)
Rampion	0	684	684	1	APEM (2024)
Scroby Sands	-	-	0	1	APEM (2024)
Sheringham Shoal	0	32	32	1	APEM (2024)
Teesside	267	40	307	1	APEM (2024)
Thanet	0	6	6	1	APEM (2024)
Westermost Rough	347	21	368	1	APEM (2024)
East Anglia One	0	28	28	1	APEM (2024)

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Project	Apportioned mean peak abundance			Tier	Source
	Breeding	Non-breeding	Annual		
Hornsea Project One	4,554	356	4,910	1	APEM (2024)
Hornsea Project Two	3,581	579	4,160	1	APEM (2024)
Moray East	0	24	24	1	APEM (2024)
Triton Knoll	425	33	458	1	APEM (2024)
Kincardine	0	0	0	1	APEM (2024)
DBC	0	100	100	2	APEM (2024)
Sofia	0	163	163	2	APEM (2024)
Moray West	0	1,680	1,680	2	APEM (2024)
Neart na Gaoithe	0	166	166	2	APEM (2024)
Seagreen (Phase 1 and 1A)	0	387	387	2	APEM (2024)
Dogger Bank A	1,893	270	2,163	3	APEM (2024)
Dogger Bank B	3,318	467	3,785	3	APEM (2024)
East Anglia Three	0	126	126	3	APEM (2024)
Inch Cape	0	140	140	3	APEM (2024)
Hornsea Three	0	782	782	3	APEM (2024)
Norfolk Boreas	0	606	606	3	APEM (2024)
Norfolk Vanguard	0	210	210	3	APEM (2024)
East Anglia ONE North	0	83	83	3	APEM (2024)
East Anglia TWO	0	74	74	3	APEM (2024)
Hornsea Four (Natural England's Bespoke Approach)*	0	0	0	3	APEM (2024)
Pentland	-	29	29	3	APEM (2024)
Forth Wind	-	18	18	3	APEM (2024)
Dudgeon & Sheringham Shoal Extension Project*	0	0	0	3	Royal HaskoningDHV (2024c)

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Project	Apportioned mean peak abundance			Tier	Source
	Breeding	Non-breeding	Annual		
Green Volt	0	710	710	3	APEM (2024)
Consented projects	14,484	8,275	22,759		
Rampion 2	0	252	252	4	APEM (2024)
West of Orkney	-	-	-	4	MacArthur Green (2024)
Berwick Bank	0	1,948	1,948	4	APEM (2024)
Ossian	0	2,132	2,132	4	NIRAS & RPS (2024)
Salamander	-	-	-	4	NIRAS Group (UK) Ltd (2024)
Dogger Bank South	14,928	886	15,814	4	Royal HaskoningDHV (2024)
Outer Dowsing	11,364	6,399	17,763	4	GoBe (2024b)
Five Estuaries	0	163	163	4	GoBe (2024a)
North Falls	0	236	236	4	Royal HaskoningDHV (2024c)
Dogger Bank D	0	327	327	4	
All projects	40,776	20,618	61,394		

Table note: Note: *Projects have committed to delivery of compensation for the kittiwake feature of the FFC SPA as part of their DCO. Therefore, impact contributions have been zeroed to account for the Project’s compensation contribution.

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Table 7-43 FFC SPA Guillemot Feature In-Combination Predicted Displacement Mortality and Increase in Baseline Mortality

Population size (breeding adults)	Bio-season	Projects included	Applicant's approach (50% Disp; 1% Mort)		SNCB approach (30% – 70% Disp; 1% – 10% Mort)	
			Displacement mortality (breeding adults)	Increase in baseline mortality (%)	Displacement mortality (breeding adults)	Increase in baseline mortality (%)
Citation (83,214)	Breeding (March – July)	DBD plus all consented	72.4	1.427	43.5 – 1,013.9	0.856 – 19.974
		All projects	203.9	4.017	122.3 – 2,854.3	2.410 – 56.231
	Non-breeding (August – February)	DBD plus all consented	43.0	0.847	25.8 – 602.1	0.508 – 11.862
		All projects	103.1	2.031	61.9 – 1,443.3	1.219 – 28.433
	Annual	DBD plus all consented	115.4	2.274	69.3 – 1,616.0	1.364 – 31.836
		All projects	307.0	6.048	184.2 – 4,297.7	3.629 – 84.665
Latest count (149,980)	Breeding (March -July)	DBD plus all consented	72.4	0.792	43.5 – 1,013.9	0.475 – 11.082
		All projects	203.9	2.228	122.3 – 2,854.3	1.337 – 31.199
	Non-breeding (August – February)	DBD plus all consented	43.0	0.470	25.8 – 602.1	0.282 – 6.582
		All projects	103.1	1.127	61.9 – 1,443.3	0.676 – 15.775
	Annual	DBD plus all consented	115.4	1.262	69.3 – 1,616.0	0.757 – 17.664
		All projects	307.0	3.355	184.2 – 4,297.7	2.013 – 46.975

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Table 7-44 Guillemot Operation and Maintenance Phase In-Combination Annual Displacement Matrix for Impacts Apportioned to FFC SPA

Guillemot annual displacement matrix (based on 61,394 breeding adults apportioned to the FFC SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	6	12	18	25	31	61	123	184	246	307	368	430	491	553	614
10	0	61	123	184	246	307	614	1,228	1,842	2,456	3,070	3,684	4,298	4,912	5,525	6,139
20	0	123	246	368	491	614	1,228	2,456	3,684	4,912	6,139	7,367	8,595	9,823	11,051	12,279
30	0	184	368	553	737	921	1,842	3,684	5,525	7,367	9,209	11,051	12,893	14,735	16,576	18,418
40	0	246	491	737	982	1,228	2,456	4,912	7,367	9,823	12,279	14,735	17,190	19,646	22,102	24,558
50	0	307	614	921	1,228	1,535	3,070	6,139	9,209	12,279	15,349	18,418	21,488	24,558	27,627	30,697
60	0	368	737	1,105	1,473	1,842	3,684	7,367	11,051	14,735	18,418	22,102	25,785	29,469	33,153	36,836
70	0	430	860	1,289	1,719	2,149	4,298	8,595	12,893	17,190	21,488	25,785	30,083	34,381	38,678	42,976
80	0	491	982	1,473	1,965	2,456	4,912	9,823	14,735	19,646	24,558	29,469	34,381	39,292	44,204	49,115
90	0	553	1,105	1,658	2,210	2,763	5,525	11,051	16,576	22,102	27,627	33,153	38,678	44,204	49,729	55,255
100	0	614	1,228	1,842	2,456	3,070	6,139	12,279	18,418	24,558	30,697	36,836	42,976	49,115	55,255	61,394
				>1% increase in baseline mortality rate against latest count					>1% increase in baseline mortality rate against citation population							

1298. Although the increase in baseline mortality for the Project in-combination is over 1%, the guillemot feature of FFC SPA is considered to be in favourable condition, with steady continual long term population increases recorded (**Section 7.6.1**. The guillemot feature is therefore considered resilient enough to withstand the potential in-combination impact predicted. Such a conclusion is supported by the findings from a PVA recently completed by Dogger Bank South (Royal HaskoningDHV, 2024d), the results of which predicted a reduction in the population growth rate of 0.21% for an in-combination impact of 344 breeding adult mortalities per annum (closest run scenario to the Applicant's preferred approach annual predicted mortality of 307 guillemots). The compound annual growth trend of the guillemot feature of the FFC SPA varies from 4.26% (short-term average) to 4.21% (long-term average) per annum. A reduction of approximately 0.21% in the colony growth rate is highly unlikely to lead to a population decline when considering the consistent increasing growth trend of the feature.
1299. When considering the SNCB preferred approach, the predicted increase in baseline mortality at the SNCB upper range of 47% is likely to negatively affect the integrity of the feature. However, based on the evidence provided in **Section 7.4.5**, such a level of effect is concluded as highly unrealistic, especially for assessing an in-combination effect. As presented in **Section 7.4.5**, the recorded level of displacement from post-construction monitoring studies ranged from +112% to -75%. Therefore, assuming all projects will cause a worst-case scenario of 70% displacement leads to over precaution within assessment. This is not withstanding the level of uncertainty regarding the analysis methods and quality of the datasets of studies which reported high displacement rates, nor the likely potential for habituation to OWF developments to occur over a 30-year operational timeframe of an OWF.
1300. With regard to the appropriateness of a 10% mortality rate, empirical evidence in relation to actual consequent mortality due to the presence of an OWF is limited, however studies focussing on the energetic consequences of displacement (Searle *et al.*, 2014 and 2018; and van Kooten *et al.*, 2019) would suggest 10% is not appropriate, even when considering a precautionary approach to assessment in the absence of empirical evidence. Additionally, the vast majority of North Sea OWF projects (especially Southern North Sea projects) are considered not to be located within important at-sea foraging areas for guillemot as presented within Cleasby *et al* (2020), further suggesting that a consequent mortality rate of 10% is highly unlikely.
1301. When considering the above, combined with the minor contribution of the Project to the overall in-combination effect, the potential for an **AEol in-combination due to displacement can confidently be ruled out** for the guillemot feature of the FFC SPA. Subject to natural change, guillemot will be maintained as a feature in the long-term.

7.6.3.2.2.2 *Razorbill*

1302. For the Project alone impact, the increase in baseline mortality is predicted to be significantly less than 0.1% per annum. Such level of effect alone would certainly be indistinguishable from natural fluctuations in the population and is unlikely to materially contribute to any in-combination effect, especially given connectivity is restricted to the non-breeding bio-seasons. Therefore, the potential for an **AEol in-combination due to disturbance can confidently be ruled out** for the razorbill feature of the FFC SPA. Subject to natural change, razorbill will be maintained as a feature in the long-term.

7.6.3.2.2.3 *Puffin*

1303. When considering the most likely (the Applicant's approach) scenario, the impact is predicted to be less than a single breeding adult per annum, which can be considered a non-material level of impact. Further, puffin is a named component of the seabird assemblage only. Such a level of predicted impact on puffin would certainly not materially contribute, nor be the tipping point for an AEol in-combination for the seabird assemblage feature. Therefore, the potential for an **AEol in-combination due to disturbance can confidently be ruled out** for the puffin feature of the FFC SPA. Subject to natural change, puffin will be maintained as a feature in the long-term.

7.6.3.2.2.4 *Gannet*

1304. The projects identified for in-combination displacement effects for the gannet feature of FFC SPA and details on the reference sources are provided in **Table 7-45**. The predicted in-combination mortality is provided in **Table 7-46** and an annual displacement matrix for all projects annually is presented in **Table 7-47**.
1305. To note, displacement assessment of gannet is a relatively recent request from SNCBs and therefore specific assessments of such an effect pathway with values apportioned to individual SPAs is scarce for older projects. The Project has therefore utilised the predicted abundance presented within the PEIR chapter, standard apportioning rates and expert judgement to best inform the likely level of impact in-combination.

7.6.3.2.2.4.1 *Breeding Bio-season*

1306. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the breeding bio-season is 46 to 62 (46.3 – 61.7) breeding adults when considering the Applicant's preferred approach (60% - 80% displacement rate and 1% mortality rate). This would result in an increase in baseline mortality of 2.177% to 2.903% (**Table 7-46**) against the latest population count (**Table 7-11**).

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Table 7-45 In-Combination Mean Peak Abundance Apportioned to FFC SPA gannet feature

Project	Apportioned mean peak abundance				Tier	Source
	Breeding	Post-breeding migration	Non-breeding	Annual		
Beatrice	0	0	0	0	1	APEM (2022c)
Beatrice Demonstrator	-	-	-	-	1	APEM (2022c)
Blyth Demonstration Site	-	-	-	-	1	APEM (2022c)
Dudgeon	53	1	1	55	1	APEM (2022c)
East Anglia One	161	175	5	340	1	APEM (2022c)
EOWDC	0	0	0	0	1	APEM (2022c)
Galloper	0	44	17	61	1	APEM (2022c)
Greater Gabbard	0	3	7	10	1	APEM (2022c)
Gunfleet Sands	0	1	1	1	1	APEM (2022c)
Hornsea Project One	671	33	16	720	1	APEM (2022c)
Humber Gateway	-	-	-	-	1	APEM (2022c)
Hywind Scotland Pilot Park	0	0	0	0	1	APEM (2022c)
Kentish Flats	-	-	-	0	1	APEM (2022c)
Kentish Flats Extension	0	1	0	1	1	APEM (2022c)
Kincardine	0	0	0	0	1	APEM (2022c)
Lincs, Lynn & Inner Dowsing	-	-	-	-	1	APEM (2022c)
London Array	-	-	-	-	1	APEM (2022c)
Methil	0	0	0	0	1	APEM (2022c)
Race Bank	92	2	2	95	1	APEM (2022c)
Rampion	0	28	0	28	1	APEM (2022c)
Scroby Sands	-	-	-	-	1	APEM (2022c)
Sheringham Shoal	47	2	0	49	1	APEM (2022c)

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Project	Apportioned mean peak abundance				Tier	Source
	Breeding	Post-breeding migration	Non-breeding	Annual		
Teesside	1	0	0	1	1	APEM (2022c)
Thanet	-	-	-	-	1	APEM (2022c)
Westermost Rough	-	-	-	-	1	APEM (2022c)
Hornsea Project Two	457	55	8	519	1	APEM (2022c)
Moray East	0	14	2	16	1	APEM (2022c)
Triton Knoll	211	1	2	213	1	APEM (2022c)
DBC	484	18	14	516	2	APEM (2022c)
Sofia	641	24	15	680	2	APEM (2022c)
Moray West	0	21	9	30	2	APEM (2022c)
Neart na Gaoithe	0	27	17	44	2	APEM (2022c)
Seagreen (Phase 1 and 1A)	0	32	21	53	2	APEM (2022c)
Dogger Bank A	259	44	11	314	3	APEM (2022c)
Dogger Bank B	319	54	14	386	3	APEM (2022c)
East Anglia Three	412	61	33	505	3	APEM (2022c)
Hornsea Three	844	47	33	924	3	APEM (2022c)
Inch Cape	0	34	13	47	3	APEM (2022c)
East Anglia ONE North	0	21	9	30	3	APEM (2022c)
East Anglia TWO	0	27	17	44	3	APEM (2022c)
Norfolk Vanguard	0	14	9	23	3	APEM (2022c)
Norfolk Boreas	0	18	12	30	3	APEM (2022c)
Hornsea Four	149	23	3	174	3	APEM (2022c)
Pentland Floating OWF	-	-	-	-	3	Xodus Group Ltd (2022)
Green Volt	3	1	4	8	3	APEM (2023)

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Project	Apportioned mean peak abundance				Tier	Source
	Breeding	Post-breeding migration	Non-breeding	Annual		
ForthWind Offshore Wind Demonstration Project - phase 1	-	-	-	-	3	ForthWind (2022)
DEP and SEP	337	31	4	372	3	Royal HaskoningDHV (2024c)
Consented projects	5,140	854	295	6,288		
Berwick Bank	55	72	17	144	4	Royal HaskoningDHV (2024c)
Rampion 2	0	4	6	10	4	GoBe (2023)
Salamander	-	-	-	-	4	NIRAS Group (UK) Ltd (2024)
Ossian	61	37	3	101	4	NIRAS & RPS (2024)
North Falls	48	14	18	80	4	Royal HaskoningDHV (2024c)
Dogger Bank South	1,560	76	10	1,646	4	Royal HaskoningDHV (2024d)
West of Orkney	0	66	9	75	4	MacArthur Green (2024)
Outer Dowsing	554	24	4	582	4	GoBe (2024b)
Five Estuaries	95	31	4	130	4	GoBe (2024a)
Dogger Bank D	202	39	5	247	4	
All projects	7,715	1,217	371	9,301		

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Table 7-46 FFC SPA Gannet Feature In-Combination Predicted Displacement Mortality and Increase in Baseline Mortality

Population size (breeding adults)	Bio-season	Projects included	Applicant's approach (60% – 80% Disp; 1% Mort)		SNCB approach (60% – 80% Disp; 1% - 10% Mort)	
			Displacement mortality (breeding adults)	Increase in baseline mortality (%)	Displacement mortality (breeding adults)	Increase in baseline mortality (%)
Citation (16,938)	Breeding (March – September)	DBD plus all consented	32.0 – 42.7	2.336 - 3.115	32.0 – 427.3	2.336 – 31.145
		All projects	46.3 – 61.7	3.374 - 4.499	46.3 – 617.2	3.374 - 44.986
	Return migration (December – February)	DBD plus all consented	1.8 - 2.4	0.131 - 0.175	1.8 - 24.0	0.131 - 1.750
		All projects	2.2 - 3.0	0.162 - 0.216	2.2 - 29.6	0.162 - 2.160
	Post-breeding migration (October – November)	DBD plus all consented	5.4 - 7.1	0.391 - 0.521	5.4 - 71.5	0.391 - 5.208
		All projects	7.3 - 9.7	0.532 - 0.710	7.3 - 97.4	0.532 - 7.096
	Annual	DBD plus all consented	39.2 – 52.3	2.858 - 3.810	39.2 – 522.7	2.858 – 38.100
		All projects	55.8 – 74.4	4.068 - 5.423	55.8 – 744.1	4.068 – 54.234
Latest count (26,250)	Breeding (March – September)	DBD plus all consented	32.0 – 42.7	1.507 – 2.010	32.0 – 427.3	1.507 – 20.097
		All projects	46.3 – 61.7	2.177 - 2.903	46.3 – 617.2	2.177 – 29.028
	Return migration (December – February)	DBD plus all consented	1.8 - 2.4	0.085 - 0.113	1.8 - 24.0	0.085 - 1.129
		All projects	2.2 - 3.0	0.105 - 0.139	2.2 - 29.6	0.105 - 1.394
	Post-breeding migration (October – November)	DBD plus all consented	5.4 - 7.1	0.252 - 0.336	5.4 - 71.5	0.252 - 3.361
		All projects	7.3 - 9.7	0.343 - 0.458	7.3 - 97.4	0.343 - 4.579
	Annual	DBD plus all consented	39.2 – 52.3	1.844 - 2.458	39.2 – 522.7	1.844 - 24.585
		All projects	55.8 – 74.4	2.625 - 3.499	55.8 – 744.1	2.625 - 34.995

Table 7-47 Gannet Operation and Maintenance Phase In-Combination Annual Displacement Matrix for Impacts Apportioned to FFC SPA

Gannet annual displacement matrix (based on 9,301 breeding adults apportioned to the FFC SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	9	19	28	37	47	56	65	74	84	93
10	0	9	19	28	37	47	93	186	279	372	465	558	651	744	837	930
20	0	19	37	56	74	93	186	372	558	744	930	1,116	1,302	1,488	1,674	1,860
30	0	28	56	84	112	140	279	558	837	1,116	1,395	1,674	1,953	2,232	2,511	2,790
40	0	37	74	112	149	186	372	744	1,116	1,488	1,860	2,232	2,604	2,976	3,348	3,720
50	0	47	93	140	186	233	465	930	1,395	1,860	2,325	2,790	3,255	3,720	4,185	4,651
60	0	56	112	167	223	279	558	1,116	1,674	2,232	2,790	3,348	3,906	4,464	5,023	5,581
70	0	65	130	195	260	326	651	1,302	1,953	2,604	3,255	3,906	4,557	5,209	5,860	6,511
80	0	74	149	223	298	372	744	1,488	2,232	2,976	3,720	4,464	5,209	5,953	6,697	7,441
90	0	84	167	251	335	419	837	1,674	2,511	3,348	4,185	5,023	5,860	6,697	7,534	8,371
100	0	93	186	279	372	465	930	1,860	2,790	3,720	4,651	5,581	6,511	7,441	8,371	9,301
			>1% increase in baseline mortality rate against latest count						>1% increase in baseline mortality rate against citation population							

7.6.3.2.2.4.2 Return Migration Bio-season

1307. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the return migration bio-season is two to three (2.2 – 3.0) breeding adults when considering the Applicant’s preferred approach. This would result in an increase in baseline mortality of 0.105% to 0.139% (**Table 7-46**) against the latest population count (**Table 7-11**).

7.6.3.2.2.4.3 Post-breeding Migration Bio-season

1308. The predicted in-combination breeding adult mortalities for all projects attributed to FFC SPA during the post-breeding migration bio-season is seven to ten (7.3 – 9.7) breeding adults when considering the Applicant’s preferred approach. This would result in an increase in baseline mortality of 0.343% to 0.458% (**Table 7-46**) against the latest population count (**Table 7-11**).

7.6.3.2.2.4.4 Annual Total

1309. For the Applicant’s approach, the predicted resultant mortality across all defined bio-seasons from all projects in-combination, attributed to FFC SPA, is 56 to 74 (55.8 – 74.4) breeding adult gannets. This would result in an increase in baseline mortality of 2.625% to 3.499% (**Table 7-46**) against the latest population count (**Table 7-11**).
1310. When considering the SNCB approach, the predicted resultant mortality across all defined bio-seasons from all projects in-combination, attributed to FFC SPA is 56 to 744 (55.8 – 744.1) breeding adult gannets. This would result in an increase in baseline mortality of 2.625% to 34.995% (**Table 7-46**, **Table 7-43**) against the latest population count (**Table 7-11**).
1311. Although the increase in baseline mortality for the Project in-combination is over 1%, the gannet feature of FFC SPA is considered to be in favourable condition, with steady continual long term population increases recorded (**Section 7.6.1**), even despite any potential impact on the feature due to HPAI. The gannet feature is therefore considered resilient enough to withstand the potential in-combination impact predicted. Such a conclusion is bolstered by the PVA recently completed by Dogger Bank South (Royal HaskoningDHV, 2024d), the results of which predicted a reduction in the population growth rate of 0.18% to 0.26% for an in-combination displacement impact of 66 to 93 breeding adult mortalities per annum. The compound annual growth trend of the gannet feature of the FFC SPA varies from 2.17% (short-term average) to 12.97% (long-term average) per annum. A reduction of up to 0.26% in the colony growth rate is highly unlikely to lead to a population decline when considering the consistent increasing growth trend of the feature.

1312. The favourable condition status and expected stable long term future growth trend of the gannet feature has also been previously suggested by Natural England as summarised within the advice provided to Norfolk Boreas (Natural England, 2020). Natural England advised Norfolk Boreas that based on their literature review of UK gannetry growth trends, they expect a future plausible growth rate for the gannet feature of FFC SPA to be between 1% and 5%. Even when considering a conservative 1% growth rate in the long term, a reduction of up to 0.26% would not compromise the overall continued growth of the colony.

1313. When considering the SNCB approach upper range of an 80% displacement rate and a 10% mortality rate, the predicted increase in baseline mortality of 34.995% is likely to negatively affect the integrity of the feature. However, based on expert judgement and factoring in the ecology of the species, a 10% mortality rate for all OWFs is concluded as wholly unrealistic (**Section 7.4.5.4**).

1314. Taking into account the above information, the potential for an **AEol in-combination due to displacement can confidently be ruled out** for the gannet feature of the FFC SPA. Subject to natural change, gannet will be maintained as a feature in the long-term.

7.6.3.2.3 Combined Operational Phase Collision and Displacement Effects

7.6.3.2.3.1 Gannet

1315. When considering the Applicant’s approach, the consequent potential mortality for breeding adult gannets from FFC SPA annually is predicted at approximately 161 to 180 (161.2 – 179.8) breeding adults per annum. This would result in an increase in the baseline mortality of 7.582% to 8.457% (**Table 7-48**) against the latest population count (**Table 7-11**).
1316. When considering the SNCB approach the consequent potential mortality for breeding adult gannets from FFC SPA annually is predicted at 161 to 850 (161.2 – 849.5) breeding adults per annum. This would result in an increase in the baseline mortality of 7.582% to 39.952% (**Table 7-48**) against the latest population count (**Table 7-11**).
1317. As previously noted for the individual in-combination assessments of collision risk and displacement separately, the gannet feature of the FFC SPA is considered in favourable condition and likely resilient to any potential impact from OWF developments in-combination. Such a conclusion is supported by the PVA recently completed by Dogger Bank South (Royal HaskoningDHV, 2024d), the results of which predicted a reduction in the population growth rate of 0.40% to 0.47% for an in-combination displacement impact of 145 to 172 breeding adult mortalities per annum. The compound annual growth trend of the gannet feature of the FFC SPA varies from 2.17% (short-term average) to 12.97% (long-term average) per annum. A reduction of up to 0.47% in the colony growth rate is highly unlikely to lead to a population decline when considering the consistent increasing growth trend of the feature.

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Table 7-48 FFC SPA Gannet Feature In-Combination Predicted Combined Collision and Displacement Mortality and Increase in Baseline Mortality

Population size (breeding adults)	Bio-season	Project included	Applicant's approach (60% – 80% Disp; 1% Mort)		SNCB approach (60% – 80% Disp; 1% – 10% Mort)	
			Displacement mortality (breeding adults)	Increase in baseline mortality (%)	Displacement mortality (breeding adults)	Increase in baseline mortality (%)
Citation (16,938)	Breeding (March – September)	DBD plus all consented	109.0 – 119.7	7.945 – 8.723	109.0 – 504.3	7.945 – 36.754
		All projects	136.5 – 151.9	9.948 – 11.073	136.5 – 707.4	9.948 – 51.561
	Return migration (December – February)	DBD plus all consented	6.1 – 6.7	0.445 – 0.488	6.1 – 28.3	0.445 – 2.063
		All projects	7.3 – 8.1	0.534 – 0.588	7.3 – 34.7	0.534 – 2.532
	Post-breeding migration (October – November)	DBD plus all consented	14.0 – 15.7	1.017 – 1.148	14.0 – 62.2	1.017 – 5.835
		All projects	17.5 – 19.9	1.276 – 1.453	17.5 – 107.6	1.276 – 7.839
	Annual	DBD plus all consented	129.1 – 142.2	9.410 – 10.363	129.1 – 612.6	9.410 – 44.653
		All projects	161.2 – 179.8	11.750 – 13.106	161.2 – 849.5	11.750 – 61.916
Latest count (26,250)	Breeding (March – September)	DBD plus all consented	109.0 – 119.7	5.126 – 5.629	109.0 – 504.3	5.126 – 23.716
		All projects	136.5 – 151.9	6.419 – 7.145	136.5 – 707.4	6.419 – 33.270
	Return migration (December – February)	DBD plus all consented	6.1 – 6.7	0.287 – 0.315	6.1 – 28.3	0.287 – 1.331
		All projects	7.3 – 8.1	0.344 – 0.379	7.3 – 34.7	0.344 – 1.634
	Post-breeding migration (October – November)	DBD plus all consented	14.0 – 15.7	0.657 – 0.741	14.0 – 62.2	0.657 – 3.765
		All projects	17.5 – 19.9	0.823 – 0.938	17.5 – 107.6	0.823 – 5.058
	Annual	DBD plus all consented	129.1 – 142.2	6.072 – 6.687	129.1 – 612.6	6.072 – 28.813
		All projects	161.2 – 179.8	7.582 – 8.457	161.2 – 849.5	7.582 – 39.952

1318. Additionally, when considering the combined collision and displacement impacts, the approach taken is considered unrealistic due to the nature of double counting of impacts, as addressed in **Section 7.4.7**. Another layer of precaution is considered when looking at both the parameters considered for CRM (**Section 1110**) and the mortality rates considered for displacement analysis (**Section 7.4.5**). All these factors deem the estimate of increase in baseline mortality as over precautionary and unrealistic, especially when considering the SNCB upper approach.

1319. Taking into account the above information, the potential for an **AEol in-combination due to combined displacement and collision can confidently be ruled out** for the gannet feature of the FFC SPA. Subject to natural change, gannet will be maintained as a feature in the long-term.

7.6.4 Summary of Potential Effects on Site Integrity

7.6.4.1 Construction

7.6.4.1.1 Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

1320. There is **no potential for AEol** for any of the qualifying features of FFC SPA assessed for displacement during the construction phase.

7.6.4.2 Operation and Maintenance

7.6.4.2.1 Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

1321. There is **no potential for AEol** for any of the qualifying features of FFC SPA assessed for displacement during the operation and maintenance phase.

7.6.4.2.2 Collision Risk with Wind Turbine Blades

1322. There is **no potential for AEol** for any of the qualifying features of FFC SPA assessed for collision risk during the operation and maintenance phase.

7.6.4.2.3 Combined Operational Phase Collision and Displacement Effects

1323. There is **no potential for AEol** for the gannet feature of FFC SPA assessed for combined collision and displacement during the operation and maintenance phase.

7.6.4.2.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

1324. There is **no potential for AEol** for the following scenarios:

- Guillemot (displacement assessment);
- Gannet (displacement assessment, collision assessment and combined effects).

1325. There is **potential for AEol** for the following scenarios:

- Kittiwake (collision assessment).

7.6.4.3 Decommissioning

1326. The summary of AEol for the decommissioning phase is the same as those stated within the construction phase conclusions above.

7.7 Farne Islands SPA

7.7.1 Site Description

1327. Farne Islands SPA is 182km (at sea) from the offshore ECC and 277km (at sea) from the DBD Array Area plus 2km buffer. Given the distance from the SPA, the Project does not directly overlap with the SPA boundary.

1328. The Farne Islands SPA site description is as follows (Natural England, 2018b):

1329. *“The Farne Islands are a group of low-lying islands 2-6km off the coast of Northumberland in north-east England. They form the easternmost outcroppings of the Great Whin Sill of quartz dolerite, and although some islands retain cappings of boulder clay or peaty deposits, vegetation is limited to pioneer communities. Vegetation is further affected by the maritime conditions and large numbers of seabirds. The islands are important as nesting areas for these birds, especially terns, gulls and auks. The seabirds feed outside the SPA in nearby waters, as well as more distantly in the North Sea.”*

7.7.1.1 Qualifying Features

1330. The qualifying features taken through for assessment for Farne Islands SPA are outlined in **Table 7-49**. Farne Islands SPA supports over 1% of the biogeographic population of these species. The citation count, latest count mortality rate and baseline mortality are provided for reference. An assessment for the seabird assemblage is also provided in **Section 7.10**.

Table 7-49 Farne Islands SPA Qualifying Species and the Citation Population, Latest Count, Mortality Rate and Baseline Mortality

Designated feature	Citation count (breeding adults) (Natural England, 2018b)	Latest count (breeding adults) (SMP, 2025)	Adult Mortality rate (Horswill & Robinson, 2015)	Baseline mortality	
				Citation count	Latest count
Guillemot	65,751	57,475 (2024)	6.10%	4,011	3,506
Seabird assemblage (component species)	>20,000	Sum of latest count of all named features and components	N/A	Sum of all named features and components	Sum of all named features and components
Puffin (component species)	76,798	100,206 (2024)	9.4	7,219	9,419
Kittiwake (species component)	8,241	5,790 (2024)	14.6	1,203	845

1331. The apportionment rates for each of the qualifying features taken through for assessment are provided in **Table 7-50**.

Table 7-50 Breeding Adult Apportioning Rates for Qualifying Features of Farne Islands SPA Taken Through for Assessment

Species	Apportioning rate (%)				
	Return migration	Breeding	Post-breeding migration	Migration-free winter	Non-breeding
Kittiwake	0.66	3.01	0.50	N/A	N/A
Guillemot	N/A	N/A	N/A	N/A	3.73
Puffin	N/A	N/A	N/A	N/A	17.23

7.7.1.1.1 Population Trends for Qualifying Features Subject to Assessment

7.7.1.1.1.1 Puffin

1332. Colony-specific population growth trends are derived from data provided within the SMP database (2025). Colony counts are presented from 1989 to 2024 and show an initial population growth of 5.49% per annum between 1989 and 2003, where the puffin population reached its peak at the Farne Islands SPA (**Table 7-51**; **Figure 7-8**). The following ten years to 2013 saw a contraction of the breeding population at a mean rate of -3.26% per annum. Since then, the population has increased steadily at a rate of 1.52% per annum to 2019 and at an increasing rate of 2.75% from 2019 to 2024. When considering the overall trend at the Farne Islands SPA over the 35-year period (between 1989 and 2024), the puffin breeding population has increased by 66% at a steady average rate of 1.86% per annum (**Table 7-52**).

Table 7-51 Historic Colony Counts for Puffin Feature of the Farne Islands SPA Between 1989 - 2024

Colony count							
Year	1989	1993	2003	2008	2013	2019	2024
Population (breeding adults)	52,658	69,420	111,348	73,670	79,924	87,504	100,206

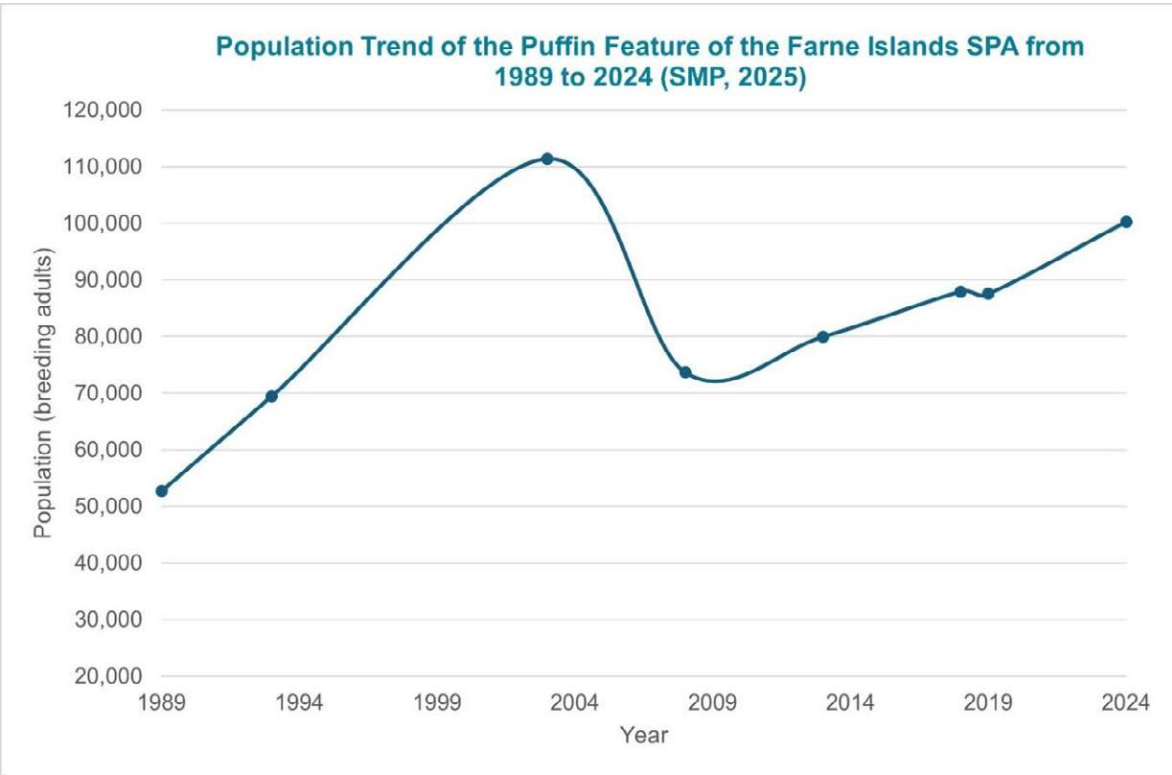


Figure 7-8 Population Trend of the Puffin Feature of the Farne Islands SPA from 1989 to 2024 (SMP, 2025)

Table 7-52 Annual Colony Compound Growth Rates for Puffin Feature of the Farne Islands SPA Between 1989 - 2024

Colony annual compound growth rate (%)					
Year	1989 - 2003	2003 - 2013	2013 - 2019	2019 - 2024	1989 - 2024
Population growth rate (%)	5.49	-3.26	1.52	2.75	1.86

7.7.1.1.2 Kittiwake

1333. Colony-specific population growth trends are derived from data provided within the SMP database (2025). Colony counts are available from 1986 to 2024 and are presented in **Table 7-53** and **Figure 7-9**. Accounting for natural fluctuations in the populations, the early period between 1986 and 2000 suggests the population was stable with a slight increase of 1% per annum up to 2005. The following ten years to 2015 recorded a decline in the kittiwake population at the Farne Islands by approximately 3% per annum. The numbers began stabilising again after this period and up to 2024 which reported a growth rate similar to that prior to 2000 of an average 1% per annum, however the overall population number was approximately 3,000 breeding adults lower than it was in 1986. When considering the broader population trend over the 38-year period between 1986 and 2024 the kittiwake population of the Farne Islands SPA has declined by 34% at an average rate of 1% per annum (**Table 7-54**).

Table 7-53 Historic Colony Counts for Kittiwake Feature of the Farne Islands SPA Between 1986 - 2024

Colony count							
Year	1986	1991	1996	2002	2014	2019	2024
Population (breeding adults)	8,776	11,486	12,472	10,110	8,350	8,804	5,790

Table 7-54 Annual Colony Compound Growth Rates for Kittiwake Feature of the Farne Islands SPA Between 1986 - 2024

Colony annual compound growth rate (%)						
Year	1986 - 2005	1986 - 2015	2005 - 2015	2000 - 2024	2015 - 2024	1986 - 2024
Population growth rate (%)	1.07	-0.36	-3.02	-0.50	0.93	-1.09

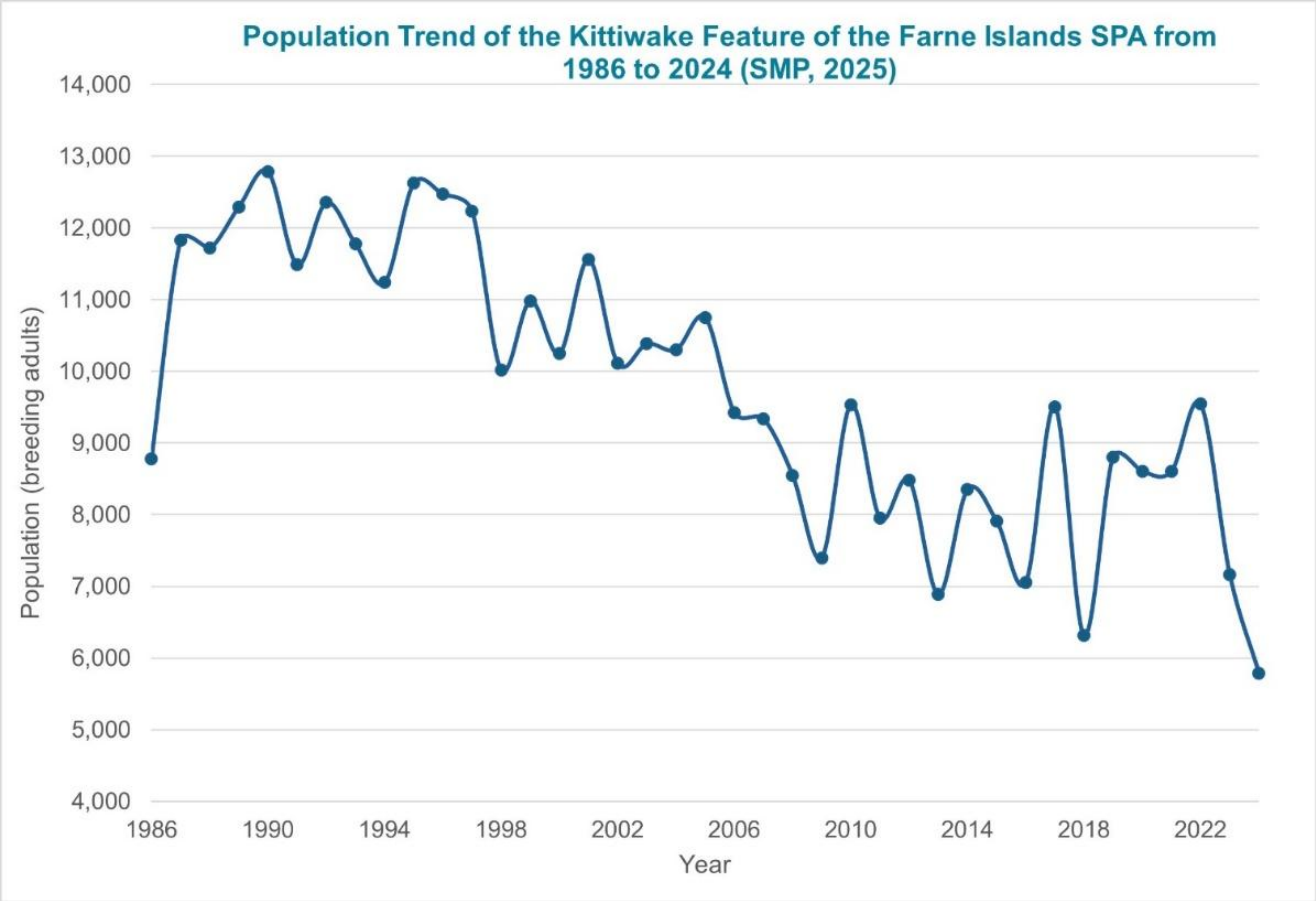


Figure 7-9 Population Trend of the Kittiwake Feature of the Farne Islands SPA from 1986 to 2024 (SMP, 2025)

7.7.1.2 Conservation Objectives

1334. With regards to the SPA and the individual species and/or assemblage of species for which the site has been classified, and subjected to natural change are listed below. Those relevant to assessment are highlighted in **bold**.
- To ensure that the integrity of the site is maintained or restored as appropriate; and
 - To ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:
 - The extent and distribution of the habitats of the qualifying features;
 - The structure and function of the habitats of the qualifying features;
 - The supporting processes on which the habitats of the qualifying features rely;
 - **The population of each of the qualifying features;** and
 - The distribution of the qualifying features within the site.

7.7.1.3 Condition Assessment

1335. A condition assessment has not been completed for the qualifying features of the Farne Islands SPA or for the site as a whole (Natural England, 2025c).
1336. When considering the qualifying features (**Section 7.7.1.1**) and the conservation objectives (**Section 7.7.1.2**) of the Farne Islands SPA an assessment of condition can be made. The latest available population count for the guillemot feature of 57,475 breeding adults (SMP, 2025) is below the citation population, therefore suggesting that the conservation objectives in relation to population size have not been maintained. The guillemot feature of the Farne Islands SPA is considered to be in an unfavourable condition with a gradual declining population trend in recent years.
1337. The latest available population count for the puffin feature of 100,206 breeding adults (SMP, 2025) is above the citation population, therefore suggesting that the conservation objectives in relation to population size have been maintained. The puffin feature of the Farne Islands SPA is considered to be in a favourable condition.
1338. The latest available population count for the kittiwake feature of 5,790 breeding adults (SMP, 2025) is below the citation population, therefore suggesting that the conservation objectives in relation to population size have not been maintained. The kittiwake feature of the Farne Islands SPA is considered to be in an unfavourable condition with an overall gradual declining population trend since 1986.

7.7.2 Assessment of Potential Effects of the Project Alone

1339. Potential for LSE alone has been identified for the following features of Farne Islands SPA:
- Guillemot (see **Section 7.7.2** and **Section 7.7.3** for assessment):
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Disturbance and displacement due to presence of wind turbines and other offshore infrastructure (non-breeding bio-season); and
 - In-combination effects (operation and maintenance phase) for the non-breeding bio-season.
 - Puffin (see **Section 7.7.2** and **Section 7.7.3** for assessment):
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Disturbance and displacement due to presence of wind turbines and other offshore infrastructure (non-breeding bio-seasons); and

- In-combination effects (operation and maintenance phase) for the breeding and non-breeding bio-season.
- Kittiwake (see **Section 7.7.2** and **Section 7.7.3** for assessment):
 - Collision risk (operation and maintenance phase) for the breeding and non-breeding bio-seasons; and
 - In-combination effects (operation and maintenance phase) for the breeding and non-breeding bio-seasons.

7.7.2.1 Direct Disturbance and Displacement due to Work Activity in the Dogger Bank D Array Area, ECC or Landfall

1340. Assessment of impacts of direct disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall have been assessed together with direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure. This is because there is no differentiation between displacement impacts due to work activity or the presence of turbines when assessing for the DBD Array Area. The assessment of apportioned displacement impacts for designated features of Farne Islands SPA are outlined in **Section 7.7.2.2**.

7.7.2.2 Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

7.7.2.2.1 Construction

7.7.2.2.1.1 *Guillemot*

1341. During the construction phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-55**, when considering both the Applicant's and SNCB preferred approach.
1342. As presented within **Table 7-55**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the guillemot feature of Farne Islands SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the guillemot feature will be maintained in the long term.

7.7.2.2.1.2 *Puffin*

1343. During the construction phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-56** when considering both the Applicant's and SNCB approach.

Table 7-55 Summary of Construction Phase Disturbance and Displacement Impacts for Guillemot Apportioned to Farne Islands SPA using the breeding adult apportioning rates within Table 7-50

Population size (breeding adults)	Bio-seasons	Guillemot apportioned to the Farne Islands SPA (breeding adults)*	Applicant’s approach		SNCB approach	
			25% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	15% – 35% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (65,751)	Breeding (March – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – February)	276	0.69	0.017	0.41 - 9.67	0.010 - 0.241
	Annual		0.69	0.017	0.41 - 9.67	0.010 - 0.241
Latest count (57,475)	Breeding (March – July)		N/A	N/A	N/A	N/A
	Non-breeding (August – February)		0.69	0.020	0.41 - 9.67	0.012 - 0.276
	Annual		0.69	0.020	0.41 - 9.67	0.012 - 0.276

Table note: *Calculated as the mean peak abundance (Table 7-6) x the Farne Islands SPA apportioning rate (Table 7-50).

Table 7-56 Summary of Construction Phase Disturbance and Displacement Impacts for Puffin Apportioned to Farne Islands SPA using the breeding adult apportioning rates within Table 7-50

Population size (breeding adults)	Bio-seasons	Puffin apportioned to the Farne Islands SPA (breeding adults)*	Applicant's approach		SNCB approach	
			25% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	15% – 35% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (76,798)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	4	0.01	<0.001	0.01 – 0.14	<0.001 – 0.002
	Annual	4	0.01	<0.001	0.01 – 0.14	<0.001 – 0.002
Latest count (100,206)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	4	0.01	<0.001	0.01 – 0.14	<0.001 – 0.002
	Annual	4	0.01	<0.001	0.01 – 0.14	<0.001 – 0.002

Table note: *Calculated as the mean peak abundance (Table 7-6) x the Farne Islands SPA apportioning rate (Table 7-50).

1344. As presented within **Table 7-56**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the puffin feature of Farne Islands SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the puffin feature will be maintained in the long term.

7.7.2.2.2 Operation and Maintenance

7.7.2.2.2.1 Guillemot

1345. During the operation and maintenance phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-57** when considering both the Applicant's and SNCB approach.
1346. A displacement matrix is also presented for the annual apportioned abundance for the DBD Array Area plus 2km asymmetrical buffer to Farne Islands SPA (**Table 7-58**).

7.7.2.2.2.1.1 Breeding Bio-season

1347. The Project is outside of guillemots MMFR + one SD foraging range from the Farne Islands SPA. Therefore, no potential for connectivity concluded during the breeding bio-season.

7.7.2.2.2.1.2 Non-breeding Bio-season

1348. When considering the Applicant's approach, the consequent potential mortality is predicted at one (1.38) breeding adult during the non-breeding bio-season. This would result in a baseline mortality increase of 0.039% against the latest population count (**Table 7-57**).

7.7.2.2.2.1.3 Annual Total

1349. When considering the Applicant's approach, the consequent potential mortality for breeding adult guillemots from Farne Islands SPA annually is predicted at one (1.38) breeding adult per annum. This would result in an increase in the baseline mortality of 0.039% against the latest population count (**Table 7-57**).
1350. When considering the SNCB approach the consequent potential mortality for breeding adult guillemots from Farne Islands SPA annually is predicted at less than one to 19 (0.83 – 19.34) breeding adults per annum. This would result in an increase in the baseline mortality of 0.024% to 0.552% against the latest population count (**Table 7-57**).

1351. These levels of impact from either the Applicant's or SNCB approach would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the guillemot feature of Farne Islands SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the guillemot feature will be maintained in the long term.

7.7.2.2.2.2 Puffin

1352. During the operation and maintenance phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-59** when considering both the Applicant's and SNCB approach.
1353. A displacement matrix is also presented for the annual apportioned abundance for the DBD Array Area plus 2km asymmetrical buffer to Farne Islands SPA (**Table 7-60**).

7.7.2.2.2.3 Breeding Bio-season

1354. The Project is outside of puffins MMFR + one SD foraging range from the Farne Islands SPA. Therefore, no potential for connectivity concluded during the breeding bio-season.

7.7.2.2.2.4 Non-breeding Bio-season

1355. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.02) breeding adult during the non-breeding bio-season. This would result in baseline mortality increase of less than 0.001% against the latest population count (**Table 7-59**).

7.7.2.2.2.4.1 Annual Total

1356. When considering the Applicant's approach, the consequent potential mortality for breeding adult puffins from Farne Islands SPA annually is predicted at less than one (0.02) breeding adult per annum. This would result in an increase in the baseline mortality of less than 0.001% against the latest population count (**Table 7-59**).
1357. When considering the SNCB approach the consequent potential mortality for breeding adult puffins from Farne Islands SPA annually is predicted at less than one (0.01 – 0.29) breeding adults per annum. This would result in an increase in the baseline mortality of less than 0.001% to 0.003% against the latest population count (**Table 7-59**).

Table 7-57 Summary of Operation and Maintenance Phase Disturbance and Displacement Impacts for Guillemot Apportioned to Farne Islands SPA using the breeding adult apportioning rates within Table 7-50

Population size (breeding adults)	Bio-season	Guillemot apportioned to the Farne Islands SPA (breeding adults)*	Applicant's approach		SNCB approach	
			50% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	30% – 70% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (65,751)	Breeding (March – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – February)	276	1.38	0.034	0.83 - 19.34	0.021 - 0.482
	Annual	276	1.38	0.034	0.83 - 19.34	0.021 - 0.482
Latest count (57,475)	Breeding (March – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – February)	276	1.38	0.039	0.83 - 19.34	0.024 - 0.552
	Annual	276	1.38	0.039	0.83 - 19.34	0.024 - 0.552

Table note: *Calculated as the mean peak abundance (Table 7-6) x Farne Islands SPA apportioning rate (Table 7-50).

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Table 7-58 Guillemot Operation and Maintenance Phase Annual Displacement Matrix for Impacts Apportioned to the Farne Islands SPA

Guillemot annual displacement matrix (based on 276 breeding adults apportioned to the Farne Islands SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	3
10	0	0	1	1	1	1	3	6	8	11	14	17	19	22	25	28
20	0	1	1	2	2	3	6	11	17	22	28	33	39	44	50	55
30	0	1	2	2	3	4	8	17	25	33	41	50	58	66	75	83
40	0	1	2	3	4	6	11	22	33	44	55	66	77	88	99	110
50	0	1	3	4	6	7	14	28	41	55	69	83	97	110	124	138
60	0	2	3	5	7	8	17	33	50	66	83	99	116	133	149	166
70	0	2	4	6	8	10	19	39	58	77	97	116	135	155	174	193
80	0	2	4	7	9	11	22	44	66	88	110	133	155	177	199	221
90	0	2	5	7	10	12	25	50	75	99	124	149	174	199	224	249
100	0	3	6	8	11	14	28	55	83	110	138	166	193	221	249	276
				>1% increase in baseline mortality rate against latest count						>1% increase in baseline mortality rate against citation population						

Table 7-59 Summary of Operation and Maintenance Phase Disturbance and Displacement Impacts for Puffin Apportioned to Farne Islands SPA using the breeding adult apportioning rates within Table 7-50

Population size (breeding adults)	Bio-season	Puffin apportioned to the Farne Islands SPA (breeding adults)*	Applicant's approach		SNCB approach	
			50% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	30% – 70% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (76,798)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	4	0.02	<0.001	0.01 – 0.29	<0.001 – 0.004
	Annual	4	0.02	<0.001	0.01 – 0.29	<0.001 – 0.004
Latest count (100,206)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	4	0.02	<0.001	0.01 – 0.29	<0.001 – 0.003
	Annual	4	0.02	<0.001	0.01 – 0.29	<0.001 – 0.003

Table note: *Calculated as the mean peak abundance (Table 7-6) x the Farne Islands SPA apportioning rate (Table 7-50).

Table 7-60 Puffin Operation and Maintenance Phase Annual Displacement Matrix for Impacts Apportioned to the Farne Islands SPA

Puffin annual displacement matrix (based on 4 breeding adults apportioned to the Farne Islands SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
30	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
40	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2
50	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2
60	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
70	0	0	0	0	0	0	0	1	1	1	1	2	2	2	3	3
80	0	0	0	0	0	0	0	1	1	1	2	2	2	3	3	3
90	0	0	0	0	0	0	0	1	1	1	2	2	3	3	3	4
100	0	0	0	0	0	0	0	1	1	2	2	2	3	3	4	4
				>1% increase in baseline mortality rate against latest count							>1% increase in baseline mortality rate against citation population					

1358. These levels of impact from either the Applicant's or SNCB approach would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the puffin feature of Farne Islands SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the puffin feature will be maintained in the long term.

7.7.2.2.3 Decommissioning

385. The worst-case scenario for decommissioning activities within the DBD Array Area is considered to be equal to or less than the worst-case scenario for the construction phase. Therefore, for the purposes of this assessment it is assumed that the impacts are likely to be similar. Closer to the time of decommissioning, it may be decided that removal would lead to a greater environmental impact than leaving some components in situ, in which case certain components may be cut off at or below seabed level (e.g. in the case of piled foundations) or left buried (e.g. in the case of sub-sea cables). This may reduce the amount of decommissioning activity required.

386. As described in **Section 7.7.2.2.1**, the potential for an **AEol in the construction phase can be confidently ruled out**, therefore **the same conclusion is considered appropriate for the decommissioning phase**.

7.7.2.3 Barrier Effect due to Presence of Wind Turbines and Other Offshore Infrastructure

1359. Assessments for barrier effects due to the presence of wind turbines and other offshore infrastructure are considered in **Section 7.12**.

7.7.2.4 Indirect Effects via Habitats or Prey Availability

1360. Assessments for indirect effects via habitat or prey availability are considered in **Section 7.11**.

7.7.2.5 Collision Risk with Wind Turbine Blades (Dogger Bank D Array Area)

7.7.2.5.1 Operation and Maintenance

7.7.2.5.1.1 Kittiwake

1361. During the operation and maintenance phase, the potential of impact from collision risk apportioned to the Farne Islands SPA seasonally is summarised in **Table 7-61**.

*Table 7-61 Kittiwake Predicted Collision Risk Mortalities During the Operation and Maintenance Phase Apportioned to the Farne Islands SPA. using the breeding adult apportioning rates within **Table 7-50***

Population size (breeding adults)	Bio-seasons	Collision risk impact	
		Breeding adults per annum	Increase in baseline mortality (%)
Citation (8,241)	Breeding (March - August)	2.05	0.170
	Return migration (January - February)	0.21	0.017
	Post-breeding migration (September - December)	0.18	0.015
	Annual total	2.44	0.202
Latest Count (5,790)	Breeding (March - August)	2.05	0.242
	Return migration (January - February)	0.21	0.024
	Post-breeding migration (September - December)	0.18	0.022
	Annual total	2.44	0.288

7.7.2.5.1.1.1 Breeding Bio-season

1362. The predicted breeding bio-season adult mortalities attributed to Farne Islands SPA is two (2.05) breeding adults per annum (**Table 7-61**). This would result in a baseline mortality increase of 0.242% against the latest population count (**Table 7-61**).

7.7.2.5.1.1.2 Return Migration Bio-season

1363. The predicted return-migration bio-season adult mortalities attributed to Farne Islands SPA is less than one (0.21) breeding adult per annum (**Table 7-61**). This would result in an increase in the baseline mortality rate of 0.024% against the latest population count (**Table 7-61**).

7.7.2.5.1.1.3 Post-breeding Migration Bio-season

1364. The predicted post-breeding migration bio-season adult mortalities attributed to Farne Islands SPA is less than one (0.18) breeding adults per annum (**Table 7-61**). This would result in an increase in the baseline mortality rate of 0.022% against the latest population count (**Table 7-61**).

7.7.2.5.1.1.4 Annual Total

1365. The predicted resultant mortality across all defined bio-seasons from the Project attributed to Farne Islands SPA, is two (2.44) breeding adult kittiwakes per annum. The addition of two predicted mortalities per annum would result in an increase to the baseline mortality rate of 0.288%.
1366. This level of impact would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the kittiwake feature of Farne Islands SPA in relation to collision risk in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the kittiwake feature will be maintained in the long term.

7.7.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

7.7.3.1 Construction and Decommissioning

1367. The potential for an in-combination effect to occur during the construction and decommissioning phases can be confidently ruled out for all features of the Farne Islands SPA. This is due to the Project having no proposed overlap of construction / decommissioning activities with other reasonably foreseeable projects for an in-combination effect to materialise, based on expert judgement. Additionally, the assessment for the Project alone concluded a non-material level of effect which would be indistinguishable from natural fluctuations in the population, and certainly wouldn't tangibly contribute to an in-combination effect.

7.7.3.2 Operation and Maintenance

7.7.3.2.1 Collision Risk with Wind Turbine Blades (Dogger Bank D Array Area)

7.7.3.2.1.1 Kittiwake

1368. For the Project alone, the impact is predicted to be just two breeding adults per annum, which can be considered a non-material level of impact. Further, kittiwake is a named component of the seabird assemblage only. Such level of predicted impact on kittiwake would certainly not materially contribute, nor be the tipping point for an AEol in-combination for the seabird assemblage feature. Therefore, the potential for an **AEol in-combination due to mortality due to collisions can confidently be ruled out** for the kittiwake feature of the Farne Islands SPA. Subject to natural change, kittiwake will be maintained as a feature in the long-term.

7.7.3.2.2 Direct Disturbance and Displacement Due to Presence of Wind Turbines and Other Offshore Infrastructure

7.7.3.2.2.1 Guillemot

1369. For the Project alone impact, the increase in baseline mortality is predicted to be at most 0.6% per annum. Such a level of effect alone would certainly be indistinguishable from natural fluctuations in the population, and it unlikely to materially contribute to any in-combination effect, especially given connectivity is temporally restricted to the non-breeding bio-season. Therefore, the potential for an **AEol in-combination due to disturbance and displacement can confidently be ruled out** for the guillemot feature of the Farne Islands SPA. Subject to natural change, guillemot will be maintained as a feature in the long-term.

7.7.3.2.2.2 Puffin

1370. For the Project alone impact, the increase in baseline mortality is predicted to be significantly less than 0.1% per annum. Such a level of effect alone would certainly be indistinguishable from natural fluctuations in the population, and it unlikely to materially contribute to any in-combination effect, especially given connectivity is temporally restricted to the non-breeding bio-season. Therefore, the potential for an **AEol in-combination due to disturbance and displacement can confidently be ruled out** for the puffin feature of the Farne Islands SPA. Subject to natural change, puffin will be maintained as a feature in the long-term.

7.7.4 Summary of Potential Effects on Site Integrity

7.7.4.1 Construction

7.7.4.1.1 Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

1371. There is **no potential for AEol** for any of the qualifying features of Farne Islands SPA assessed for displacement during the construction phase.

7.7.4.2 Operation and Maintenance

7.7.4.2.1 Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

1372. There is **no potential for AEol** for any of the qualifying features of Farne Islands SPA assessed for displacement during the operation and maintenance phase.

7.7.4.2.2 Collision Risk with Wind Turbine Blades

1373. There is **no potential for AEol** for any of the qualifying features of Farne Islands SPA assessed for collision risk during the operation and maintenance phase.

7.7.4.2.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

1374. There is **no potential for AEol** for any of the qualifying features of Farne Islands SPA assessed for in-combination impacts.

7.7.4.3 Decommissioning

1375. The summary of AEol for the decommissioning phase is the same as those stated within the construction phase conclusions above.

7.8 Coquet Island SPA

7.8.1 Site Description

1376. Coquet Island SPA is 170km (at sea) from the offshore ECC and 269km (at sea) from the DBD Array Area plus 2km buffer. Given the distance from the SPA, the Project does not directly overlap with the SPA boundary.

1377. The Coquet Island SPA site description is as follows (Natural England, 2018c):

1378. *“Coquet Island is located 1km off the coast of Northumberland in north-east England. It is a small, flat-topped island with a plateau extent of approximately 7 hectares. The island consists of sandy soil and peat over a soft sandstone base. Low cliffs of approx. 2.4-3.7m high result from earlier quarrying. Surrounding the island is a rocky upper shore and intertidal covering 15 ha when fully exposed. There is a sandy beach on the south-west of the island and the south-east corner is shingle and rock. A small, shallow, man-made well lies in the centre of the plateau, which is fed by non-potable surface water. The peaty soil of the plateau supports short fescue grassland (mainly Festuca rubra but with some F. ovina), with dock (Rumex spp.) and ragwort (Senecio jacobea). Maritime species such as sea campion (Silene maritime) and thrift (Armeria maritima) are scarce. Where nutrient input from seabird colonies is greatest, there are dense stands of taller species, including nettles Urtica spp. These provide cover for some of the nesting terns (Stroud et al., 2001).”*

7.8.1.1 Qualifying Features

1379. Coquet Island SPA is regularly used by over 20,000 seabirds within an assemblage. The component species taken through for assessment for Coquet Island SPA are outlined in **Table 7-62**. The citation count, latest count mortality rate and baseline mortality are provided for reference. An assessment for the seabird assemblage is also provided in **Section 7.10**.

Table 7-62 Coquet Island SPA Qualifying Species and the Citation Population, Latest Count, Mortality Rate and Baseline Mortality

Designated feature	Citation count (breeding adults) (Natural England, 2018c)	Latest count (breeding adults) (SMP, 2025)	Adult Mortality rate (Horswill & Robinson, 2015)	Baseline mortality	
				Citation count	Latest count
Seabird assemblage	>20,000	Sum of latest count of all named features and components.	N/A	Sum of all named features and components.	Sum of all named features and components
Puffin	31,686	35,082 (2024)	9.4%	2,978	3,298

1380. The apportionment rate for each of the qualifying features taken through for assessment are provided in **Table 7-63**.

Table 7-63 Breeding Adult Apportioning Rates for Qualifying Features of Coquet Island SPA Taken Through for Assessment

Species	Apportioning rate (%)				
	Return migration	Breeding	Post-breeding migration	Migration-free winter	Non-breeding
Puffin	N/A	N/A	N/A	N/A	5.32

7.8.1.1.1 Population Trends for Qualifying Features Subject to Assessment

7.8.1.1.1.1 Puffin

1381. Colony-specific population growth trends are derived from data provided within the Seabirds Count book (Burnell *et al.*, 2023; **Table 7-64**). This presents the Coquet Island colony counts completed for Seabird 2000 (Mitchell *et al.*, 2004) and for the Seabirds count book (between 2015 and 2021). The puffin population at Coquet Island SPA has grown by 45% between the two censuses, with an average annual increase of 2.10%. This translates to an addition of 15,642 breeding adults over this time period.

Table 7-64 Historic Colony Counts for Puffin Feature of the Coquet Island SPA Between 2000 - 2018

Colony Count		
Year	2000	2018
Population (breeding adults)	34,416	50,058

7.8.1.2 Conservation Objectives

1382. With regards to the SPA and the individual species and/or assemblage of species for which the site has been classified, and subjected to natural change are listed below. Those relevant to assessment are highlighted **bold**, based on consideration of how the identified impact pathways may affect the qualifying features screened in for assessment:

- To ensure that the integrity of the site is maintained or restored as appropriate; and
- To ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:
 - The extent and distribution of the habitats of the qualifying features;
 - The structure and function of the habitats of the qualifying features;
 - The supporting processes on which the habitats of the qualifying features rely;
 - **The population of each of the qualifying features;** and
 - The distribution of the qualifying features within the site.

7.8.1.3 Condition Assessment

1383. A condition assessment has not been completed for the qualifying features of Coquet Island SPA or for the site as a whole (Natural England, 2025d).

1384. When considering the qualifying features (**Section 7.8.1.1**) and the conservation objectives (**Section 7.8.1.2**) of Coquet Island SPA an assessment of condition can be made. The latest available population count for the puffin feature of 50,058 breeding adults (Burnell *et al.*, 2023) is above the citation population, therefore suggesting that the conservation objectives in relation to population size have been maintained. The puffin feature of Coquet Island SPA is considered to be in a favourable condition.

7.8.2 Assessment of Potential Effects of the Project Alone

1385. Potential for LSE alone has been identified for the following features of Coquet Island SPA:

- Puffin (see **Section 7.8.2** and **Section 7.8.3** for assessment);
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Disturbance and displacement due to presence of wind turbines and other offshore infrastructure (non-breeding bio-seasons); and
 - In-combination effects (operation and maintenance phase) for the breeding and non-breeding bio-season.

7.8.2.1 Direct Disturbance and Displacement due to Work Activity in the Dogger Bank D Array Area, ECC or Landfall

1386. Assessment of impacts of direct disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall have been assessed together with direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure. This is because there is no differentiation between displacement impacts due to work activity or the presence of turbines when assessing for the DBD Array Area. The assessment of apportioned displacement impacts for designated features of Farne Islands SPA are outlined in **Section 7.8.2.2**.

7.8.2.2 Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

7.8.2.2.1 Construction

7.8.2.2.1.1 Puffin

1387. During the construction phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-65** when considering both the Applicant's and SNCB approach.

Table 7-65 Summary of Construction Phase Disturbance and Displacement Impacts for Puffin Apportioned to Coquet Island SPA using the breeding adult apportioning rate within Table 7-63

Population size (breeding adults)	Bio-seasons	Puffin apportioned to Coquet Island SPA (breeding adults)*	Applicant’s approach		SNCB approach	
			25% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	15% – 35% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (31,686)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	1	<0.01	<0.001	<0.01 – 0.04	<0.001 – 0.002
	Annual	1	<0.01	<0.001	<0.01 – 0.04	<0.001 – 0.002
Latest count (35,082)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	1	<0.01	<0.001	<0.01 – 0.04	<0.001 – 0.001
	Annual	1	<0.01	<0.001	<0.01 – 0.04	<0.001 – 0.001

Table note: *Calculated as the mean peak abundance (Table 7-6) x the Coquet Island SPA apportioning rate (Table 7-63).

1388. As presented within **Table 7-65**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the puffin feature of Coquet Island SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the puffin feature will be maintained in the long term.

7.8.2.2.2 Operation and Maintenance

7.8.2.2.2.1 Puffin

1389. During the operation and maintenance phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-66** when considering both the Applicant's and SNCB approach.

1390. A displacement matrix is also presented for the annual apportioned abundance for the DBD Array Area plus 2km asymmetrical buffer to Coquet Island SPA (**Table 7-67**).

7.8.2.2.2.1.1 Breeding Bio-season

1391. The Project is outside of puffins MMFR + one SD foraging range from the Coquet Island SPA. Therefore, no potential for connectivity concluded during the breeding bio-season.

7.8.2.2.2.1.2 Non-breeding Bio-season

1392. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.01) breeding adult during the non-breeding bio-season. This would result in baseline mortality increase of less than 0.001% against the latest population count (**Table 7-66**).

7.8.2.2.2.1.3 Annual Total

1393. When considering the Applicant's approach, the consequent potential mortality for breeding adult puffins from Coquet Island SPA annually is predicted at less than one (0.01) breeding adult per annum. This would result in an increase in the baseline mortality of less than 0.001% against the latest population count (**Table 7-66**).

1394. When considering the SNCB approach the consequent potential mortality for breeding adult puffins from Coquet Island SPA annually is predicted at less than one (<0.01 – 0.09) breeding adult per annum. This would result in an increase in the baseline mortality of less than 0.001% to 0.003% against the latest population count (**Table 7-66**).

1395. These levels of impact from either the Applicant's or SNCB approach would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the puffin feature of Coquet Island SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the puffin feature will be maintained in the long term.

7.8.2.2.3 Decommissioning

1396. The summary of AEol for the decommissioning phase is the same as those stated within the construction phase conclusions above.

7.8.2.3 Barrier Effect due to Presence of Wind Turbines and Other Offshore Infrastructure

1397. Assessments for barrier effects due to the presence of wind turbines and other offshore infrastructure are considered in **Section 7.12**.

7.8.2.4 Indirect Effects via Habitats or Prey Availability

1398. Assessments for indirect effects via habitat or prey availability are considered in **Section 7.11**.

7.8.2.5 Collision Risk with Wind Turbine Blades (Dogger Bank D Array Area)

1399. No designated features of Coquet Island SPA have been screened in for collision risk with wind turbines and so no assessment is required.

7.8.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

7.8.3.1 Construction and Decommissioning

1400. The potential for an in-combination effect to occur during the construction and decommissioning phases can be confidently ruled out for all features of the Coquet Island SPA. This is due to the Project having no proposed overlap of construction / decommissioning activities with other reasonably foreseeable projects for an in-combination effect to materialise, based on expert judgement. Additionally, the assessment for the Project alone concluded a non-material level of effect which would be indistinguishable from natural fluctuations in the population, and certainly wouldn't tangibly contribute to an in-combination effect.

Table 7-66 Summary of Operation and Maintenance Phase Disturbance and Displacement Impacts for Puffin Apportioned to Coquet Island SPA using the breeding adult apportioning rate within **Table 7-63**

Population size (breeding adults)	Bio-season	Puffin apportioned to Coquet Island SPA (breeding adults)*	Applicant’s approach		SNCB approach	
			50% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	30% – 70% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (31,686)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	1	0.01	<0.001	<0.01 – 0.09	<0.001 – 0.003
	Annual	1	0.01	<0.001	<0.01 – 0.09	<0.001 – 0.003
Latest count (35,082)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	1	0.01	<0.001	<0.01 – 0.09	<0.001 – 0.003
	Annual	1	0.01	<0.001	<0.01 – 0.09	<0.001 – 0.003

Table note: *Calculated as the mean peak abundance (**Table 7-6**) x the Coquet Island SPA apportioning rate (**Table 7-63**).

Table 7-67 Puffin Operation and Maintenance Phase Annual Displacement Matrix for Impacts Apportioned to the Coquet Island SPA

Puffin annual displacement matrix (based on 1 breeding adult apportioned to the Coquet Island SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
50	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
60	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
70	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
80	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
90	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
100	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
				>1% increase in baseline mortality rate against latest count							>1% increase in baseline mortality rate against citation population					

7.8.3.2 Operation and Maintenance

7.8.3.2.1 Direct Disturbance and Displacement Due to Presence of Wind Turbines and Other Offshore Infrastructure

7.8.3.2.1.1 Puffin

1401. For the Project alone impact, the increase in baseline mortality is predicted to be significantly less than 0.1% per annum. Such a level of effect alone would certainly be indistinguishable from natural fluctuations in the populations and is unlikely to materially contribute to any in-combination effect, especially given connectivity is temporally restricted to the non-breeding bio-season. Therefore, the potential for an **AEol in-combination due to disturbance and displacement can confidently be ruled out** for the puffin feature of the Coquet Island SPA. Subject to natural change, puffin will be maintained as a feature in the long-term.

7.8.4 Summary of Potential Effects on Site Integrity

7.8.4.1 Construction

7.8.4.1.1 Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

1402. There is **no potential for AEol** for any of the qualifying features of Coquet Island SPA assessed for displacement during the construction phase.

7.8.4.2 Operation and Maintenance

7.8.4.2.1 Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

1403. There is **no potential for AEol** for any of the qualifying features of Coquet Island SPA assessed for displacement during the operation and maintenance phase.

7.8.4.2.2 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

1404. There is **no potential for AEol** for any of the qualifying features of Coquet Island SPA assessed for in-combination impacts.

7.8.4.2.3 Decommissioning

1405. The summary of AEol for the decommissioning phase is the same as those stated within the construction phase conclusions above.

7.9 Forth Islands SPA

7.9.1 Site Description

1406. Forth Islands SPA is 259km (at sea) from the offshore ECC and 346km (at sea) from the DBD Array Area plus 2km buffer. Given the distance from the SPA, the Project does not directly overlap with the SPA boundary.

1407. The Forth Islands SPA site description is as follows (NatureScot, 2018):

1408. *“The Forth Islands SPA consists of a series of islands supporting the main seabird colonies in the Firth of Forth. The islands of Inchmickery, Isle of May, Fidra, the Lamb, Craigleith and Bass Rock were classified on 25 April 1990. The extension to the site, classified on the 16 February 2004 consists of the island of Long Craig, which, at the time of classification, supported the largest colony of roseate tern in Scotland. It is the most northerly of only six regular British colonies. The seaward extension extends approximately 2km into the marine environment to include the seabed, water column and surface.”*

7.9.1.1 Qualifying Features

1409. Forth Islands SPA supports population of importance for the species outlined in **Table 7-68**. The citation count, latest count mortality rate and baseline mortality are provided for reference.

Table 7-68 Forth Islands SPA Qualifying Species and the Citation Population, Latest Count, Mortality Rate and Baseline Mortality

Designated feature	Citation count (breeding adults) (NatureScot, 2018)	Latest count (breeding adults) (SMP, 2025)	Adult Mortality rate (Horswill & Robinson, 2015)	Baseline mortality	
				Citation count	Latest count
Gannet	43,200	103,688 (2023)*	8.1%	3,499	8,399
Puffin	28,000	121,524 (2022 - 2024)**	9.4%	2,632	11,423

Table Note: *Value extrapolated from Harris *et al*(2023). **count made up of the latest component colony counts for the SPA which varies from 2022 to 2024.

1410. Apportioning rates for each of the qualifying features taken through for assessment are provided in **Table 7-69**.

Table 7-69 Breeding Adult Apportioning Rates for Qualifying Features of Forth Islands SPA Taken Through for Assessment

Species	Apportioning rate (%)				
	Return migration	Breeding	Post-breeding migration	Migration-free winter	Non-breeding
Puffin	N/A	N/A	N/A	N/A	26.83
Gannet	31.27	0*	24.32	N/A	N/A

Table Note: *Although the Forth Islands SPA is within mean max plus one SD from the Project, the apportionment process concluded 100% breeding season apportionment to the FFC SPA gannet feature as detailed within Appendix A.3 Apportionment Report.

7.9.1.1.1 Population Trends for Qualifying Features Subject to Assessment

7.9.1.1.1.1 Puffin

1411. Colony-specific population growth trends are derived from data provided within the Seabirds Count book (Burnell *et al.*, 2023; Table 7-70). This presents the Forth Islands SPA counts completed for Seabird 2000 (Mitchell *et al.*, 2004) and for the latest Seabirds Count book (between 2015 and 2021). The population of puffin at Forth Islands SPA has declined by 39% between the two censuses at a mean rate of -2.71% per annum. This equates to a reduction in the puffin breeding population at Forth Islands SPA of 55,022 adults over this time period.

Table 7-70 Historic Colony Counts for Puffin Feature of the Forth Islands SPA Between 2000 – 2018 from Burnell *et al* (2023)

Colony Count		
Year	2000	2018
Population (breeding adults)	140,868	85,846

7.9.1.1.1.2 Gannet

1412. Colony-specific population growth trends for gannet are based on the information contained within the SMP database (2025) and Harris *et al* (2023) (Table 7-71; Figure 7-10) The compound growth rates presented would suggest the Forth Islands colony in the long term has been on a stable increase in population size since 1990 (citation count), though the colony is known to have been increasing for over 100 years (Jeglinski *et al.*, 2022) (Table 7-72). Although the 2021 colony count is an extrapolation only, the reduction of growth rate predicted is likely to be consistent with the actual trend, as the colony (pre-HPAI) was close to carrying capacity in the early 2020s (Harris *et al.*, 2023).

Table 7-71 Historic Colony Counts for Gannet Feature of the Forth Islands SPA Between 1985 - 2023

Colony Count									
Year	1985	1994	1999	2004	2009	2014	2021	2022	2023
Population (breeding adults)	43,182	68,794	88,220	96,130	121,706	150,518	162,000	42,454	103,688

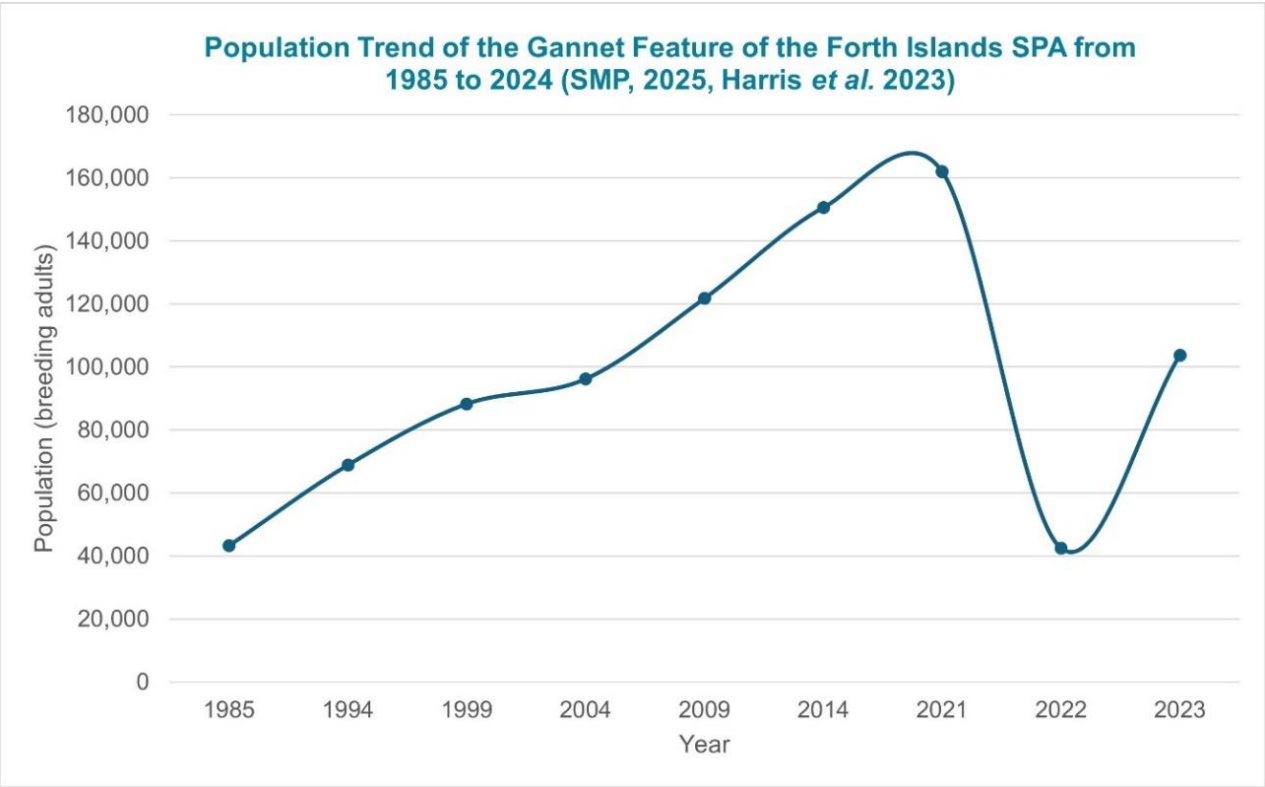


Figure 7-10 Population Trend of the Gannet Feature of the Forth Islands SPA from 1985 to 2024 (SMP, 2025; Harris *et al.*, 2023)

Table 7-72 Annual Colony Compound Growth Rates for Gannet Feature of the Forth Islands SPA Between 1985 - 2023

Colony annual compound growth rate (%)							
Year	1985 - 2023	1985 - 2014	1985 - 2004	2004 - 2014	2014 - 2021	2021 - 2022	2022 - 2023
Compound growth rate (%)	2.33%	4.40%	4.30%	4.59%	1.06%	-73.79%	144.24%

1413. In 2022, the Forth Islands gannet population was significantly impacted by HPAI, with 5,035 confirmed cases of dead gannets at the SPA and a stark reduction in colony size in 2022 (total of 42,454 birds recorded in June 2022) as reported in Lane *et al*(2023). Counts undertaken in 2023 recorded a total of 103,688 birds, indicating an increase of 144% compared to the 2022 count and above the citation count, though still a marked reduction in size in contrast to the previous 2014 census (31% decline). No population figure is currently available for 2024, though counts for other gannetries significantly impacted by HPAI have reported significant increases in numbers in contrast to 2022 (SMP, 2025). Additionally, only two confirmed cases of HPAI were reported between 1st October to 28th March 2024 (DEFRA, 2024), suggesting limited current effect from the virus.
1414. As noted within Harris *et al*(2023), recovery of the Forth Islands population is dependent on the number of potential recruits. The Forth Islands colony has been producing thousands of young which previously were considered to recruit into other UK gannetries due to limited space at the Forth Islands Colony (Burnell *et al.*, 2023). This would suggest that there is a significant recruitment pool to ensure the Forth Islands colony will recover from the effects of HPAI.

7.9.1.2 Conservation Objectives

1415. The overarching conservation objectives for the SPA are listed below. Those relevant to assessment are highlighted **bold**, based on consideration of how the identified impact pathways may affect the qualifying features screened in for assessment:
- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
 - To ensure for the qualifying species that the following are maintained in the long term:
 - **Population of the species as a viable component of the site;**
 - Distribution of the species within site;
 - Distribution and extent of the habitats supporting the species;
 - Structure, function and supporting processes of habitats supporting the species; and
 - No significant disturbance of the species.

7.9.1.3 Condition Assessment

1416. The latest condition assessment for the gannet feature of Forth Islands SPA was completed by NatureScot in 2014. With sustained population growth up to 2014 the gannet feature is considered to be in a favourable condition, therefore suggesting that the conservation objectives in relation to population size have been maintained.
1417. The latest condition assessment for the puffin feature of Forth Islands SPA was completed by NatureScot in 2020. Puffin was considered to be in a favourable condition suggesting that the conservation objectives in relation to population size have been maintained.

7.9.2 Assessment of Potential Effects of the Project Alone

- Puffin (see **Sections 7.9.2** and **7.9.3** for assessment):
 - Direct disturbance and displacement due to work activity in the DBD Array Area, ECC or Landfall;
 - Disturbance and displacement due to presence of wind turbines and other offshore infrastructure (non-breeding bio-seasons); and
 - In-combination effects (operation and maintenance phase) for the breeding and non-breeding bio-season.
- Gannet (see **Sections 7.9.2** and **7.9.3** for assessment):
 - Disturbance and displacement due to presence of wind turbines and other offshore infrastructure (breeding and non-breeding bio-seasons);
 - Collision risk (operation and maintenance phase) for the breeding and non-breeding season; and
 - In-combination effects (operation and maintenance phase) for the breeding and non-breeding season.

7.9.2.1 Direct Disturbance and Displacement due to Work Activity in the Dogger Bank D Array Area, ECC or Landfall

1418. Assessment of impacts of direct disturbance and displacement due to work activity in the DBD Array Area, Offshore ECC or landfall have been assessed together with direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure. This is because there is no differentiation between displacement impacts due to work activity or the presence of turbines when assessing for the DBD Array Area. The assessment of apportioned displacement impacts for designated features of Forth Islands SPA are outlined in **Section 7.9.2.2**.

7.9.2.2 Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

1419. In relation to the most appropriate displacement and mortality rates to inform assessment of Scottish SPAs, the Applicant discussed such matters with NatureScot during consultation held on 14th October 2024. Despite there being differences between the rates recommended by Natural England (see **Table 7-6**) and NatureScot (NatureScot, 2023), to ensure consistency in assessment approach between SPAs, NatureScot agreed with the Project assessing Scottish SPAs based on Natural England's recommended displacement and mortality rates. For clarity, the Applicant has separately calculated predicted impacts following NatureScot's preferred displacement and mortality rates, the results of which are summarised within **Appendix A.4 Scottish Sites - Presentation of Quantitative Results**.

7.9.2.2.1 Construction

7.9.2.2.1.1 Puffin

1420. During the construction phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-73** when considering both the Applicant's and SNCB approach.
1421. As presented within **Table 7-73**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the puffin feature of Forth Islands SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the puffin feature will be maintained in the long term.

7.9.2.2.1.2 Gannet

1422. During the construction phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-74** when considering both the Applicant's and SNCB approach.
1423. As presented within **Table 7-74**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the gannet feature of Forth Islands SPA in relation to disturbance and displacement effects in the construction phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term.

7.9.2.2.2 Operation and Maintenance

7.9.2.2.2.1 Puffin

1424. During the operation and maintenance phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-75** when considering both the Applicant's and SNCB approach.

1425. A displacement matrix is also presented for the annual apportioned abundance for the DBD Array Area plus 2km asymmetrical buffer to Forth Islands SPA (**Table 7-76**).

7.9.2.2.2.1.1 Breeding Bio-season

1426. The Project is outside of puffins MMFR + one SD foraging range from the Forth Islands SPA. Therefore, no potential for connectivity concluded during the breeding bio-season.

7.9.2.2.2.1.2 Non-breeding Bio-season

1427. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.03) breeding adults during the non-breeding bio-season. This would result in a baseline mortality increase of less than 0.001% against the latest population count (121,524).

7.9.2.2.2.1.3 Annual Total

1428. When considering the Applicant's approach, the consequent potential mortality for breeding adult puffins from Forth Islands SPA annually is predicted at less than one (0.03) breeding adult per annum. This would result in a baseline mortality increase of less than 0.001% against the latest population count (**Table 7-75**).

Table 7-73 Summary of Construction Phase Disturbance and Displacement Impacts for Puffin Apportioned to Forth Islands SPA using the breeding adult apportioning rates within Table 7-69

Population size (breeding adults)	Bio-seasons	Puffin apportioned to the Forth Islands SPA (breeding adults)*	Applicant’s approach		SNCB approach	
			25% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	15% – 35% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (28,000)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	6	0.02	0.001	0.01 – 0.23	<0.001 – 0.009
	Annual	6	0.02	0.001	0.01 – 0.23	<0.001 – 0.009
Latest count (121,524)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	6	0.02	<0.001	0.01 – 0.23	<0.001 – 0.002
	Annual	6	0.02	<0.001	0.01 – 0.23	<0.001 – 0.002

Table note: *Calculated as the mean peak abundance (Table 7-6) x the Forth Islands SPA apportioning rate (Table 7-69).

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Table 7-74 Summary of Construction Phase Disturbance and Displacement Impacts for Gannet Apportioned to Forth Islands SPA using the breeding adult apportioning rates within Table 7-69

Population size (breeding adults)	Bio-seasons	Gannet apportioned to the Forth Islands SPA (breeding adults)*	Applicant's approach		SNCB approach	
			30% - 40% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	30% - 40% Disp; 1% - 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (43,200)	Breeding (March – September)	0	N/A	N/A	N/A	N/A
	Return migration (December – February)	27	0.08 - 0.11	0.002 - 0.003	0.08 - 1.06	0.002 - 0.030
	Post-breeding migration (October – November)	198	0.59 - 0.79 -	0.017 - 0.023	0.59 - 7.91	0.017 - 0.226
	Annual	224	0.67 - 0.90	0.019 - 0.026	0.67 – 8.97	0.019 - 0.256
Latest count (103,688)	Breeding (March – September)	0	N/A -	N/A -	N/A -	N/A -
	Return migration (December – February)	27	0.08 - 0.11	0.001 - 0.001	0.08 - 1.06	0.001 - 0.013
	Post-breeding migration (October – November)	198	0.59 - 0.79	0.007 - 0.009	0.59 - 7.91	0.007 - 0.094
	Annual	224	0.67 - 0.90	0.008 - 0.011	0.67 - 8.97	0.008 - 0.107

Table note: *Calculated as the mean peak abundance (Table 7-6) x the Forth Islands SPA apportioning rate (Table 7-69).

Table 7-75 Summary of Operation and Maintenance Phase Disturbance and Displacement Impacts for Puffin Apportioned to Forth Islands SPA using the breeding adult apportioning rates within **Table 7-69**

Population size (breeding adults)	Bio-seasons	Puffin apportioned to Forth Islands SPA (breeding adults)*	Applicant’s approach		SNCB approach	
			50% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	30% – 70% Disp; 1% – 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (28,000)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	6	0.03	0.001	0.02 – 0.45	0.001 – 0.017
	Annual	6	0.03	0.001	0.02 – 0.45	0.001 – 0.017
Latest count (121,524)	Breeding (April – July)	0	N/A	N/A	N/A	N/A
	Non-breeding (August – March)	6	0.03	<0.001	0.02 – 0.45	<0.001 – 0.004
	Annual	6	0.03	<0.001	0.02 – 0.45	<0.001 – 0.004

Table note: *Calculated as the mean peak abundance (**Table 7-6**) x the Forth Islands SPA apportioning rate (**Table 7-69**).

Table 7-76 Puffin Operation and Maintenance Phase Annual Displacement Matrix for Impacts Apportioned to the Forth Islands SPA

Puffin annual displacement matrix (based on 6 breeding adults apportioned to the Forth Islands SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
20	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
30	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2
40	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	3
50	0	0	0	0	0	0	0	1	1	1	2	2	2	3	3	3
60	0	0	0	0	0	0	0	1	1	2	2	2	3	3	3	4
70	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5
80	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5	5
90	0	0	0	0	0	0	1	1	2	2	3	3	4	5	5	6
100	0	0	0	0	0	0	1	1	2	3	3	4	5	5	6	6
			>1% increase in baseline mortality rate against latest count					>1% increase in baseline mortality rate against citation population								

1429. When considering the SNCB approach the consequent potential mortality for breeding adult puffins from Forth Islands SPA annually is predicted at less than one (0.02 – 0.45) breeding adult per annum. This would result in a baseline mortality increase of less than 0.001% to 0.004% against the latest population count (**Table 7-75**).

1430. As presented within **Table 7-75**, the level of predicted impact from either the Applicant's or SNCB approach is predicted to be less than a 1% increase in baseline mortality, which is considered to be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the puffin feature of Forth Islands SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the puffin feature will be maintained in the long term.

7.9.2.2.2.2 Gannet

1431. During the operation and maintenance phase the potential level of impact apportioned to the SPA seasonally is summarised in **Table 7-77** when considering both the Applicant's and SNCB approach.

1432. A displacement matrix (**Table 7-78**) is also presented for the annual apportioned abundance for the DBD Array Area plus 2km asymmetrical buffer to Forth Island SPA.

7.9.2.2.2.2.1 Breeding Bio-season

1433. No gannets have been apportioned to the Forth Islands SPA during the breeding bio-season and so no impacts are predicted (**Table 7-77**).

7.9.2.2.2.2.2 Return Migration Bio-season

1434. When considering the Applicant's approach, the consequent potential mortality is predicted at less than one (0.16 – 0.21) breeding adult during the return migration bio-season. This would result in a baseline mortality increase of 0.002% to 0.003% against the latest population count (**Table 7-77**).

7.9.2.2.2.2.3 Post-breeding Migration Bio-season

1435. When considering the Applicant's approach, the consequent potential mortality is predicted at one to two (1.19 – 1.58) breeding adults during the post-breeding migration bio-season. This would result in a baseline mortality increase of 0.014% to 0.019% against the latest population count (**Table 7-77**).

7.9.2.2.2.4 Annual Total

1436. When considering the Applicant's approach, the consequent potential mortality for breeding adult gannets from Forth Islands SPA annually is predicted at approximately one to two (1.35 – 1.79) breeding adults per annum. This would result in a baseline mortality increase of 0.016% to 0.021% against the latest population count (**Table 7-77**).

1437. When considering the SNCB approach the consequent potential mortality for breeding adult gannets from Forth Islands SPA annually is predicted at one to 18 (1.35 – 17.94) breeding adults per annum. This would result in a baseline mortality increase of 0.016% to 0.214% against the latest population count (**Table 7-77**).

1438. These levels of impact from either the Applicant's or SNCB approach would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the gannet feature of Forth Islands SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEol can be confidently ruled out**. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term.

7.9.2.2.3 Decommissioning

1439. The worst-case scenario for decommissioning activities within the DBD Array Area is considered to be equal to or less than the worst-case scenario for the construction phase. Therefore, for the purposes of this assessment it is assumed that the impacts are likely to be similar. Closer to the time of decommissioning, it may be decided that removal would lead to a greater environmental impact than leaving some components in situ, in which case certain components may be cut off at or below seabed level (e.g. in the case of piled foundations) or left buried (e.g. in the case of sub-sea cables). This may reduce the amount of decommissioning activity required.

1440. As described in **Section 7.9.2.2.1**, the potential for an **AEol in the construction phase can be confidently ruled out**, therefore **the same conclusion is considered appropriate for the decommissioning phase**.

7.9.2.3 Barrier Effect due to Presence of Wind Turbines and Other Offshore Infrastructure

1441. Assessments for barrier effects due to the presence of wind turbines and other offshore infrastructure are considered in **Section 7.12**.

7.9.2.4 Indirect Effects via Habitats or Prey Availability

1442. Assessments for indirect effects via habitat or prey availability are considered in **Section 7.11**.

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Table 7-77 Summary of Operation and Maintenance Phase Disturbance and Displacement Impacts for Gannet Apportioned to Forth Islands SPA using the breeding adult apportioning rates within **Table 7-69**

Population size (breeding adults)	Bio-seasons	Gannet apportioned to the Forth Islands SPA (breeding adults)*	Applicant's approach		SNCB approach	
			60% - 80% Disp; 1% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)	60% – 80% Disp; 1% - 10% Mort (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (43,200)	Breeding (March – September)	0	N/A	N/A	N/A	N/A
	Return migration (December – February)	27	0.16 – 0.21	0.005 - 0.006	0.016 - 2.13	0.005 - 0.061
	Post-breeding migration (October – November)	198	1.19 – 1.58	0.034 - 0.045	1.19 - 15.82	0.034 - 0.452
	Annual	224	1.35 - 1.79	0.038 - 0.051	1.35 - 17.94	0.038 - 0.513
Latest count (103,688)	Breeding (March – September)	0	N/A	N/A	N/A	N/A
	Return migration (December – February)	27	0.16 - 0.21	0.002 – 0.003	0.016 - 2.13	0.002 – 0.025
	Post-breeding migration (October – November)	198	1.19 - 1.58	0.014 – 0.019	1.19 - 15.82	0.014 – 0.188
	Annual	224	1.35 - 1.79	0.016 - 0.021	1.35 - 17.94	0.016 - 0.214

Table note: *Calculated as the mean peak abundance (**Table 7-6**) x the Forth Islands SPA apportioning rate (**Table 7-69**).

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Table 7-78 Gannet Operation and Maintenance Phase Annual Displacement Matrix for Impacts Apportioned to the Forth Islands SPA

Gannet annual displacement matrix (based on 224 breeding adults apportioned to the Forth Islands SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2
10	0	0	0	1	1	1	2	4	7	9	11	13	16	18	20	22
20	0	0	1	1	2	2	4	9	13	18	22	27	31	36	40	45
30	0	1	1	2	3	3	7	13	20	27	34	40	47	54	60	67
40	0	1	2	3	4	4	9	18	27	36	45	54	63	72	81	90
50	0	1	2	3	4	6	11	22	34	45	56	67	78	90	101	112
60	0	1	3	4	5	7	13	27	40	54	67	81	94	108	121	134
70	0	2	3	5	6	8	16	31	47	63	78	94	110	125	141	157
80	0	2	4	5	7	9	18	36	54	72	90	108	125	143	161	179
90	0	2	4	6	8	10	20	40	60	81	101	121	141	161	181	202
100	0	2	4	7	9	11	22	45	67	90	112	134	157	179	202	224
				>1% increase in baseline mortality rate against latest count						>1% increase in baseline mortality rate against citation population						

7.9.2.5 Collision Risk with Wind Turbine Blades (Dogger Bank D Array Area)

7.9.2.5.1 Operation and Maintenance

7.9.2.5.1.1 Gannet

1443. During the operation and maintenance phase, the potential of impact from collision risk apportioned to the Forth Islands SPA seasonally is summarised in **Table 7-79**.

Table 7-79 Gannet Predicted Collision Risk Mortalities During the Operation and Maintenance Phase Apportioned to the Forth Islands SPA using the breeding adult apportioning rates within Table 7-69

Population size (breeding adults)	Bio-seasons	Collision risk impact	
		Breeding adults per annum	Increase in baseline mortality (%)
Citation (43,200)	Breeding (March - September)	0	N/A
	Return migration (December - February)	0.2	0.005
	Post-breeding migration (October - November)	0.8	0.024
	Annual total	1.0	0.029
Latest Count (103,688)	Breeding (March - September)	0	N/A
	Return migration (December - February)	0.2	0.002
	Post-breeding migration (October - November)	0.8	0.010
	Annual total	1.0	0.012

7.9.2.5.1.1.1 Breeding Bio-season

1444. No gannets have been apportioned to the Forth Islands SPA during the breeding bio-season and so no impacts are predicted (**Table 7-79**).

7.9.2.5.1.1.2 Return Migration Bio-season

1445. The predicted return-migration bio-season adult mortalities attributed to Forth Island SPA is less than one (0.2) breeding adult per annum (**Table 7-79**). This would result in an increase in the baseline mortality rate of 0.002% against the latest population count (**Table 7-79**).

7.9.2.5.1.1.3 Post-breeding Migration

1446. The predicted post-breeding migration bio-season adult mortalities attributed to Forth Islands SPA is less than one (0.8) breeding adult per annum (**Table 7-79**). This would result in an increase in the baseline mortality rate of 0.024% against the latest population count (**Table 7-79**).

7.9.2.5.1.1.4 Annual Total

1447. The predicted resultant mortality across all defined bio-seasons from the Project attributed to Forth Islands SPA, is a single (1.0) breeding adult gannet per annum. The addition of one predicted mortality per annum would result in an increase to the baseline mortality rate of 0.012%.

1448. This level of impact would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the gannet feature of Forth Islands SPA in relation to collision risk in the operation and maintenance phase from the Project alone, the potential for an **AEoI can be confidently ruled out**. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term.

7.9.2.6 Combined Operational Phase Collision and Displacement Effects

1449. For species screened in for both displacement and collision risk assessment, during the O&M phase, there is the potential that the two impacts can adversely impact species populations of SPA features cumulatively. Therefore, combined impacts have been conducted for the following species:

- Gannet.

7.9.2.6.1.1 Gannet

1450. Due to gannet being screened in for both displacement and collision risk assessment during the O&M phase, there is a potential for these two potential impacts to adversely affect gannet populations cumulatively. Previous sections have ruled out AEoI when assessing collision risk or displacement acting alone. However, the combined impact of both collision risk and displacement may be greater than either one acting alone. Further consideration of both impacts acting together is therefore required.

1451. It is recognised that assessing these two potential impacts together amounts to double counting, as birds that are subject to displacement would not be subject to potential collision risk as they are already assumed to have not entered the DBD Array Area. Equally, birds estimated to be subject to collision risk mortality would not be able to be subjected to consequent displacement mortality. As a more refined method to consider displacement and collision together whilst reducing any double counting of impacts is not agreed with SNCBs the precautionary and highly unlikely approach of simply adding both impacts together is presented in this assessment.
1452. When considering the Applicant's approach, the consequent potential mortality for breeding adult gannets from Forth Islands SPA annually is predicted at approximately two to three (2.36 – 2.80) breeding adults per annum. This would result in an increase in the baseline mortality of 0.028% to 0.033% against the latest population count (**Table 7-80**).

Table 7-80 Summary of Predicted Operation and Maintenance Phase Combined Collision Risk and Displacement Mortalities for Gannet Apportioned to Forth Islands SPA using the breeding adult apportioning rates within Table 7-69

Population size (breeding adults)	Bio-season	Applicant's approach		SNCB approach	
		60% - 80% Disp; 1% Mort plus CRM (breeding adults per annum)	Increase in baseline mortality rate (%)	60% – 80% Disp; 1% - 10% Mort plus CRM (breeding adults per annum)	Increase in baseline mortality rate (%)
Citation (43,200)	Breeding (March – September)	0	N/A	N/A	N/A
	Post-breeding migration (October – November)	2.03 – 2.42	0.058 – 0.069	2.03 – 16.66	0.058 – 0.476
	Return migration (December – February)	0.32 – 0.37	0.009 – 0.011	0.32 – 2.29	0.009 – 0.065
	2.36 - 2.80	0.067 - 0.080	2.36 - 18.95	0.067 - 0.542	2.36 - 2.80

Population size (breeding adults)	Bio-season	Applicant's approach		SNCB approach	
		60% - 80% Disp; 1% Mort plus CRM (breeding adults per annum)	Increase in baseline mortality rate (%)	60% – 80% Disp; 1% - 10% Mort plus CRM (breeding adults per annum)	Increase in baseline mortality rate (%)
Latest Count (103,688)	0	N/A	N/A	N/A	0
	Post-breeding migration (October – November)	2.03 – 2.42	0.024 – 0.029	2.03 – 16.66	0.024 – 0.198
	Return migration (December – February)	0.32 – 0.37	0.004 – 0.004	0.32 – 2.29	0.004 – 0.027
	Annual	2.36 - 2.80	0.028 - 0.033	2.36 - 18.95	0.028 - 0.226

1453. When considering the SNCB approach the consequent potential mortality for breeding adult gannets from Forth Islands SPA annually is predicted at two to 19 (2.36 – 18.95) breeding adults per annum. This would result in an increase in the baseline mortality of 0.024% to 0.198% against the latest population count (**Table 7-80**).
1454. These levels of impact from either the Applicant's or SNCB approach would be indistinguishable from natural fluctuations in the populations. With regard to the conservation objectives of the gannet feature of Forth Islands SPA in relation to disturbance and displacement effects in the operation and maintenance phase from the Project alone, the potential for an **AEoI can be confidently ruled out**. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term.

7.9.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

7.9.3.1 Construction and Decommissioning

1455. The potential for an in-combination effect to occur during the construction and decommissioning phases can be confidently ruled out for all features of the Forth Islands SPA. This is due to the Project having no proposed overlap of construction / decommissioning activities with other reasonably foreseeable projects for an in-combination effect to materialise, based on expert judgement. Additionally, the assessment for the Project alone concluded a non-material level of effect which would be indistinguishable from natural fluctuations in the population, and certainly wouldn't tangibly contribute to an in-combination effect.

7.9.3.2 Operation and Maintenance

7.9.3.2.1 Collision Risk with Wind Turbine Blades (Dogger Bank D Array Area)

7.9.3.2.1.1 Gannet

1456. The projects identified for in-combination collision risk effects for the gannet feature of Forth Islands SPA and details on the reference sources are provided in **Table 7-81**. The predicted in-combination mortality is provided in **Table 7-82**.
1457. To ensure the in-combination assessment for the gannet feature of the Forth Islands SPA adheres to the recent update to recommended avoidance rates (SNCBs, 2024), where applicable the collision estimates which rely on previously recommended avoidance rates have been corrected in the same way as undertaken for DEP & SEP (Royal HaskoningDHV, 2023b). Additionally, macro avoidance has been applied to the estimates from those projects for which this was not already included, in accordance with relevant statutory bodies advice (SNCBs, 2024). In the case of Scottish projects, macro-avoidance was only applied during the non-breeding bio-seasons as per NatureScot advice (NatureScot, 2025).

7.9.3.2.1.1.1 Breeding Bio-season

1458. No impacts have been apportioned to the gannet feature of Forth Islands SPA during the breeding bio-season for the Project alone, therefore the Project does not contribute to an in-combination effect during the breeding bio-season.

7.9.3.2.1.1.2 Return Migration Bio-season

1459. The predicted in-combination breeding adult mortalities for all projects attributed to Forth Islands SPA during the return migration bio-season is 41 (41.2) breeding adults. This would result in an increase in baseline mortality of 0.490% (**Table 7-82**) against the latest population count (**Table 7-11**).

7.9.3.2.1.1.3 Post-breeding Migration Bio-season

1460. The predicted in-combination breeding adult mortalities for all projects attributed to Forth Islands SPA during the post-breeding migration bio-season is 18 (18.1) breeding adults. This would result in an increase in baseline mortality of 0.215% (**Table 7-82**) against the latest population count (**Table 7-11**).

7.9.3.2.1.1.4 Annual Total

1461. The predicted resultant mortality across all defined bio-seasons from all projects in-combination, attributed to Forth Islands SPA is 529 (529.2) breeding adult gannets. This would result in an increase in baseline mortality of 6.301% (**Table 7-41**) against the latest population count (**Table 7-11**).
1462. The gannet feature of Forth Islands SPA is currently cited as 'favourable maintained' (**Section 7.9.1.1**). Since citation in 1990, the colony has undergone significant and sustained and in 2014, Bass Rock become the world's largest gannet colony (Murray *et al.*, 2014).
1463. In 2022, the Forth Islands gannet population was significantly impacted by HPAI (Lane *et al.*, 2023). Surveys undertaken in 2023 recorded a total of 103,688 breeding adults indicating the population has remained above the citation count, though a considerable reduction in size since the previous 2014 count (Table 7-71).
1464. The Forth Islands colony has been producing thousands of young which were considered to recruit into other UK gannetries due to Bass Rock being at carrying capacity (Harris *et al.*, 2023). Recovery of the Forth Islands SPA population is dependent on the size of the recruitment pool. When considering the consistent annual growth rate of the colony prior to the HPAI outbreak, combined with the faster than anticipated rates of increase at the neighbouring colonies such as at Troup, Pennan and Lion's Heads SPA and the colonisation of nearby St Abb's Head and Fast Castle SPA (Wanless *et al.*, 2023), it can be hypothesised that there is likely a significant recruitment pool available to recruit and aid in the recovery of the bass rock population. It is also reasonable to assume that the regional recruitment pool has remained relatively healthy and of a significant size, based on information suggesting younger age classes suffered far less from HPAI than adults (Camphuysen *et al.*, 2023).

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Table 7-81 In-Combination Predicted Collision Mortality Apportioned to Forth Islands SPA Gannet Feature

Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate	Macro avoidance applied
	Breeding	Post-breeding migration	Return migration	Annual						
Beatrice	-	2.5	0.6	3.1	1	*	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Beatrice Demonstrator	0.0	0.0	0.0	0.1	1	**	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Blyth Demonstration Site	0.0	0.1	0.2	0.3	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Dudgeon	0.0	2.0	1.3	3.2	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
East Anglia One	0.0	6.7	0.4	7.1	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
EOWDC	-	0.3	0.0	0.3	1	*	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Galloper	0.0	1.6	0.8	2.4	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Greater Gabbard	0.0	0.4	0.3	0.8	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Gunfleet Sands	-	-	-	-	1	**	Deterministic	N/A	0.9923	Yes – 70% all seasons
Hornsea Project One	0.0	1.6	1.5	3.1	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Humber Gateway	0.0	0.1	0.1	0.2	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Hywind Scotland Pilot Park	-	0.0	0.1	0.1	1	*	Deterministic	0.989	0.9923	Yes – 70% all seasons
Kentish Flats	0.0	0.0	0.1	0.1	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Kentish Flats Extension	-	-	-	-	1	**	Deterministic	N/A	0.9923	Yes – 70% all seasons
Kincardine	-	0.0	0.0	0.0	1	*	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Lincs, Lynn & Inner Dowsing	0.0	0.1	0.1	0.2	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
London Array	0.0	0.1	0.1	0.2	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Methil	-	0.0	0.0	0.0	1	**	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Race Bank	0.0	0.6	0.3	0.9	1	**	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Rampion	0.0	3.2	0.1	3.4	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Scroby Sands	-	-	-	-	1	**	Deterministic	N/A	0.9923	Yes – 70% all seasons

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Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate	Macro avoidance applied
	Breeding	Post-breeding migration	Return migration	Annual						
Sheringham Shoal	0.0	0.2	0.0	0.2	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Teesside	-	0.1	0.0	0.1	1	*	Deterministic	0.989	0.9923	Yes – 70% all seasons
Thanet	0.0	0.0	0.0	0.0	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Westermost Rough	0.0	0.0	0.0	0.0	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Hornsea Project Two	0.0	0.7	0.4	1.1	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Moray East	-	1.8	0.6	2.4	1	*	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Triton Knoll	0.0	3.3	2.0	5.3	1	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Neart na Gaoithe	62.3	0.4	0.5	63.1	2	***	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
DBC and Sofia	-	0.5	0.7	1.2	2	*	Deterministic	0.989	0.9923	Yes – 70% all seasons
Seagreen (Phase 1 and 1A)	204.7	0.7	0.5	205.9	2	***	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Moray West	-	0.1	0.1	0.2	2	**	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Dogger Bank A and B	-	4.3	3.6	7.8	3	*	Deterministic	0.989	0.9923	Yes – 70% all seasons
East Anglia Three	0.0	1.7	0.6	2.3	3	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Hornsea Three	0.0	0.3	0.3	0.5	3	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Inch Cape	75.4	0.3	0.3	75.9	3	***	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
East Anglia ONE North	0.0	0.6	0.1	0.6	3	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
East Anglia TWO	0.0	1.2	0.3	1.4	3	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Norfolk Boreas	0.0	0.6	0.3	0.9	3	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Norfolk Vanguard	0.0	0.9	0.3	1.3	3	**	Deterministic	0.989	0.9923	Yes – 70% all seasons
Hornsea Four	0.0	0.3	0.1	0.4	3	**	Stochastic	0.989	0.9929	No - 70% all seasons already included
Pentland Floating OWF	0.1	0.0	0.0	0.0	3	Xodus Group Ltd (2022)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season

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Project	Apportioned predicted collision mortality (breeding adults)				Tier	Source	Modelling approach	Original avoidance rate	Updated avoidance rate	Macro avoidance applied
	Breeding	Post-breeding migration	Return migration	Annual						
Green Volt	4.9	0.0	0.3	5.3	3	APEM (2023)	Stochastic	0.993	0.9929	Yes – 70% non-breeding season
ForthWind Offshore Wind Demonstration Project - phase 1	-	-	-	-	3	ForthWind (2022)	Deterministic	0.98	0.9923	Yes – 70% non-breeding season
DEP and SEP	0.0	0.2	0.0	0.2	3	**	Deterministic	0.992	0.9923	Yes – 70% all seasons
Total consented	347.5	37.4	16.8	401.5						
Rampion 2	-	-	-	-	4	GoBe (2023)	Stochastic	0.993	0.9929	No - 70% all seasons already included
Berwick Bank	102.8	0.7	0.2	103.6	4	Royal HaskoningDHV (2022)	Deterministic	0.989	0.9923	Yes – 70% non-breeding season
Salamander	0.2	0.2	0.4	0.6	4	NIRAS Group (UK) Ltd (2024)	Stochastic	0.993	0.9929	Yes – 70% non-breeding season
Ossian	19.9	0.3	0.0	20.2	4	NIRAS & RPS (2024)	Stochastic	0.993	0.9929	Yes – 70% non-breeding season
North Falls	0.0	0.2	0.2	0.5	4	Royal HaskoningDHV (2024c)	Stochastic	0.993	0.9929	No - 70% all seasons already included
Dogger Bank South	0.0	0.9	0.1	1.0	4	Royal HaskoningDHV (2024d)	Stochastic	0.998	0.9929	No - 70% all seasons already included
West of Orkney	0.0	0.6	0.2	0.8	4	MacArthur Green (2024)	Stochastic	0.9928	0.9929	Yes – 70% non-breeding season
Outer Dowsing	0.0	0.1	0.0	0.1	4	GoBe (2024b)	Stochastic	0.993	0.9929	No - 70% all seasons already included
Five Estuaries	-	-	-	0.0	4	GoBe (2024a)	Stochastic	0.9979	0.9929	No – already incorporated within the avoidance rate
Dogger Bank D	0.0	0.8	0.2	1.0	4	-	Stochastic	0.9929	0.9929	No - 70% all seasons already included
Total all projects	470.3	41.2	18.1	529.2						

*Table note 1: Breeding Season value: Inch Cape Offshore Limited (2018). HRA Report - Diadromous Fish, Marine Mammals and Ornithology. Marine Scotland suggested only qualitative included needed for Inch Cape OWF, for which the Project concluded project is unlikely to materially contribute. Non-breeding Season: Standard Furness (2015) Biologically Defined Minimum Population Scales (BDMPS) apportioning rates applied.

**Table note 2: Breeding season: No connectivity expected. Non-breeding season: Standard Furness (2015) BDMPS apportioning rates applied to EIA values.

***Table note 3: Breeding Season: Apportioning rate advocated by Marine Scotland as part of the Neart na Gaoithe Offshore Windfarm (Revised Design) Application, available online: <https://marine.gov.scot/data/neart-na-gaoithe-offshore-windfarm-revised-design-information-inform-appropriate-assessment>, have been applied to the latest approved design variation. Non-breeding Season: Standard Furness (2015) BDMPS apportioning rates applied.

Table 7-82 Forth Islands SPA Gannet Feature In-Combination Predicted Collision Mortality and Increase in Baseline Mortality

Population size (breeding adults)	Bio-season	Projects included	Mean collisions (breeding adults per annum)	Increase in baseline mortality (%)
Citation (43,200)	Breeding (March - September)	DBD plus all consented	347.5	9.931
		All projects	470.3	13.440
	Return migration (December - February)	DBD plus all consented	38.2	1.092
		All projects	41.2	1.176
	Post-breeding migration (October - November)	DBD plus all consented	17.0	0.485
		All projects	18.1	0.516
	Annual	DBD plus all consented	402.5	11.504
		All projects	529.2	15.123
Latest count (103,688)	Breeding (March - September)	DBD plus all consented	347.5	4.138
		All projects	470.3	5.600
	Return migration (December - February)	DBD plus all consented	38.2	0.455
		All projects	41.2	0.490
	Post-breeding migration (October - November)	DBD plus all consented	17.0	0.202
		All projects	18.1	0.215
	Annual	DBD plus all consented	402.5	4.793
		All projects	529.2	6.301

1465. Although no count of Bass Rock is currently available for 2024, counts for other gannetries significantly impacted by HPAI have reported significant increases in numbers for example, the Grassholm SPA and other Northeast Scottish (Fair Isle and Noss SPA) populations have increased by 7.5% to 16.5% post HPAI (SMP, 2024) suggesting a strong recovery and a healthy recruitment pool. The colony is therefore, expected to have shown significant, if not full recovery by the point of which the Project would be operational and be contributing to any in-combination effect.

1466. The increase in baseline mortality for the Project in-combination is over 1% when taking into account the precaution within the assessment, however, the gannet feature is considered resilient enough to withstand the potential in-combination impact predicted, based on the above information. Such a conclusion is bolstered by the PVA recently completed by Ossian (NIRAS & RPS, 2024), the results of which predicted a reduction in the population growth rate of 0.40% for an in-combination collision impact of 575 breeding adult mortalities per annum. Such a reduction in annual growth rate per annum is unlikely to compromise the growth of the colony when compared to the known historical growth trends of the feature (Table 7-72).

1467. In light of the above information, the potential for an **AEol in-combination due to collision risk can confidently be ruled out** for the gannet feature of Forth Islands SPA. Subject to natural change, gannet will be maintained as a feature in the long-term.

7.9.3.2.2 Direct Disturbance and Displacement Due to Presence of Wind Turbines and Other Offshore Infrastructure

7.9.3.2.2.1 Puffin

1468. For the Project alone impact, the increase in baseline mortality is predicted to be significantly less than 0.1% per annum. Such a level of effect alone would certainly be indistinguishable from natural fluctuations in the populations and is unlikely to materially contribute to any in-combination effect, especially given connectivity is temporally restricted to the non-breeding bio-season. Therefore, the potential for an **AEol in-combination due to disturbance and displacement can confidently be ruled out** for the puffin feature of the Forth Islands SPA. Subject to natural change, puffin will be maintained as a feature in the long-.

7.9.3.2.2.2 Gannet

1469. The projects identified for in-combination displacement effects for the gannet feature of Forth Islands SPA and details on the reference sources are provided in **Table 7-83**.

1470. The predicted in-combination mortality is provided in **Table 7-84** and an annual displacement matrix for all projects annually is presented in **Table 7-85**.

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Table 7-83 In-Combination Mean Peak Abundance Apportioned to Forth Islands SPA Gannet Feature

Project	Apportioned mean peak abundance				Tier	Source
	Breeding	Post-breeding migration	Non-breeding	Annual		
Beatrice	-	0	0	0	1	*
Beatrice Demonstrator	-	-	-	-	1	**
Blyth Demonstration Site	-	-	-	-	1	**
Dudgeon	0	6	3	10	1	**
East Anglia One	0	885	24	909	1	**
EOWDC	-	1	0	1	1	*
Galloper	0	221	86	307	1	**
Greater Gabbard	0	17	33	50	1	**
Gunfleet Sands	-	3	3	6	1	**
Hornsea Project One	0	169	78	247	1	**
Humber Gateway	0	0	0	0	1	**
Hywind Scotland Pilot Park	-	0	1	1	1	*
Kentish Flats	0	0	0	0	1	**
Kentish Flats Extension	0	3	0	3	1	**
Kincardine	-	0	0	0	1	*
Lincs, Lynn & Inner Dowsing	-	-	-	-	1	**
London Array	-	-	-	-	1	**
Methil	-	0	0	0	1	*
Race Bank	0	8	9	17	1	**
Rampion	0	143	0	143	1	**
Scroby Sands	-	0	0	0	1	**
Sheringham Shoal	0	8	1	8	1	**

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Project	Apportioned mean peak abundance				Tier	Source
	Breeding	Post-breeding migration	Non-breeding	Annual		
Teesside	-	0	0	0	1	*
Thanet	-	-	-	-	1	**
Westermost Rough	-	-	-	-	1	**
Hornsea Project Two	0	277	39	316	1	**
Moray East	-	71	8	79	1	*
Neart na Gaoithe	1,986	134	88	2,208	2	***
DBC and Sofia	0	216	145	361	2	*
Seagreen (Phase 1 and 1A)	2,923	161	104	3,188	2	***
Moray West	-	107	45	152	2	*
Triton Knoll	-	4	8	11	1	**
Dogger Bank A and B	0	498	123	621	3	*
East Anglia Three	0	309	164	472	3	**
Hornsea Three	-	239	164	403	3	**
Inch Cape	2,392	171	66	2,629	3	***
Norfolk Vanguard	-	107	45	152	3	**
Norfolk Boreas	0	597	137	733	3	**
East Anglia ONE North	0	419	164	584	3	**
East Anglia TWO	0	114	14	128	3	**
Hornsea Four	0	217	60	277	3	**
ForthWind Offshore Wind Demonstration Project - phase 1	0	192	125	318	3	ForthWind (2022)
Pentland Floating OWF	-	-	-	-	3	Xodus Group Ltd (2022)
Green Volt	16	0	0	16	3	APEM (2023)

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Project	Apportioned mean peak abundance				Tier	Source
	Breeding	Post-breeding migration	Non-breeding	Annual		
Sheringham Shoal Extension	41	4	22	67	3	Royal HaskoningDHV (2024c)
Dudgeon Extension	0	72	3	75		Royal HaskoningDHV (2024c)
Consented projects	7,357	5,371	1,763	14,491		
Berwick Bank	4,097	267	88	4,452	4	Royal HaskoningDHV (2022)
West of Orkney	0	44	333	377	4	MacArthur Green (2024)
Salamander	12	115	-	128	4	NIRAS Group (UK) Ltd (2024)
Ossian	979	188	13	1,181	4	NIRAS & RPS (2024)
Outer Dowsing	0	120	22	142	4	GoBe (2024b)
Rampion 2	-	-	-	-	4	GoBe (2023)
North Falls	0	70	91	160	4	Royal HaskoningDHV (2024c)
Dogger Bank South	0	382	51	433	4	Royal HaskoningDHV (2024d)
Five Estuaries	-	-	-	-	4	GoBe (2024a)
Dogger Bank D	0	198	27	224	4	
All projects	12,445	6,756	2,386	21,588		

Table note 1: * Breeding Season: Inch Cape Offshore Limited (2018). HRA Report - Diadromous Fish, Marine Mammals and Ornithology. Marine Scotland suggested only qualitative included needed for Inch Cape OWF, for which the Project concluded project is unlikely to materially contribute. Non-breeding Season: Standard Furness (2015) BDMPS apportioning rates applied.

Table note 2: **Breeding season: No connectivity expected. Non-breeding seasons: Standard Furness (2015) BDMPS apportioning rates applied to EIA values.

Table note 3: *** Breeding Season: Apportioning rate advocated by Marine Scotland as part of the Neart na Gaoithe Offshore Windfarm (Revised Design) Application, available online: <https://marine.gov.scot/data/neart-na-gaoithe-offshore-windfarm-revised-design-information-inform-appropriate-assessment>, have been applied to the latest approved design variation. Non-breeding Season: Standard Furness (2015) BDMPS apportioning rates applied.

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Table 7-84 Forth Islands SPA Gannet Feature In-Combination Predicted Displacement Mortality and Increase in Baseline Mortality

Population size (breeding adults)	Bio-season	Projects included	Applicant's approach (60% – 80% Disp; 1% Mort)		SNCB approach (60% – 80% Disp; 1% - 10% Mort)	
			Displacement mortality (breeding adults)	Increase in baseline mortality (%)	Displacement mortality (breeding adults)	Increase in baseline mortality (%)
Citation (43,200)	Breeding (March – September)	DBD plus all consented	44.1 – 58.9	1.262 – 1.682	44.1 – 588.6	1.262 – 16.821
		All projects	74.7 – 99.6	2.134 - 2.845	74.7 – 995.6	2.134 - 28.453
	Return migration (December – February)	DBD plus all consented	10.7 - 14.3	0.307 – 0.409	10.7 - 143.1	0.307 - 4.091
		All projects	14.3 - 19.1	0.409 - 0.546	14.3 - 190.9	0.409 - 5.456
	Post-breeding migration (October – November)	DBD plus all consented	33.4 – 44.5	0.955 – 1.273	33.4 – 445.5	0.955 - 12.731
		All projects	40.5 - 54.0	1.158 - 1.545	40.5 - 540.5	1.158 - 15.445
	Annual	DBD plus all consented	88.3 – 117.7	2.523 – 3.364	88.3 – 1,177.2	2.523 - 33.642
		All projects	129.5 – 172.7	3.702 - 4.935	129.5 – 1,727.0	3.702 - 49.354
Latest count (103,688)	Breeding (March – September)	DBD plus all consented	44.1 – 58.9	0.526 - 0.701	44.1 – 588.6	0.526 - 7.008
		All projects	74.7 – 99.6	0.889 - 1.185	74.7 – 995.6	0.889 - 11.855
	Return migration (December – February)	DBD plus all consented	10.7 - 14.3	0.128 - 0.170	10.7 - 143.1	0.128 - 1.704
		All projects	14.3 - 19.1	0.170 - 0.227	14.3 - 190.9	0.170 - 2.273
	Post-breeding migration (October – November)	DBD plus all consented	33.4 – 44.5	0.398 - 0.530	33.4 – 445.5	0.398 - 5.304
		All projects	40.5 - 54.0	0.483 - 0.644	40.5 - 540.5	4.826 - 6.435
	Annual	DBD plus all consented	88.3 – 117.7	1.051 - 1.402	88.3 – 1,177.2	1.051 - 14.017
		All projects	129.5 – 172.7	1.542 - 2.056	129.5 – 1,727.0	1.542 - 20.563

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Table 7-85 Gannet Operation and Maintenance Phase In-Combination Annual Displacement Matrix for Impacts Apportioned to Forth Islands SPA

Gannet annual displacement matrix (based on 21,558 breeding adults apportioned to the Forth Islands SPA)																
Displacement (%)	Mortality (%)															
	0	1	2	3	4	5	10	20	30	40	50	60	70	80	90	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	2	4	6	9	11	22	43	65	86	108	129	151	172	194	216
10	0	22	43	65	86	108	216	431	647	862	1,078	1,293	1,509	1,725	1,940	2,156
20	0	43	86	129	172	216	431	862	1,293	1,725	2,156	2,587	3,018	3,449	3,880	4,312
30	0	65	129	194	259	323	647	1,293	1,940	2,587	3,234	3,880	4,527	5,174	5,821	6,467
40	0	86	172	259	345	431	862	1,725	2,587	3,449	4,312	5,174	6,036	6,899	7,761	8,623
50	0	108	216	323	431	539	1,078	2,156	3,234	4,312	5,390	6,467	7,545	8,623	9,701	10,779
60	0	129	259	388	517	647	1,293	2,587	3,880	5,174	6,467	7,761	9,054	10,348	11,641	12,935
70	0	151	302	453	604	755	1,509	3,018	4,527	6,036	7,545	9,054	10,563	12,072	13,582	15,091
80	0	172	345	517	690	862	1,725	3,449	5,174	6,899	8,623	10,348	12,072	13,797	15,522	17,246
90	0	194	388	582	776	970	1,940	3,880	5,821	7,761	9,701	11,641	13,582	15,522	17,462	19,402
100	0	216	431	647	862	1,078	2,156	4,312	6,467	8,623	10,779	12,935	15,091	17,246	19,402	21,558
			>1% increase in baseline mortality rate against latest count						>1% increase in baseline mortality rate against citation population							

7.9.3.2.2.1 Breeding Bio-season

1471. No impacts have been apportioned to the gannet feature of Forth Islands SPA during the breeding bio-season for the Project alone, therefore the Project does not contribute to an in-combination effect during the breeding bio-season.

7.9.3.2.2.2 Return Migration Bio-season

1472. The predicted in-combination breeding adult mortalities for all projects attributed to Forth Islands SPA during the return migration bio-season is 14 to 19 (14.3 – 19.1) breeding adults when considering the Applicant's preferred approach. This would result in an increase in baseline mortality of 0.170% to 0.227% (**Table 7-84**) against the latest population count (**Table 7-11**).

7.9.3.2.2.3 Post-breeding Migration Bio-season

1473. The predicted in-combination breeding adult mortalities for all projects attributed to Forth Islands SPA during the post-breeding migration bio-season is 41 to 54 (40.5 – 54.0) breeding adults when considering the Applicant's preferred approach. This would result in an increase in baseline mortality of 0.483% to 0.644% (**Table 7-84**) against the latest population count (**Table 7-11**).

7.9.3.2.2.4 Annual Total

1474. For the Applicant's preferred approach, the predicted resultant mortality across all defined bio-seasons from all projects in-combination, attributed to Forth Islands SPA, is 130 to 173 (129.5 – 172.7) breeding adult gannets. This would result in an increase in baseline mortality of 1.542% to 2.056% (**Table 7-84**) against the latest population count (**Table 7-11**).
1475. When considering the SNCB approach, the predicted resultant mortality across all defined bio-seasons from all projects in-combination, attributed to Forth Islands SPA is 130 to 1,727 (129.5 – 1,727.0) breeding adult gannets. This would result in an increase in baseline mortality of 1.542% to 20.563% (**Table 7-84**) against the latest population count (**Table 7-11**).
1476. As previously noted in **Section 7.9.3.2.1**, the gannet population at Forth Islands SPA is in favourable condition, and therefore expected to be resilient enough to withstand the level of impact predicted for the Applicant's approach and lower SNCB range, without compromising on the feature integrity. Such a conclusion is bolstered by the PVA recently completed by Ossian (NIRAS & RPS, 2024), the results of which predicted a reduction in the population growth rate of 0.10% for an in-combination displacement impact of 154 breeding adult mortalities per annum. Such a reduction in annual growth rate per annum is unlikely to compromise the growth of the colony when compared to the known historical growth trends of the feature (**Table 7-72**).

1477. When considering the SNCB upper range approach of an 80% displacement rate and a 10% mortality rate, the predicted increase in baseline mortality at the SNCB upper range of 20.563% is likely to negatively affect the integrity of the feature. However, based on expert judgement and factoring in the ecology of the species, a 10% mortality rate for all OWFs is concluded as wholly unrealistic (**Section 7.4.5.4**).

1478. Taking into account the above information, the potential for an **AEol in-combination due to displacement can confidently be ruled out** for the gannet feature of Forth Islands SPA. Subject to natural change, gannet will be maintained as a feature in the long-term.

7.9.3.2.3 Combined Operational Phase Collision and Displacement Effects

7.9.3.2.3.1 Gannet

1479. When considering the Applicant's approach, the consequent potential mortality for breeding adult gannets from Forth Islands SPA annually is predicted at approximately 659 to 702 (658.7 – 701.9) breeding adults per annum. This would result in an increase in the baseline mortality of 7.843% to 8.357% (**Table 7-86**) against the latest population count (**Table 7-68**).
1480. When considering the SNCB approach the consequent potential mortality for breeding adult gannets from Forth Islands SPA annually is predicted at 659 to 2,256 (660.4 – 2,266.2) breeding adults per annum. This would result in an increase in the baseline mortality of 7.843% to 26.864% (**Table 7-86**) against the latest population count (**Table 7-68**).
1481. As previously noted in **Section 7.9.3.2.1**, the gannet population at Forth Islands SPA is in favourable condition, and therefore expected to be resilient enough to withstand the level of impact predicted for the Applicant's approach and SNCB lower range, without compromising on the integrity of the feature. Such a conclusion is supported by the PVA recently completed by Ossian (NIRAS & RPS, 2024), the results of which predicted a reduction in the population growth rate of 0.50% to 0.70% for combined in-combination displacement and collision impacts of 697 to 851 breeding adult mortalities per annum. Such a reduction in annual growth rate per annum is unlikely to compromise the growth of the colony when compared to the known historical growth trends of the feature (**Table 7-72**).
1482. When considering the SNCB upper range approach which is based on an 80% displacement rate and a 10% mortality rate, the predicted increase in baseline mortality at the SNCB upper range of 26.864% is likely to negatively affect the integrity of the feature. However, based on expert judgement and factoring in the ecology of the species, a 10% mortality rate for all OWFs is concluded as wholly unrealistic (**Section 7.4.5.4**).

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Table 7-86 Forth Islands SPA Gannet Feature In-Combination Predicted Combined Collision and Displacement Mortality and Increase in Baseline Mortality

Population size (breeding adults)	Bio-season	Project included	Applicant's approach (60% – 80% Disp; 1% Mort)		SNCB approach (60% – 80% Disp; 1% – 10% Mort)	
			Displacement mortality (breeding adults)	Increase in baseline mortality (%)	Displacement mortality (breeding adults)	Increase in baseline mortality (%)
Citation (43,200)	Breeding (March – September)	DBD plus all consented	391.6 – 406.4	11.192 - 11.613	391.6 – 936.1	11.192 – 26.752
		All projects	545.0 – 569.9	15.574 - 16.285	545.0 – 1,465.9	15.574 – 41.892
	Return migration (December – February)	DBD plus all consented	27.7 – 31.3	0.792 – 0.894	27.7 – 160.1	0.792 - 4.576
		All projects	32.4 - 37.2	0.925 - 1.062	32.4 - 209.0	0.925 - 5.972
	Post-breeding migration (October – November)	DBD plus all consented	71.6 – 82.8	2.047 – 2.365	71.6 - 483.7	2.047 - 13.823
		All projects	81.7 - 95.2	2.334 - 2.721	81.7 - 581.6	2.334 - 16.622
	Annual	DBD plus all consented	490.8 – 520.2	14.026 - 14.867	490.8 – 1,579.7	14.026 - 45.145
		All projects	658.7 – 701.9	18.825 - 20.059	658.7 – 2,256.2	18.825 - 64.478
Latest count (103,688)	Breeding (March – September)	DBD plus all consented	391.6 – 406.4	4.663 - 4.838	391.6 – 936.1	4.663 - 11.146
		All projects	545.0 – 569.9	6.489 - 6.785	545.0 – 1,465.9	6.489 - 17.454
	Return migration (December – February)	DBD plus all consented	27.7 – 31.3	0.330 - 0.372	27.7 – 160.1	0.330 – 1.906
		All projects	32.4 - 37.2	0.386 - 0.442	32.4 - 209.0	0.386 - 2.488
	Post-breeding migration (October – November)	DBD plus all consented	71.6 – 82.8	0.853 - 0.985	71.6 - 483.7	0.853 - 5.759
		All projects	81.7 - 95.2	0.973 - 1.134	81.7 - 581.6	0.973 - 6.925
	Annual	DBD plus all consented	490.8 – 520.2	5.844 - 6.194	490.8 – 1,579.7	5.844 - 18.809
		All projects	658.7 – 701.9	7.843 - 8.357	658.7 – 2,256.2	7.843 - 26.864

1483. Taking into account the above information, the potential for an **AEol in-combination due to combined displacement and collision can confidently be ruled out** for the gannet feature of Forth Islands SPA. Subject to natural change, gannet will be maintained as a feature in the long-term.

7.9.4 Summary of Potential Effects on Site Integrity

7.9.4.1 Construction

- 7.9.4.1.1 Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

1484. There is **no potential for AEol** for any of the qualifying features of Forth Islands SPA assessed for displacement during the construction phase.

7.9.4.2 Operation and Maintenance

- 7.9.4.2.1 Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure (Dogger Bank D Array Area)

1485. There is **no potential for AEol** for any of the qualifying features of Forth Islands SPA assessed for displacement during the operation and maintenance phase.

- 7.9.4.2.2 Collision Risk with Wind Turbine Blades

1486. There is **no potential for AEol** for any of the qualifying features of Forth Islands SPA assessed for collision risk during the operation and maintenance phase.

- 7.9.4.2.3 Combined Operational Phase Collision and Displacement Effects

1487. There is **no potential for AEol** for the gannet feature of Forth Islands SPA assessed for combined collision and displacement during the operation and maintenance phase.

- 7.9.4.2.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

1488. There is **no potential for AEol** for the gannet feature of Forth Islands SPA assessed for in-combination effects.

7.9.4.3 Decommissioning

1489. The summary of AEol for the decommissioning phase is the same as those stated within the construction phase conclusions above.

7.10 Seabird Assemblage

1490. The SPAs for which seabird assemblage was screened in for assessment during the operation and maintenance phase of the Project are as follows:

- FFC SPA;
- Farne Islands SPA; and
- Coquet Island SPA.

1491. Species-specific assessments were carried out for all named components of the seabird assemblages as detailed above, for all components where it was concluded that there was potential for LSE from the Project. The conclusions of these assessments were that for all components (qualifying features and named components) of the seabird assemblages considered, an AEol could confidently be ruled out. Therefore, with regard to the conservation objectives of the seabird assemblages screened in for assessment in relation to operation and maintenance phase impacts from the Project alone, the potential for an **AEol can also be ruled out**, subject to natural change, the seabird assemblage population will be maintained as a feature in the long term.

7.11 Indirect Effects via Habitat or Prey Availability

1492. Impacts from the production of suspended sediments may alter the distribution, physiology and behaviour of prey species and their associated habitats. These mechanisms could potentially result in reduced prey availability in seabird foraging areas adjacent to operational wind farm sites. This may result in disturbance and displacement effects by effectively reducing the available habitat for foraging and other activities. Any form of indirect effect (including reductions in prey and habitat availability) may cause reduced survival or reproductive fitness of the species deemed at risk. The maximum impact on ornithological receptors would result from the maximum impact on fish and benthic organisms.

1493. Potential indirect impacts may occur during the construction, operational and decommissioning phase of the Project. These impacts are likely to occur within or immediately adjacent to the Project Array Area, ECC and areas of intertidal landfall through effects on benthic habitat and prey species. Such potential effects on benthic invertebrates and fish have been assessed at an EIA level within **PEIR Volume 1, Chapter 10: Benthic and Intertidal Ecology** and **PEIR Volume 1, Chapter 11: Fish and Shellfish Ecology**. The conclusions of those assessments inform this assessment of indirect effects on ornithology receptors.

1494. Regarding changes to the seabed and to suspended sediment levels, **PEIR Volume 1, Chapter 8 Marine and Physical Processes, PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality and PEIR Volume 1, Chapter 10 Benthic and Intertidal Ecology** discusses the nature of any change and impacts on the seabed and benthic habitats. Impacts that have been assessed are considered to have no potential for AEol to any designated site. The consequent indirect impact on fish through habitat loss is considered to be low at most (see **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**) from an EIA perspective and **no potential for an AEol with respect to fish species from designated sites assessed** (see **Section 7**) for species such as herring, sprat and sandeels, which are the main prey items of seabirds such as gannet and auks. With a low impact on fish that are seabird prey species, it is concluded that the there is **no potential for an AEol with respect to changes in prey availability** for any designated sites and ornithology features screened in for assessment.

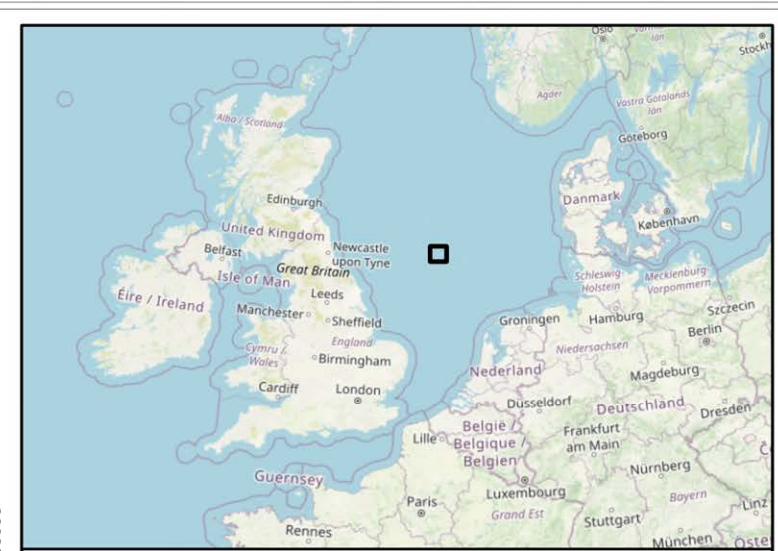
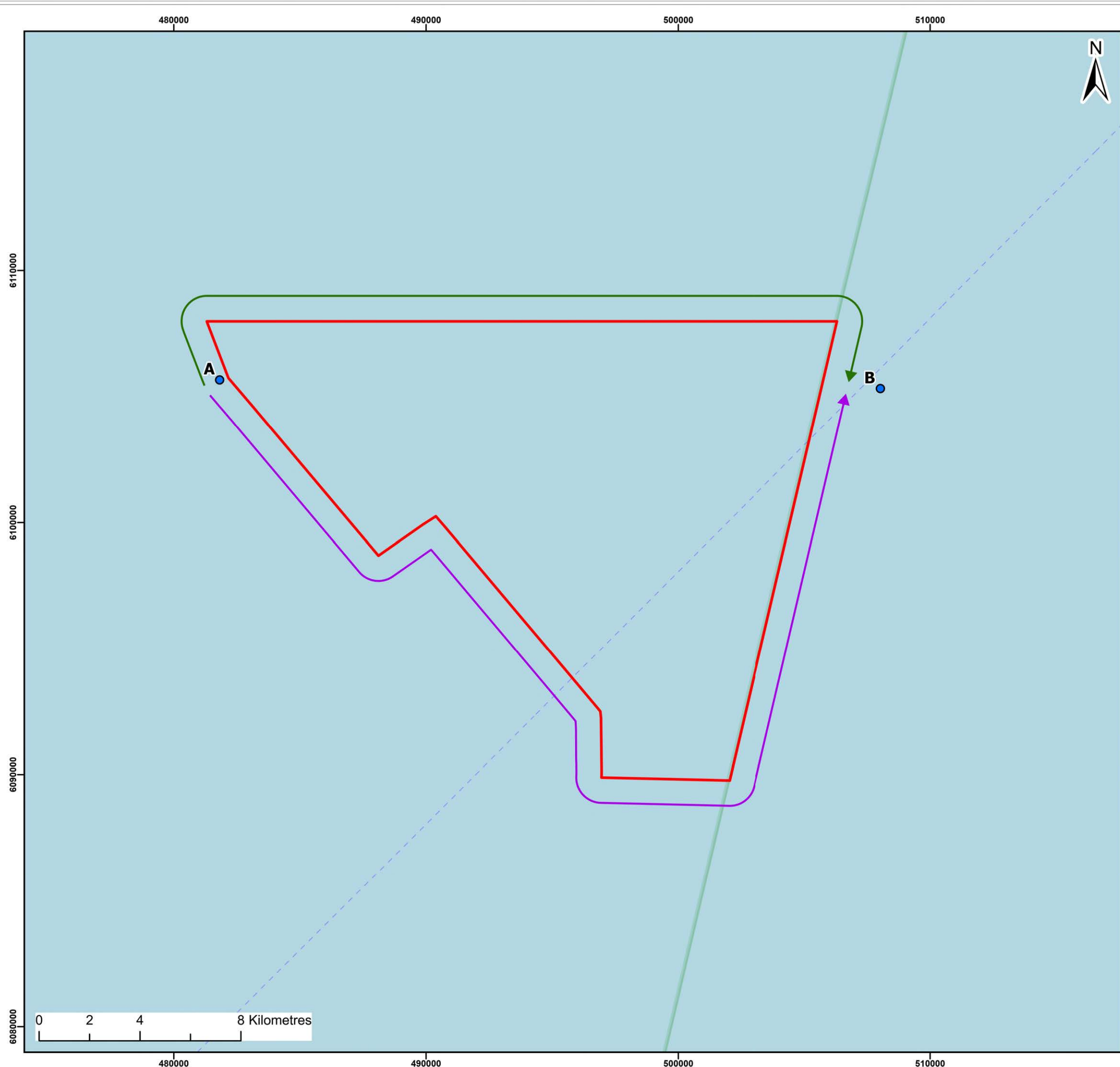
7.12 Barrier Effects

1495. The presence of wind turbines could create a barrier to the movements of seabirds during the operational phase of the Project. This may result in permanent changes in flight routes for the seabirds concerned and potentially an increase in energy demands associated with those movements. This might result in a lower rate of breeding success or in reduced survival chances for individuals affected, with the potential to cause population level effects.
1496. Ecological theory suggests that central place foraging seabirds take the shortest (energetically most efficient) route to and from known areas that provide good foraging resources. These routes would, if the location of food resources is known, result in straight-out-and-back flights from the breeding cliffs to known foraging areas. For the Project to create a barrier to such flights then it would need to be sited across such flight lines and the bird species concerned would have to be known, or suspected, not to enter an operational OWF (i.e. exhibit a high degree of avoidance). Given the location of the Project and its distance offshore only those seabirds with the largest known foraging ranges would potentially encounter the DBD Array Area once operational.
1497. The initial process for the purpose of assessing a potential barrier effect identified fulmar (*Fulmarus glacialis*), gannet and kittiwake as having the potential to forage on a regular basis out to a distance as far as, or further than the DBD Array Area based on the species foraging ranges (Woodward *et al.*, 2019). **Table 7-87** details the SPAs considered for the species of interest.

Table 7-87 SPAs Considered for Potential Barrier Effect Assessment, the Qualifying Features and Distance to the Project Array Area

SPA	Species	Distance from DBD Array Area (nearest point)
FFC	Fulmar	210.6km
	Gannet	
	Kittiwake	
Forth Islands	Gannet	353.4km
Farne Islands	Kittiwake	278.9km

1498. The potential for the Project’s operational wind turbines to create a barrier to the movement of seabirds can be informed by knowledge of the existing routes that seabirds take between breeding sites and offshore foraging areas. Data of seabird foraging routes from SPA colonies during the breeding season available online at the Seabird Tracking Database (Seabird Tracking Database, 2023) were examined against the DBD Array Area to identify potential connectivity between the sites.
1499. In addition, the energetic costs associated with a potential barrier effect can be considered in order to conclude no **AEol** from barrier effects. The width of the Project Array Area at the widest point (W – E) is 23.62km as depicted by the ‘point A’ to ‘point B’ on **Figure 7-11**. When a 2km buffer is attached to the DBD Array Area the redirected route would equal 49.51km anticlockwise or 36.00km clockwise around the DBD Array Area plus 2km buffer (**Figure 7-12**). These redirected routes would have a difference from the original direct distance through the DBD Array Area (23.62km) of 25.89km and 12.38km, depending on the direction of travel. These differences in journey length can be compared against various foraging ranges for the species (Woodward *et al.*, 2019) to calculate percentage change and form a narrative on energetic costs associated with a longer journey.
1500. Using existing foraging tracking data and the consideration of energetic costs from a potential barrier effect, a qualitative evaluation has been made of the likelihood that the Project would create a significant barrier to known movements for each species.

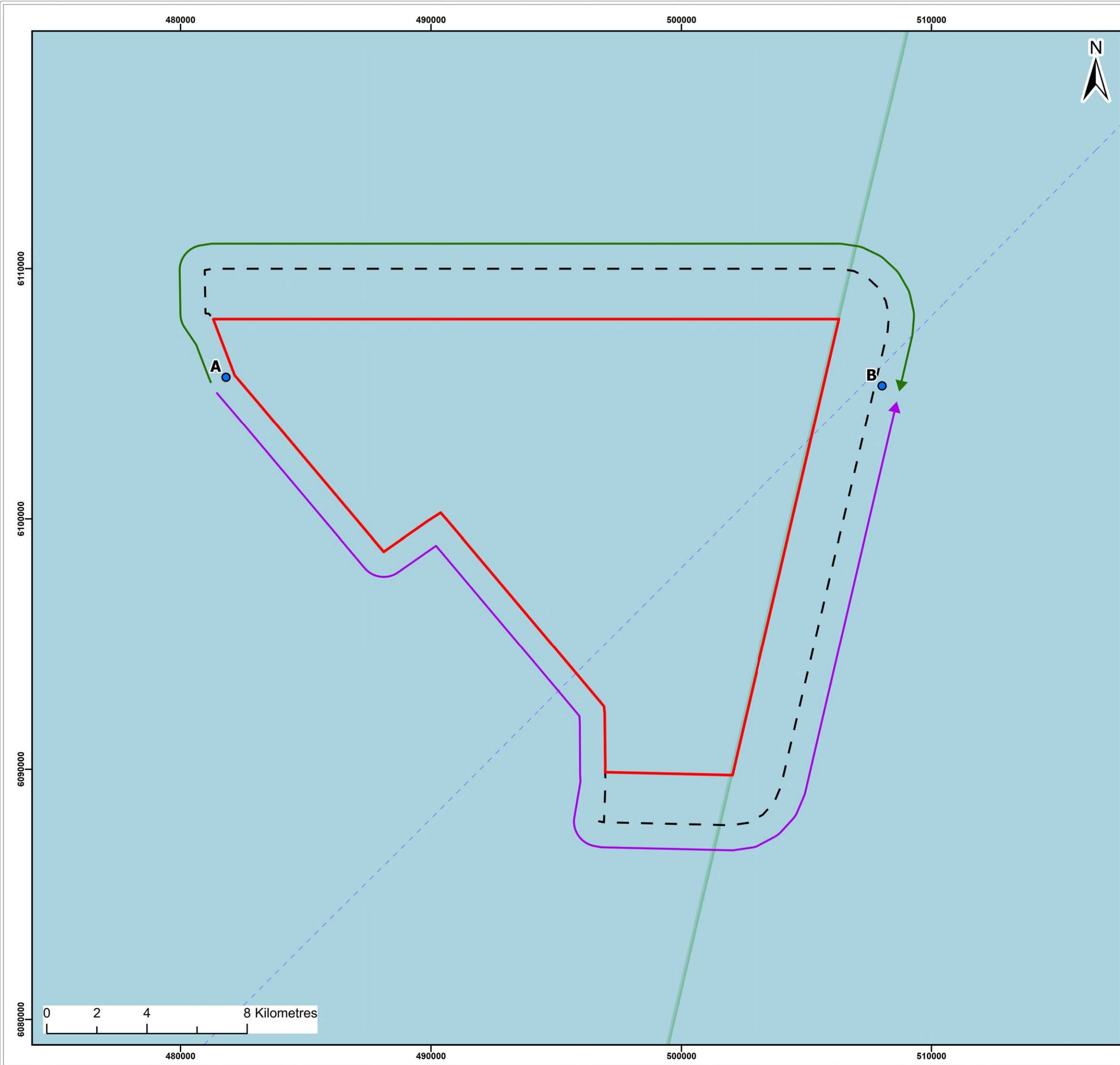


Legend:

- Dogger Bank D Array Area
- Barrier Effect Points
- Clockwise Flight Route
- Anti-clockwise Flight Route

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Project:		<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">Dogger Bank D Offshore Wind Farm</div> <div style="font-size: 24px; font-weight: bold; color: #00728f;">DOGGER BANK</div> <div style="font-size: 24px; font-weight: bold; color: #00a68a;">WIND FARM</div> </div>			
Title:					
Barrier Effect around the Array Area					
Figure: 7-11		Drawing No: PC6250-RHD-XX-ON-DR-GS-0591			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	27/03/2025	AB	PT	A3	1:150,000
Co-ordinate system: WGS 1984 UTM Zone 31N					
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> </div> <div style="text-align: center;"> </div> </div>					



Legend:

- Dogger Bank D Array Area
- Dogger Bank D plus 2 km Asymmetric Buffer
- Barrier Effect Points
- ➔ Clockwise Flight Route
- ➔ Anti-clockwise Flight Route

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Project:

Dogger Bank D
Offshore Wind Farm

Title:

Barrier Effect around the Array Area plus 2km Buffer

Figure:	7-12	Drawing No:	PC6250-RHD-XX-ON-DR-GS-0592			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:	
01	27/03/2025	AB	PT	A3	1:150,000	

Co-ordinate system: WGS 1984 UTM Zone 31N

7.12.1 Fulmar

1501. Fulmars are considered to have a very low sensitivity to displacement as well as exhibiting weak avoidance behaviour to OWFs (Bradbury *et al.*, 2014; Dierschke *et al.*, 2016; Furness *et al.*, 2013), however, limited evidence of fulmar presence within OWF areas may suggest that fulmars do exhibit avoidance behaviour (Dierschke *et al.*, 2018). The reduced presence of fulmars within OWF sites could also relate to a lack of fishing activity within the area, as this species is known to utilise fishery discards. This was considered within work conducted at the BARD OWF, located within German waters, where avoidance of the OWF by fulmars was observed (Neumann *et al.*, 2013; Braasch *et al.*, 2015). A review of post-construction monitoring of OWFs in the North and Baltic Seas by Lamb *et al* (2024) found that the magnitude for displacement was large for fulmars, relative to other species when such an impact was detected. However, there was a low chance of detecting significant effects relative to other species as few studies reported the presence of fulmar, and those which did often reported low densities of the species.
1502. The Project Array Area is located 210.6km away from the FFC SPA. Therefore, when considering the various foraging ranges provided by Woodward *et al* (2019), the amount of connectivity between the FFC SPA and the Project notably changes. The largest foraging ranges Max Max (2,736km), MMFR plus one SD (1,200km) and MMFR (542km) indicate significant connectivity to the FFC SPA. If the Mean plus one SD (224.7km) foraging range is considered, then there would only be partial connectivity to the FFC SPA. Using the Mean (134.6km) foraging range would mean there is no connectivity to the Project and the FFC SPA (Table 7-88).

Table 7-88 Increase in Journey Length When Compared Against Various Foraging Ranges for Fulmar

Foraging range	Clockwise route		Anti-clockwise route	
	Woodward <i>et al</i> (2019) plus additional distance (12.38km)	Percentage increase in journey length (%)	Woodward <i>et al</i> (2019) plus additional distance (25.89km)	Percentage increase in journey length (%)
Max Max (2,736km)	2,748.4	0.5	2,761.9	0.9
Mean Max (542km)	554.4	2.3	567.9	4.8
Mean Max plus one SD (1,200km)	1,212.4	1.0	1,225.9	2.2
Mean plus one SD (224.7km)	237.1	5.5	250.6	11.5

1503. Depending on the journey taken around the DBD Array Area, the change in journey length using the SNCBs recommended MMFR plus one SD varies from 1.0% to 2.2% for the clockwise or the anticlockwise route, respectively. When considering the large foraging range of 1,200km (MMFR plus one SD) the addition of 12.38km to 25.89km is minimal in terms of the change in journey length that would be required from a foraging fulmar. If the Mean plus one SD foraging range, is considered, the increase in journey length would be 5.5% to 11.5% for the clockwise or the anticlockwise route, respectively. Such increases in journey length may not be routine as birds can alter their flight trajectories up to 1km to 2km prior to reaching an OWF and thus reducing the energy expenditure required if making a complete circumnavigation of a site (Vanermen *et al.*, 2013). Additionally, fulmar breeding season foraging behaviour involves few and long foraging trips (as noted by their foraging range values; Woodward *et al.*, 2019). The species is adapted to using efficient gliding flights, so any additional flight distance requirement is likely to result in minimal energy expenditure (Masden *et al.*, 2010).
1504. Although no tracking data for fulmar is available for the FFC SPA, there is potential connectivity between the Project and fulmar feature of the FFC SPA due to the species foraging ranges (Woodward *et al.*, 2019). However, if a barrier effect would occur for fulmar the increase in travel distance around the Project is minor and given the species flight and foraging behaviour is unlikely to have a material increase in energy expenditure. Therefore, potential for an **AEol can confidently be ruled out** for the Project in regard to distributional response effects on fulmar feature of the FFC SPA.

7.12.2 Gannet

1505. Gannets are known to avoid entering operational OWFs (e.g. Krijgsveld *et al.*, 2011; APEM, 2014), indicating the potential for a barrier effect to the species. Moreover, the results of the post-consent monitoring surveys for Thanet OWF found a reduction in gannet densities within the site during the third year, but quantification was provided. This would further support avoidance behaviour in the species (Royal HaskoningDHV, 2013). A more recent study conducted by APEM (APEM, 2014) provided evidence that gannets on migration would avoid flying into areas with operational wind turbines (macro-avoidance), estimating a macro-avoidance rate of 95%.
1506. If the various foraging ranges provided by Woodward *et al* (2019) are considered, the amount of connectivity between the listed SPAs and the Project changes significantly. The Max Max foraging range (709km) and the MMFR plus one SD (509.4km) indicates connectivity to both SPAs screened in for gannet. The MMFR (315.2km) allows for connectivity to only FFC SPA. If the Mean plus one SD (170.4km) and the Mean (120km) foraging ranges are considered, there is no connectivity between the Project and FFC SPA or Forth Islands SPA (Table 7-89).

Table 7-89 Increase in Journey Length When Compared Against Various Foraging Ranges for Gannet

Foraging range	Clockwise route		Anti-clockwise route	
	Woodward <i>et al</i> (2019) plus additional distance (12.38km)	Percentage increase in journey length (%)	Woodward <i>et al</i> (2019) plus additional distance (25.89km)	Percentage increase in journey length (%)
Max Max (709km)	721.4	1.7	734.9	3.7
Mean Max (315.2km)	327.6	3.9	341.1	8.2
Mean Max plus one SD (509.4km)	521.8	2.4	535.3	5.1

1507. Depending on the journey taken around the DBD Array Area, the change in journey length using the SNCBs recommended MMFR plus one SD varies from 2.4% to 5.1% for the clockwise or the anticlockwise route, respectively. When considering the large foraging range of 509.4km (MMFR plus one SD) the addition of 12.38km to 25.89km is minimal in terms of the change in journey length that would be required from a foraging gannet. If the Mean Max foraging range, is considered, the increase in journey length would be 3.9% to 8.2% for the clockwise or the anticlockwise route, respectively. Such increases in journey length may not be routine as birds can alter their flight trajectories up to 1km to 2km prior to reaching an OWF and thus reducing the energy expenditure required if making a complete circumnavigation of a site (Vanermen *et al.*, 2013).
1508. Tracking data for gannet has been collected at both SPAs. Of the 11 datasets of breeding adult gannets from Forth Islands SPA (Seabird Tracking Database, 2023) available, two show foraging tracks with potential overlap with the Project (pre-incubation foraging tracks 2017 – 2019 and in 2015). All other datasets highlight limited connectivity to the Project, with the majority of tracks remaining closer to the colony. One of the two dataset available from the FFC SPA show potential connectivity, with several foraging tracks having potential overlap with the Project (tracking is entitled Northern Gannet_Bempton Cliffs_breeding10 (Seabird Tracking Database, 2023)). The other tracking dataset from FFC SPA suggests limited connectivity with gannet foraging trips remaining closer to the colony. Similarly foraging route tracks from Forth Islands and FFC SPAs provided in Wakefield *et al* (2013) support the above and suggest connectivity with these colonies and the Project is limited.

1509. On consideration of all of the information above, it is likely connectivity between the Project and gannet features of the Forth Islands and FFC SPAs is limited given the Project’s distant location offshore. In addition, for those datasets which show potential connectivity there are very few commuting flights which go beyond the eastern extent of the DBD Array Area suggesting a barrier effect is unlikely. Although if a barrier effect would occur for gannet the increase in travel distance of a maximum 25.9km is likely minor given the species foraging range size and is therefore unlikely to have a material increase in energy expenditure. When considering the above evidence, potential for an **AEol can confidently be ruled out** for Project in regard to distributional response effects on gannet features of both SPAs.

7.12.3 Kittiwake

1510. The current UK SNCBs guidance on the requirements for displacement assessment (SNCBs, 2022), does not consider kittiwake to be a priority species as it falls below the SNCBs recommended threshold for assessment relating to both ‘disturbance susceptibility’ and ‘habitat specialisation’. Dierschke *et al* (2016) completed a comprehensive review on avoidance and attraction to offshore wind farms based on behavioural responses of kittiwakes from 11 OWFs. Mean scores were variable, with one account of strong attraction (increase of >80%), one account of weak attraction (increase of >50%), five accounts of no windfarm effect, one account of weak avoidance, one account of strong avoidance (decrease >80%) and two accounts of macro avoidance behaviour. The two accounts of macro avoidance at Horns Rev 1 and 2 were based on only 11 tracks (Skov *et al.*, 2012) and in previous studies on distributional responses at the two sites no significant effects were reported and kittiwake were observed roosting on the jacket foundations (Skov *et al.*, 2018; Peterson *et al.*, 2014). The account of strong avoidance was from studies at Thornton Bank which suggested a displacement rate of 70%, however at the neighbouring Bligh Bank site displacement was not observed for kittiwake (Vanermen *et al.*, 2016). Therefore, the high distributional response reported by one statistical model may not be genuine nor can it be attributed with high confidence to the presence of the wind farm. The concluding remark from the authors was, ‘*due to inconsistency between the significance levels of the MMI and full model OWF coefficients, the results for black-legged kittiwake should yet be regarded as inconclusive*’ (Vanermen *et al.*, 2019). The Dierschke review concluded a mean score of 2.7 for kittiwake, classifying them as a species which are hardly affected by offshore wind farms or with attraction and avoidance approximately equal over all studies.
1511. Further studies on displacement effects to kittiwake since the Dierschke *et al* (2016) review (APEM, 2017; Percival & Ford, 2017; Peschko *et al.*, 2020; Trinder *et al.*, 2024; and Lamb *et al.*, 2024), overall concluded that there is a lack of strong empirical evidence to suggest kittiwake is significantly susceptible to displacement from OWFs.

1512. If the various foraging ranges provided by Woodward *et al* (2019) are considered, the amount of connectivity between the listed SPAs and the Project changes significantly (see **Table 7-90**). The Max Max foraging range (770km) indicates connectivity to all SPA sites screened in for kittiwake. The MMFR plus one SD (300.6km) indicates connectivity to the FFC SPA and only partial connectivity to Farne Islands SPA. If the MMFR (156.1km), Mean plus one SD (105.1km) and the Mean (54.7km) foraging ranges are considered, there is no connectivity between the Project and FFC SPA or Farne Islands SPA.

Table 7-90 Increase in Journey Length When Compared Against Various Foraging Ranges for Kittiwake

Foraging range	Clockwise route		Anti-clockwise route	
	Woodward <i>et al</i> (2019) plus additional distance (12.38km)	Percentage increase in journey length	Woodward <i>et al</i> (2019) plus additional distance (25.89km)	Percentage increase in journey length
Max Max (770km)	782.4	1.6%	795.9	3.4%
Mean Max plus one SD (300.6km)	313.0	4.1%	326.5	8.6%

1513. Depending on the journey taken around the DBD Array Area, the change in journey length using the SNCBs recommended MMFR plus one SD varies from 4.1% to 8.6% for the clockwise or the anticlockwise route, respectively. Such increases in journey length may not be routine as birds can alter their flight trajectories up to 1km to 2km prior to reaching an OWF and thus reducing the overall energy expenditure required if making a complete circumnavigation of a site (Vanermen *et al.*, 2013).
1514. Tracking data for kittiwake has been collected at one of the listed SPAs. Of the five datasets available from the FFC SPA, only one dataset suggests potential overlap with the Project, though overall overlap is limited. The other tracking dataset from FFC SPA suggests limited connectivity with kittiwake foraging trips remaining closer to the colony.
1515. Considering all of the information above, it is likely connectivity between the Project and kittiwake features of the listed SPAs is limited given the Project’s distant location offshore. In addition, the tracking datasets highlight a lack of regular commuting flights beyond the eastern extent of the DBD Array Area which suggests the potential for a barrier effect is unlikely. Therefore, considering the above and the limited evidence for strong avoidance behaviour in the species (Dierschke *et al.*, 2016), potential for an **AEol can confidently be ruled out** for Project, in regard to distributional response effects on kittiwake features of all SPAs listed.

7.13 Scottish SPAs

1516. The following section includes species by species assessments for the various designated sites in which they are qualifying features. This provides a more concise review for SPAs and features where potential connectivity or level of predicted effect is considered limited. This approach was discussed within a meeting with NatureScot and agreed upon as the most suitable way of presenting results for Scottish SPAs (**Section 7.2**).
1517. In relation to assessment of disturbance and displacement, in particular, the most appropriate displacement and mortality rates to inform assessment of Scottish SPAs, the Applicant discussed such matters with NatureScot during consultation held on 14th October 2024. Despite there being differences between the rates recommended by Natural England (see **Table 7-6**) and NatureScot (NatureScot, 2023), to ensure consistency in assessment approach between SPAs, NatureScot agreed with the Project assessing Scottish SPAs based on Natural England’s recommended displacement and mortality rates. For clarity, the Applicant has separately calculated predicted impacts following NatureScot’s preferred displacement and mortality rates, the results of which are summarised within **Appendix A.4 Scottish Sites - Presentation of Quantitative Results**.
- 7.13.1 Conservation Objectives
1518. Scottish SPAs have been assessed against the following conservation objectives:
- To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and
 - To ensure for the qualifying species that the following are maintained in the long term:
 - Population of the species as a viable component of the site;
 - Distribution of the species within the site;
 - Distribution and extent of habitat supporting the species;
 - Structure, function and supporting processes of habitats supporting the species; and
 - No significant disturbance of the species.
1519. The conservation objectives of relevance to the assessments presented are highlighted in bold, based on the proximity of the designated sites, functional linkages and potential impact pathways identified.

7.13.2 Assessment of Adverse Effects

7.13.2.1 Kittiwake

1520. The kittiwake feature of a number of Scottish SPAs has been screened in for the assessment of operation and maintenance phase impacts. The potential impacts are from collision risk for the Project alone in relation to the conservation objectives outlined in previous sections for the following SPAs:
- Fowlsheugh SPA (non-breeding); and
 - East Caithness Cliffs SPA (non-breeding).
1521. Assessments have been carried out for the non-breeding bio-seasons broken down into post-breeding migration (September to December) and return migration (January to February).
1522. Due to there being multiple colonies identified as having potential connectivity to the Project, an apportionment process was completed in order to attribute and assess the level of potential effect at an individual SPA. For the non-breeding bio-seasons, the Furness (2015) BDMPS apportioning rates were applied as agreed in consultation. A summary of the seasonal apportioning rates for each SPA is presented in **Table 7-91**. Further detail on the apportionment process applied for the Project is provided within **Appendix A.3 Apportionment Report**.

Table 7-91 Summary of Kittiwake Seasonal Apportionment to Designated Sites Screened in for Assessment

SPA	Return migration (%)	Post-breeding migration (%)
Fowlsheugh SPA	1.78	1.35
East Caithness Cliffs SPA	1.72	5.84

7.13.2.1.1 Operation and Maintenance Phase Collision Risk Impacts on Qualifying Features

1523. The apportioned predicted consequent mortality as a result of collision risk for each designated site considered are presented in **Table 7-91**, based on the level of PEIR predicted effect summarised in **Table 7-7** apportioned seasonally to each designated site using the apportioning rates presented in **Table 7-92**.

1524. For all SPAs considered in **Table 7-92**, the level of predicted annual additional mortality due to collision is at most five (4.56) breeding adults. Additionally, for all assessments the increase in baseline mortality does not exceed an increase of 1% annually. Therefore, for all SPAs it can be confidently concluded that the potential for an **AEol can confidently be ruled out** in relation to potential collision risk from the Project alone during the operation and maintenance phase. Therefore, subject to natural change, the population of the kittiwake feature will be maintained in the long term for all SPAs.

Table 7-92 Kittiwake Predicted Collision Mortalities During the Operation and Maintenance Phase Attributed to SPAs using the breeding adult apportioning rates within Table 7-91

SPA	Bio-season	Apportioned predicted collision risk mortality for each SPA (breeding adults per annum)	SPA population (breeding adults)	Increase from baseline mortality (%)
Fowlsheugh SPA	Return migration	0.56	30,966	0.012
	Post-breeding migration	0.50		0.011
	Annual	1.05		0.023
East Caithness Cliffs SPA	Return migration	2.41	48,958	0.034
	Post-breeding migration	2.15		0.030
	Annual	4.56		0.064

7.13.2.1.2 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

1525. For the Project alone impacts for both SPAs, the increase in baseline mortality is predicted to be significantly less than 0.1% per annum. Such level of effect alone would certainly be indistinguishable from natural fluctuations in the population and is unlikely to materially contribute to any in-combination effect, especially given connectivity is temporally restricted to the non-breeding bio-seasons. Therefore, the potential for an **AEol in-combination due to mortality as a result of collisions can confidently be ruled out** for the kittiwake feature of the Fowlsheugh SPA and the East Caithness Cliffs SPA. Subject to natural change, kittiwake will be maintained as a feature of both SPAs in the long-term.

7.13.2.2 Herring Gull

1526. The herring gull feature of one Scottish SPA has been screened in for the assessment of operation and maintenance phase impacts. The potential impacts are from collision risk for the Project alone in relation to the conservation objectives outlined in previous sections for the following SPA:
- East Caithness Cliffs SPA (non-breeding).
1527. Assessments have been carried out for the non-breeding bio-season (March to August).
1528. Due to there being multiple colonies identified as having potential connectivity to the Project, an apportionment process was completed in order to attribute and assess the level of potential effect at an individual SPA. For the non-breeding bio-season, the Furness (2015) BDMPS apportioning rates were applied as agreed in consultation. A summary of the seasonal apportioning rates for each SPA is presented in **Table 7-93**. Further detail on the apportionment process applied for the Project is provided within **Appendix A.3 Apportionment Report**.

Table 7-93 Summary of Herring Gull Seasonal Apportionment to Designated Sites Screened in for Assessment

SPA	Non-breeding bio-season (%)
East Caithness Cliffs SPA	1.44

7.13.2.2.1 Operation and Maintenance Phase Collision Risk Impacts on Qualifying Features

1529. The apportioned predicted consequent mortality as a result of collision risk for each designated site considered are presented in Table 7-94, based on the level of PEIR predicted effect summarised in **Table 7-7** apportioned seasonally to each designated site using the apportioning rates presented in Table 7-94.
1530. For SPAs considered in Table 7-94, the level of predicted annual additional mortality due to collision is at most less than one (0.02) breeding adult. Additionally, for all assessments the increase in baseline mortality does not exceed an increase of 1% annually. Therefore, for East Caithness Cliffs SPA it can be confidently concluded that the potential for an **AEol can confidently be ruled out** in relation to potential collision risk from the Project alone during the operation and maintenance phase. Therefore, subject to natural change, the population of the herring gull feature will be maintained in the long term for this SPA.

Table 7-94 Herring Gull Predicted Collision Mortalities During the Operation and Maintenance Phase Attributed to East Caithness Cliffs SPA using the breeding adult apportioning rate within Table 7-93

SPA	Bio-season	Apportioned predicted collision risk mortality for each SPA (breeding adults per annum)	SPA population (breeding adults)	Increase from baseline mortality (%)
East Caithness Cliffs SPA	Non-breeding	0.02	2,226	0.005
	Annual	0.02		0.005

7.13.2.2.2 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

1531. For the Project alone impacts for East Caithness Cliffs SPA, the increase in baseline mortality is predicted to be significantly less than 0.1% per annum. Such level of effect alone would certainly be indistinguishable from natural fluctuations in the population and is unlikely to materially contribute to any in-combination effect, especially given connectivity is temporally restricted to the non-breeding bio-season. Therefore, the potential for an **AEol in-combination due to mortality as a result of collisions can confidently be ruled out** for the herring gull feature of the East Caithness Cliffs SPA. Subject to natural change, herring gull will be maintained as a feature in the long-term.

7.13.2.3 Gannet

1532. The gannet feature of a number of Scottish SPAs has been screened in for the assessment of operation and maintenance phase impacts. The potential impacts are from collision risk for the Project alone in relation to the conservation objectives outlined in previous sections for the following SPAs:
- Hermaness, Saxa Vord and Valla Field SPA (non-breeding); and
 - Noss SPA (non-breeding).
1533. Assessments have been carried out for the non-breeding bio-seasons broken down into post-breeding migration (October to November) and return migration (December to February).

1534. Due to there being multiple colonies identified as having potential connectivity to the Project, an apportionment process was completed in order to attribute and assess the level of potential effect at an individual SPA. For the non-breeding bio-seasons, the Furness (2015) BDMPS apportioning rates were applied as agreed in consultation. A summary of the seasonal apportioning rates for each SPA is presented in **Table 7-95**. Further detail on the apportionment process applied for the Project is provided within **Appendix A.3 Apportionment Report**.

Table 7-95 Summary of Gannet Seasonal Apportionment to Designated Sites Screened in for Assessment

SPA	Return migration (%)	Post-breeding migration (%)
Hermaness, Saxa Vord and Valla Field SPA	13.73	8.54
Noss SPA	5.51	3.42

7.13.2.3.1 Operation and Maintenance Phase Collision Risk Impacts on Qualifying Features

1535. The apportioned predicted consequent mortality as a result of collision risk for each designated site considered are presented in **Table 7-96**, based on the level of PEIR predicted effect summarised in **Table 7-7** apportioned seasonally to each designated site using the apportioning rates presented in **Table 7-95**.
1536. For all SPAs considered in **Table 7-96**, the level of predicted annual additional mortality due to collision is at most less than one (0.37) breeding adult. Additionally, for all assessments the increase in baseline mortality does not exceed an increase of 1% annually. Therefore, for all SPAs it can be confidently concluded that the potential for an **AEol can confidently be ruled out** in relation to potential collision risk from the Project alone during the operation and maintenance phase. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term for this SPA.

Table 7-96 Gannet Predicted Collision Mortalities During the Operation and Maintenance Phase Attributed to SPAs using the breeding adult apportioning rates within Table 7-95

SPA	Bio-season	Apportioned predicted collision risk mortality for each SPA (breeding adults per annum)	SPA population (breeding adults)	Increase from baseline mortality (%)
	Return migration	0.07	37,478	0.002

SPA	Bio-season	Apportioned predicted collision risk mortality for each SPA (breeding adults per annum)	SPA population (breeding adults)	Increase from baseline mortality (%)
Hermaness, Saxa Vord and Valla Field SPA	Post-breeding migration	0.30		0.010
	Annual	0.37		0.012
Noss SPA	Return migration	0.03	24,670	0.001
	Post-breeding migration	0.12		0.006
	Annual	0.15		0.007

7.13.2.3.2 Operation and Maintenance Phase Direct Disturbance and Displacement due to Presence of Wind Turbines and Other Offshore Infrastructure

1537. The apportioned predicted consequent mortality as a result of displacement for each designated site considered are presented in **Table 7-95**, based on the level of PEIR predicted effect summarised in **Table 7-7** apportioned seasonally to each designated site using the apportioning rates presented in **Table 7-97**.
1538. For all SPAs considered in **Table 7-97**, the level of predicted annual additional mortality due to displacement is at most one (6.48) breeding adults. Additionally, for all assessments the increase in baseline mortality does not exceed an increase of 1% annually. Therefore, for all SPAs it can be confidently concluded that the potential for an **AEol can confidently be ruled out** in relation to potential collision risk from the Project alone during the operation and maintenance phase. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term for all SPAs.

*Table 7-97 Gannet Predicted Displacement Mortalities During the Operation and Maintenance Phase Attributed to SPAs using the breeding adult apportioning rates within **Table 7-95***

SPA	Bio-season	SPA Population (breeding adults)	Apportioned predicted displacement mortality (breeding adults per annum)		Increase from baseline mortality (%)	
			Applicant's approach based on 60% – 80% Disp; 1% Mort	SNCB approach based on 60%-80% Disp; 1% - 10% Mort	Applicant's approach based on 60% – 80% Disp; 1% Mort	SNCB approach based on 60% - 80% Disp; 1% - 10% Mort
Hermaness, Saxa Vord and Valla Field SPA	Return migration	37,478	0.07 – 0.09	0.07 – 0.93	0.002 – 0.003	0.002 – 0.031
	Post-breeding migration		0.42 – 0.56	0.42 – 5.55	0.014 – 0.018	0.014 – 0.183
	Annual		0.49 – 0.65	0.49 – 6.48	0.016 – 0.021	0.016 – 0.214
Noss SPA	Return migration	24,670	0.03 – 0.04	0.03 – 0.37	0.001 – 0.002	0.001 – 0.019
	Post-breeding migration		0.17 – 0.22	0.17 – 0.56	0.008 – 0.011	0.008 – 0.111
	Annual		0.20 – 0.26	0.20 – 0.93	0.009 – 0.013	0.009 – 0.130

7.13.2.3.3 Operation and Maintenance Phase Combined Collision Risk and Displacement Impacts on Qualifying Features

1539. The apportioned predicted consequent mortality as a result of combined collision risk and displacement for each designated site considered are presented in **Table 7-98**, based on the level of PEIR predicted effect summarised in **Table 7-6** and **Table 7-7** apportioned seasonally to each designated site using the apportioning rates presented in **Table 7-95**.

*Table 7-98 Gannet Predicted Combined Collision and Displacement Mortalities During the Operation and Maintenance Phase Attributed to SPAs using the breeding adult apportioning rates within **Table 7-95***

SPA	Bio-season	SPA Population (breeding adults)	Apportioned predicted displacement mortality (breeding adults per annum)		Increase from baseline mortality (%)	
			Applicant's approach based on 60% – 80% Disp; 1% Mort	SNCB approach based on 60%-80% Disp; 1% - 10% Mort	Applicant's approach based on 60% – 80% Disp; 1% Mort	SNCB approach based on 60% - 80% Disp; 1% - 10% Mort
Hermaness, Saxa Vord and Valla Field SPA	Return migration	37,478	0.14 – 0.16	0.14 – 1.00	0.005 – 0.005	0.005 – 0.033
	Post-breeding migration		0.72 – 0.86	0.72 – 5.85	0.024 – 0.028	0.024 – 0.193
	Annual		0.86 – 1.02	0.86 – 6.86	0.028 – 0.034	0.028 – 0.226
Noss SPA	Return migration	24,670	0.06 – 0.07	0.06 – 0.40	0.003 – 0.003	0.003 – 0.020
	Post-breeding migration		0.29 – 0.34	0.29 – 2.34	0.014 – 0.017	0.014 – 0.117
	Annual		0.34 – 0.41	0.34 – 2.75	0.017 – 0.021	0.017 – 0.138

1540. For all SPAs considered in **Table 7-95**, the level of predicted annual additional mortality due to combined collision and displacement is at most seven (6.86) breeding adults. Additionally, for all assessments the increase in baseline mortality does not exceed an increase of 1% annually. Therefore, for all SPAs it can be confidently concluded that the potential for an **AEol can confidently be ruled out** in relation to combined collision risk and displacement impacts from the Project alone during the operation and maintenance phase. Therefore, subject to natural change, the population of the gannet feature will be maintained in the long term for all SPAs.

7.13.2.3.4 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

1541. Even when considering the potential for collision risk and displacement effects (most likely scenario of 60% – 80% displacement and 1% mortality) combined for the most likely scenario, the increase in baseline mortality is predicted to be significantly less than 0.1% per annum. Such level of effect alone would certainly be indistinguishable from natural fluctuations in the population and is unlikely to materially contribute to any in-combination effect, especially given connectivity is temporally restricted to the non-breeding bio-seasons. Therefore, the potential for an **AEol in-combination due to mortality as a result of collisions and displacement effects can confidently be ruled out** for the gannet feature of the Hermaness, Saxa Vord and Valla Field SPA and the Noss SPA. Subject to natural change, gannet will be maintained as a feature of both SPAs in the long-term.

8 Stage 2 Assessment of Sites Designated for Annex II Migratory Fish

8.1 Approach to Assessment

1542. This section provides information to allow the determination of the potential for the Project to have an adverse effect on the integrity of sites designated for offshore Annex II Migratory Fish.
1543. For each site designated for migratory fish that was screened in for further consideration, the following information has been provided:
- A summary of the site and migratory fish features considered for assessment;
 - An assessment of potential effects during the construction phase of the Project; and
 - Assessment of the potential for in-combination effects alongside other relevant developments and projects.

8.2 Consultation

1544. **Table 1-1 of Appendix A-1** provides a summary of how the consultation responses relevant to migratory fish have been considered in the approach that has been taken within this assessment.

8.3 Assessment of Potential Effects

1545. In light of Project design changes, in particular a change in landfall location and the removal of hydrogen production facilities with a coolant water outflow into the Humber Estuary, the HRA Addendum Report set out that there is no longer a pathway for effect from onshore elements of the Project (see *Section 8* in **Appendix A-2**). The remaining potential effect taken forwards for further assessment is therefore:

- Underwater noise impacts due to UXO clearance.

1546. UXO clearance would be subject to a separate, standalone Marine Licence with the relevant receptors assessed when required. Therefore in this RIAA, the assessment is for information only.

1547. There is an expectation to present a full assessment of UXO effects in EIA and HRA terms as part of a separate Marine Licensing process, based on an accurate understanding of UXO presence, which will be informed by future site-specific UXO detection surveys.

8.3.1 Embedded and Standard Mitigation Measures

1548. **Table 8-1** outlines the embedded mitigation measures incorporated into the Project relevant to the assessment for Annex II Migratory Fish species.

8.3.2 Worst-Case Scenario

1549. A UXO clearance noise assessment is included here for information purposes only to inform a high level assessment. UXO clearance would be assessed in detail in a future separate Marine Licence application for clearance works post-consent. This separate application will be accompanied with an assessment of underwater impacts, with a refined understanding of the likely level of impact magnitude, based on UXO identification surveys.
1550. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken during construction activity for the Project. It is possible that UXO devices with a range of charge weights (or quantity of contained explosive) are present within the Dogger Bank D boundaries. These would need to be cleared during the construction phase before other construction activities can safely proceed.

1551. The Project has undertaken site specific modelling for underwater noise associated with UXO clearance (**PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report**). A selection of explosive sizes has been considered based on what could feasibly be present, and in each case, it has been assumed that the maximum explosive charge in each device is present and either detonates with the clearance (high-order) or alternatively a clearance method such as deflagration (low-order) can be used. Whilst the Project will aim to use low-order techniques to clear UXO (if required), as a worst-case the assessment in this RIAA assumes that a high order clearance will be used.
1552. The maximum equivalent charge weight for the potential UXO devices that could be present within the Offshore Development Area has been estimated as 907kg, giving a peak-to-peak source level of 296.6dB re 1 μ Pa @ 1m.
1553. In 2024 there were 25 cases of UXO detonations reported to the Marine Noise Registry in the North Sea. All 25 reported UXO clearances were using low-order techniques. No high-order clearances were reported. This gives an average of zero high-order, and less than one low-order UXO detonation on any given day within a year in the North Sea (acknowledging that this data does not cover the North sea beyond the UK's EEZ).

REPORT TO INFORM APPROPRIATE ASSESSMENT

Table 8-1 Embedded Mitigation Measures Relevant to Fish and Shellfish Ecology

Parameter	Commitment ID	Proposed Embedded Mitigation	How the Embedded Mitigation Will be Secured
General	CO21	An Offshore Decommissioning Programme would be provided prior to the construction of the offshore works and implemented at the time of decommissioning, based on the relevant guidance and legislation.	DCO Requirement - Offshore Decommissioning Programme
	CO25	<p>A Project Environmental Management Plan (PEMP) will be provided in accordance with the Outline PEMP and will include:</p> <ul style="list-style-type: none"> • A Marine Pollution Contingency Plan (MPCP), which will include plans to address the risks, methods and procedures to deal with any spills and collision incidents in relation to all activities carried out below Mean High Water Springs (MHWS) to safeguard the marine environment; • Best practice measures for the storage, use and disposal of lubricant and chemicals will be undertaken throughout the construction phase; • A Chemical Risk Assessment (CRA) to ensure any chemicals, substances and materials to be used will be suitable for use in the marine environment and in accordance with the Health and Safety Executive and the Environment Agency Pollution Prevention Control Guidelines or latest relevant available guidelines; • A marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised; and • Details of waste management and disposal arrangements. 	DML Condition - Project Environmental Management Plan
	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
Reduction of noise	CO22	<p>A piling Marine Mammal Mitigation Protocol (MMMP) will be provided in accordance with the Outline MMMP and will be implemented during construction.</p> <p>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.</p>	DML Condition - Marine Mammal Mitigation Protocol
Reduction of disturbance	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
	CO24	<p>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.</p> <p>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.</p>	DML Condition - Cable Specification and Installation Plan
	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

1554. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO detonation, even if they had overlapping UXO clearance operation durations. The in-combination assessment is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst-case), and one low-order detonation occurring within the same day.

8.4 River Derwent Special Area of Conservation

8.4.1 Site Description

1555. The Yorkshire Derwent is considered to represent one of the best British examples of the classic river profile. This lowland section, stretching from Ryemouth to the confluence with the Ouse, supports diverse communities of aquatic flora and fauna. Fed from an extensive upland catchment, the lowland course of the Derwent has been considerably diverted and extended as a result of glacial action in the Vale of Pickering. The Derwent is noted for the diversity of its fish communities, which include river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* populations that spawn in the lower reaches (Natural England, 2025).

8.4.1.1 Qualifying Features

1556. The site is designated under article 4(4) of the Directive (92/43/EEC) as it hosts the following migratory fish species listed in Annex II:
- River lamprey (primary reason for selection of this site); and
 - Sea lamprey (present as a qualifying feature, but not a primary reason for site selection) (JNCC, n.d.).

8.4.1.2 Conservation Objectives

1557. The conservation objectives of the SAC are to ensure that the integrity of the site is maintained or restored as appropriate, and to ensure the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:
- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
 - The structure and function (including typical species) of qualifying natural habitats;
 - The structure and function of the habitats of qualifying species;
 - The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;

- The populations of qualifying species, and
- The distribution of qualifying species within the site (Natural England, 2018a).

8.4.1.3 Condition Assessment

1558. Natural England's (2025a) condition assessment states that both river and sea lamprey are in unfavourable recovering condition. The returning adult sea lamprey population is currently estimated to be 1 to 15 individuals, with an estimate of 1,000 adult river lamprey individuals (Natural England, 2022).

8.4.2 Assessment of Potential Effects of the Project Alone

8.4.2.1 Underwater Noise

1559. By listening to the sounds around them, fish can obtain substantial information about their environment and some species use sound to communicate (Popper *et al.*, 2019; Popper and Hawkins, 2019). Each species has differing sensitivity to noise and, therefore, the potential impact of a given underwater sound may vary across different species of fish. Anthropogenic sounds can be so intense as to result in death or mortal injury, or lower sound levels may result in temporary hearing impairment, physiological changes including stress effects, changes in behaviour or the masking of biologically important sounds (Popper and Hawkins, 2019; Kastelein *et al.*, 2017).
1560. Relatively few experiments on the hearing of fish have been carried out under suitable acoustic conditions, and only a few species have valid data that provide actual thresholds (Popper and Hawkins, 2019). However, studies on how noise affects fish and shellfish species have brought to light that there is a lack of clear evidence supporting defined thresholds. This is due to the focus only on sound pressure, and not particle motion, when the latter may be critical to understanding the importance of sound to fish and invertebrates (Popper and Hawkins, 2018).
1561. The most recent and relevant guidelines for the purposes of this assessment are the Acoustical Society of America (ASA) Sound Exposure Guidelines for Fishes and Sea Turtles (Popper *et al.*, 2014). These guidelines provide directions and recommendations for setting criteria (including injury and behavioural criteria) for fish. The Popper *et al.* (2014) guidelines broadly group fish into the following categories, based on their anatomy and the available information on hearing of other fish species with comparable anatomies:
- Group 1: Fish lacking swim bladders that are sensitive only to sound particle motion and show sensitivity to a narrow band of frequencies;
 - Group 2: Fish with a swim bladder where the organ does not appear to play a role in hearing. These fish are sensitive only to particle motion and show sensitivity to a narrow band of frequencies;

- Group 3: Fish with swim bladders that are close, but not intimately connected to the ear. These fish are sensitive to both particle motion and sound pressure and show a more extended frequency range than Groups 1 and 2, extending to about 500Hz; and
- Group 4: Fish that have special structures mechanically linking the swim bladder to the ear. These fish are sensitive primarily to sound pressure, although they also detect particle motion. These species have a wider frequency range, extending to several kHz, and generally show higher sensitivity to sound pressure than fish in Groups 1, 2 and 3.

1562. Lamprey species, including both sea lamprey and river lamprey, do not have swim bladders or specialised hearing structures. They are considered to be of low noise sensitivity (Popper, 2005) and are members of the least sensitive ‘Group 1’ hearing group defined by Popper *et al* (2014). They are incapable of detecting sound pressures and, therefore, particle motion is the only sound stimulus which can be detected (Casper *et al.*, 2012).
1563. Whilst the Project will aim to use low-order techniques to clear UXO (if required) wherever feasible, as a worst-case a high-order clearance may be used as a last resort. Based on site-specific modelling (see **PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report**), the impact ranges associated with UXO clearance options are set out in **Table 8-2**. These impact ranges are based on the assumption of a single impulsive detonation event, and therefore do not incorporate any assumptions that fish may flee the area prior to detonation occurring. As a worst-case, mortality and potential mortal injury resulting from a large (907kg NEQ plus donor charge) high-order detonation could occur on fish receptors at a distance of 970m.

Table 8-2 Summary of the Impact Ranges for the Project from UXO Detonation Using the Explosions Lp,pk Noise Criteria from Popper *et al* (2014) for Species Of Fish. Worst-Case Highlighted

Popper <i>et al</i> (2014) Lp,pk	Mortality and potential mortal injury	
	234dB	229dB
Low order (0.25 kg)	< 50m	60m
25 kg + donor	170m	290m
55 kg + donor	230m	380m
120 kg + donor	300m	490m
240 kg + donor	370m	620m
525 kg + donor	490m	810m

Popper <i>et al</i> (2014) Lp,pk	Mortality and potential mortal injury	
	234dB	229dB
698 kg + donor	530m	890m
907 kg + donor	580m	970m

1564. The Project will be carrying out targeted UXO surveys prior to construction to understand the extent and characteristics of any potential UXO that may be present in the Offshore Development Area. Following detailed surveys, a separate Marine Licence application specifically for UXO clearance works will be submitted. This application will be accompanied with an assessment of underwater impacts, with a refined understanding of the likely level of impact magnitude.
1565. Both river lamprey and sea lamprey are anadromous species (i.e. spawning in freshwater but completing their life cycle in the sea).
1566. After spending 18 to 24 months feeding at sea, adult sea and river lampreys migrate into rivers during the spring and early summer. Lamprey species need clean gravel for spawning, and marginal silt or sand for the burrowing larvae following egg-hatching. They spawn between the months of May-July in areas of pebble and cobble substrate.
1567. Whilst sea lampreys spend much of their adult life in the open seas, the range of river lamprey tends to be restricted to coastal waters and estuaries during their adult marine phase.
1568. There is no potential for direct impact on the River Derwent SAC due to distance from the Project Area. However, the River Derwent connects to the Humber Estuary SAC/Ramsar, which in turn connects to the wider North Sea. The Offshore Development Area is also too distant from the Humber Estuary SAC/Ramsar to directly impact any lamprey species within the Humber Estuary (distance of approximately 45km at the closest point on the Offshore ECC). Therefore, the remaining potential is that adult river and sea lamprey could be found within the vicinity of UXO clearance activities in the nearshore offshore export cable corridor.
1569. Little is known about the distribution of river and sea lamprey during the marine phase of their lifecycle, as reports vary, suggesting a wide range and use of habitats (Maitland, 2004). There is evidence that river and sea lamprey are found in any significant numbers within the Offshore ECC at any point throughout the year. On this basis, the likelihood of any lamprey species with connectivity to the River Derwent SAC (or similarly the Humber Estuary SAC/Ramsar, which is part of the same lamprey migratory pathway) being found within the 970m mortality and potential mortal injury impact range of a large high-order UXO clearance in the Offshore ECC is minimal.

1570. No appropriate thresholds exist for behavioural disturbance of lamprey species from explosions, but given that they are part of the low sensitivity to sound ‘Group 1’ hearing group (Popper *et al.*, 2014), and a minimum distance of 45km from Project-related UXO clearance and the mouth of the Humber Estuary, the likelihood of significant numbers of sea or river lamprey experiencing behavioural disturbance (a temporary effect) is low.
1571. Given the highly limited potential for effects to occur on river lamprey and sea lamprey due to UXO clearance in coastal waters, there is therefore no potential for AEol on the conservation objectives of the River Derwent SAC.

8.4.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

8.4.3.1 Construction

1572. The plans and projects that have overlapping construction phases with the Project (and may therefore need to undertake UXO clearance at the same time), are set out in **Table 8-3**.
1573. As set out in **Section 8.4.2**, both river lamprey and sea lamprey have low sensitivity to underwater sound.
1574. As identified in **Section 8.4.2.1**, the worst-case range for mortality and potential mortal injury from a high order UXO detonation is 970m. In reality, the use of a high order detonation would be unlikely and would only be used as a last resort, with low order deflagration of UXO preferred, with greatly reduced noise as a result. The other projects screened in are taking the same approach to the hierarchy of preferred clearance methods. It is not expected that UXO clearance from the Project would be undertaken at the same time as piling for the Project. The likelihood of UXO clearance being undertaken at the same time from other projects e.g. Dogger Bank South is unlikely with their intended construction period. Therefore, this limits the potential for the Project to significantly contribute to underwater noise cumulatively.
1575. Given the low sensitivity of sea lamprey and river lamprey to underwater noise, the low likelihood of UXO clearance for other projects occurring at the same time as the Project, the fact that other projects are following the same preference hierarchy for clearance methods, and the low likelihood that significant numbers of lamprey individuals will be found within the Offshore Development Area at any given time, the likelihood of lamprey species experiencing cumulative noise impacts is low.
1576. There is therefore no potential for AEol on the conservation objectives of the River Derwent SAC in combination with other plans and projects.

8.4.4 Summary of Potential Effects on Site Integrity

1577. Due to the limited potential for high-order UXO clearances to be required in the inshore section of the Offshore ECC closest to the Humber Estuary, the low sensitivity of lamprey species to underwater noise, and the hierarchy of preferences for clearance methods (with high order clearance as a last resort only), there is no potential for river lamprey or sea lamprey associated with the River Derwent SAC to be significantly affected by UXO noise from the Project-alone or in-combination with other plans or projects.
1578. There is no potential for the Project alone, or in-combination with other plans or projects to cause an AEol on the conservation objectives of the River Derwent SAC.

8.5 Humber Estuary Special Area of Conservation

8.5.1 Site Description

1579. The Humber Estuary is a large estuary with a high tidal range (macro-tidal). With high suspended sediment loading in the estuary that feed a dynamic and rapidly changing system of accreting and eroding intertidal and sub-tidal mudflats and sandflats as well as saltmarsh and reedbeds. Other notable habitats include a range of sand dune types in the outer estuary, together with sub-tidal sandbanks and coastal lagoons. A number of developing managed realignment sites on the estuary also contribute to the wide variety of estuarine and wetland habitats. The estuary supports a full range of saline conditions from the open coast to the limit of saline intrusion. As salinity declines upstream tidal reedbeds and brackish saltmarsh communities fringe the estuary (Natural England, 2025b).
1580. Both river and sea lamprey migrate through the estuary to breed in rivers of the Humber catchment (Natural England, 2025b).

Table 8-3 Plans and Projects with Potential for Spatial and Temporal Overlap with the Project UXO Clearance Activities

Project / Plan	Development Type	Status	Tier	Construction Period	Closest Distance to Array Area (km)	Closest Distance to Offshore ECC (km)	Potential for Significant Cumulative Effects
Dogger Bank South East	Offshore Wind Farm and associated export cables	Application submitted	4	Construction: 2026 to 2032	71	46	Yes
Dogger Bank South West	Offshore Wind Farm and associated export cables	Application submitted	4	Construction: 2026 to 2032	79	16	Yes
Hornsea 4	Offshore Wind Farm and associated export cables	Consented	3	Construction: 2025 to 2029	134	31	Yes
Northern Endurance	Carbon Capture Storage	In planning	4	Construction: 2026 to 2029	132	15	Yes
Aminth Energy Interconnector	Interconnector	In planning	7	Construction: 2027 to 2032	10	25	Yes
Continental Link	Interconnector	In planning	7	Construction: 2030 to 2034	78	0	Yes
Eastern Green Link (EGL2)	Interconnector	Pre-construction	3	Construction: 2025 to 2029	356	283	Yes
Eastern Green Link (EGL3)	Interconnector	In planning	6	Unknown	357	285	Yes
Eastern Green Link (EGL4)	Interconnector	In planning	6	Unknown	163	0	Yes

8.5.1.1 Qualifying Features

1581. The site is designated under article 4(4) of the Directive (92/43/EEC) as it hosts the following migratory fish species listed in Annex II:
- River lamprey; and
 - Sea lamprey.
1582. Both lamprey species present as qualifying features, but neither are the primary reason for site selection.

8.5.1.2 Conservation Objectives

1583. The conservation objectives of the SAC are to ensure that the integrity of the site is maintained or restored as appropriate, and to ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:
- The extent and distribution of qualifying natural habitats and habitats of qualifying species;
 - The structure and function (including typical species) of qualifying natural habitats;
 - The structure and function of the habitats of qualifying species;
 - The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
 - The populations of qualifying species, and
 - The distribution of qualifying species within the site (Natural England, 2018b).

8.5.1.3 Condition Assessment

1584. There is limited publicly available data with regards to the populations of either river or sea lamprey within the Humber Estuary SAC. There have been no recordings via Natural England's (2025c) monitored features on units for either lamprey species.

8.5.2 Assessment of Potential Effects of the Project Alone

8.5.2.1 Underwater Noise

8.5.2.1.1 Construction

1585. The Humber Estuary SAC has the same Annex II migratory fish as designated features (sea lamprey and river lamprey) as the River Derwent SAC. It also forms part of the same lamprey migratory pathway, with lamprey migrating from the River Derwent SAC, through the Humber Estuary SAC, and outwards into coastal waters (and the reverse for returning adults).
1586. The Offshore Development Area is also too distant from the Humber Estuary SAC/Ramsar to directly impact any lamprey species within the Humber Estuary (distance of approximately 45km at the closest point on the Offshore ECC). Therefore, the remaining potential is that adult river and sea lamprey could be found within the vicinity of UXO clearance activities in the nearshore offshore export cable corridor. For this reason, the same rationale underpinning the assessment for the River Derwent SAC also applies in the same way to the Humber Estuary SAC.
1587. To avoid duplication of text, the same Project-alone assessment is not repeated here and can be found in **Section 8.4.2**.
1588. Given the highly limited potential for effects to occur on river lamprey and sea lamprey due to UXO clearance in coastal waters, there is therefore no potential for AEoI on the conservation objectives of the Humber Estuary SAC.

8.5.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

8.5.3.1 Construction

1589. The Humber Estuary SAC has the same Annex II migratory fish as designated features (sea lamprey and river lamprey) as the River Derwent SAC. It also forms part of the same lamprey migratory pathway, with lamprey migrating from the River Derwent SAC, through the Humber Estuary SAC, and outwards into coastal waters (and the reverse for returning adults). For this reason, the same rationale underpinning the assessment for the River Derwent SAC also applies in the same way to the Humber Estuary SAC. To avoid duplication of text, the same in-combination assessment is not repeated here and can be found in **Section 8.5.3**.

1590. Given the low sensitivity of sea lamprey and river lamprey to underwater noise, the low likelihood of UXO clearance for other projects occurring at the same time as the Project, the fact that other projects are following the same preference hierarchy for clearance methods, and the low likelihood that significant numbers of lamprey individuals will be found within the Offshore Development Area at any given time, the likelihood of lamprey species experiencing cumulative noise impacts is low.
1591. There is therefore no potential for AEol on the conservation objectives of the Humber Estuary SAC in combination with other plans and projects.

8.5.4 Summary of Potential Effects on Site Integrity

1592. Due to the limited potential for high-order UXO clearances to be required in the inshore section of the Offshore ECC closest to the Humber Estuary, the low sensitivity of lamprey species to underwater noise, and the hierarchy of preferences for clearance methods (with high order clearance as a last resort only), there is no potential for river lamprey or sea lamprey associated with the Humber Estuary SAC to be significantly affected by UXO noise from the Project-alone or in-combination with other plans or projects.
1593. There is no potential for the Project alone, or in-combination with other plans or projects to cause an AEol on the conservation objectives of the Humber Estuary SAC.

8.6 Humber Estuary Ramsar Site

8.6.1 Site Description

1594. The Humber Estuary Ramsar Site covers the same area as the Humber Estuary SAC and therefore has the same site description. For a detailed site description of the Humber Estuary Ramsar see **Section 8.5.1**.

8.6.1.1 Qualifying Features

1595. Ramsar criterion 8 for the Humber Estuary is that it acts as an important migration route for both river lamprey and sea lamprey between coastal waters and their spawning areas (JNCC, 2008).

8.6.1.2 Conservation Objectives

1596. No conservation measures have been put in place in the Humber Estuary Ramsar specifically for criterion 8 (important migratory route for river and sea lamprey) (JNCC, 2008).

8.6.1.3 Condition Assessment

1597. Whilst condition assessments do not exist for the Humber Estuary Ramsar in the same way as the Humber Estuary SAC, it is acknowledged in the Humber Estuary Ramsar Information Sheet (RIS) that substantial bycatch of lamprey species occurs within the estuary and its catchment, particularly due to eel nets in the River Ouse (JNCC, 2008).

8.6.2 Assessment of Potential Effects of the Project Alone

8.6.2.1 Underwater Noise

8.6.2.1.1 Construction

1598. The Humber Estuary Ramsar has the same Annex II migratory fish as designated features (sea lamprey and river lamprey) as the River Derwent SAC. It also forms part of the same lamprey migratory pathway, with lamprey migrating from the River Derwent SAC, through the Humber Estuary SAC/Ramsar, and outwards into coastal waters (and the reverse for returning adults). For this reason, the same rationale underpinning the assessment for the River Derwent SAC also applies in the same way to the Humber Estuary Ramsar. To avoid duplication of text, the same Project-alone assessment is not repeated here and can be found in **Section 8.4.2**.

1599. Given the highly limited potential for effects to occur on river lamprey and sea lamprey due to UXO clearance in coastal waters, there is therefore no potential for AEol on the conservation objectives of the Humber Estuary Ramsar.

8.6.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

8.6.3.1 Construction

1600. The Humber Estuary Ramsar has the same Annex II migratory fish as designated features (sea lamprey and river lamprey) as the River Derwent SAC. It also forms part of the same lamprey migratory pathway, with lamprey migrating from the River Derwent SAC, through the Humber Estuary SAC/Ramsar, and outwards into coastal waters (and the reverse for returning adults). For this reason, the same rationale underpinning the assessment for the River Derwent SAC also applies in the same way to the Humber Estuary SAC. To avoid duplication of text, the same in-combination assessment is not repeated here and can be found in **Section 8.5.3**.

1601. Given the low sensitivity of sea lamprey and river lamprey to underwater noise, the low likelihood of UXO clearance for other projects occurring at the same time as the Project, the fact that other projects are following the same preference hierarchy for clearance methods, and the low likelihood that significant numbers of lamprey individuals will be found within the Offshore Project Area at any given time, the likelihood of lamprey species experiencing cumulative noise impacts is low.
1602. There is therefore no potential for AEol on the conservation objectives of the Humber Estuary Ramsar in combination with other plans and projects.

8.6.4 Summary of Potential Effects on Site Integrity

1603. Due to the limited potential for high-order UXO clearances to be required in the inshore section of the Offshore ECC closest to the Humber Estuary, the low sensitivity of lamprey species to underwater noise, and the hierarchy of preferences for clearance methods (with high order clearance as a last resort only), there is no potential for river lamprey or sea lamprey associated with the Humber Estuary SAC to be significantly affected by UXO noise from the Project-alone or in-combination with other plans or projects.
1604. There is **no potential for the Project alone, or in-combination with other plans or projects to cause an AEol on the conservation objectives of the Humber Estuary Ramsar.**

9 Stage 2 Assessment of Sites Designated for Offshore Annex II Marine Mammals

9.1 Approach to Assessment

1605. For marine mammals, the approach to the RIAA primarily focuses on the potential for connectivity between individual marine mammals from designated populations and the Offshore Development Area (i.e. demonstration of a clear source-pathway-receptor relationship). This is based on the distance of the Offshore Development Area from a European site, the range of each effect, the potential for animals from a European site to be within range of an effect, and the overall distribution and movement patterns of each marine mammal species.
1606. A HRA screening exercise was undertaken to consider European sites (SCIs and SACs) which meet the following criteria (Annex A.2 HRA Screening Report):
- The distance between the potential effect of the Offshore Development Area and a European site with marine mammals as a qualifying feature is within the range for which there could be an interaction. For example, the distance is within potential effect ranges from underwater noise and therefore the site is within the area of effect for underwater noise effects;
 - The distance between the Offshore Development Area and resources on which the qualifying marine mammal feature depends (i.e. an indirect effect acting through prey or access to habitat) is within the potential area of effect (for example the distance is within potential effect ranges); and
 - The likelihood that a foraging area or a migratory route occurs within the area of effect of the proposed Project (applies to mobile interest features when outside the designated site).
1607. Designated European sites that did not meet these criteria have been screened out from further assessment. For further details on the screening process see the **HRA Screening Report** (see **Annex A.2**).
1608. Assessment of species-specific risk to potential effects of OWFs is informed by industry-standard advice and guidance, relevant scientific papers, and representations from both the Project and stakeholders during DCO examinations for OWFs.

9.2 Consultation

1609. **PEIR Volume 2, Appendix 12.1** provides a summary of how the consultation responses relevant to Marine Mammals received to date have influenced the approach that has been taken.

9.3 Assessment of Potential Effects

9.3.1 Embedded and Standard Mitigation Measures

1610. Embedded mitigation measures are discussed further in **Section 12.4.3** and **Table 12-7** in **PEIR Volume 1, Chapter 12 Marine Mammals**. The same embedded mitigation measures that are presented in that section and table are appropriate for this HRA assessment in relation to commitments that the Project is going to follow for marine mammals (**PEIR Volume 2, Appendix 6.3 Commitments Register**).

9.3.2 Additional Mitigation

1611. In addition to the mitigation measures referred to above, the Project has also committed to the following measures (**Table 9.1**).

Table 9.1 Additional Mitigation Measures

Commitment ID	Mitigation Measure	Description
CO22	MMMP for piling activities	<p>A piling MMMP will be provided in accordance with the PEIR Outline MMMP (document reference 8.1) 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 PTS, for example, the activation of an Acoustic Deterrent Device (ADD) prior to the soft-start, as much as is practicable.</p> <p>Whilst this is primarily for marine mammal mitigation, the measures included will also benefit some sound sensitive fish species and allows for pursuit diving species (such as guillemot and razorbill) to move away from the piling activities ahead of more intensive noise levels being reached.</p> <p>An Outline MMMP (document reference 8.1) has been submitted for consultation alongside the PEIR (Outline MMMP, document reference 8.1).</p>

Commitment ID	Mitigation Measure	Description
CO20	MMMP for UXO clearance	<p>A UXO specific MMMP for UXO clearances will be developed and will include details on clearance options, and 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 ADD prior to the clearance, as much as is practicable. Any required UXO clearance activities would be subject to a separate Marine Licence application.</p> <p>An Outline MMMP has been provided for consultation alongside the PEIR (Outline MMMP, document reference 8.1).</p>

9.3.3 Worst-Case Scenario

1612. **Table 9.2** provides the relevant worst-case parameters for the offshore Project infrastructure relevant to Annex II Marine Mammals. 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.
1613. The realistic worst-case scenarios used to assess impacts on marine mammals are defined in **Table 9.2**. Following the draft RIAA, further design refinements will be made based on ongoing engineering studies and considerations of the RIAA and stakeholder feedback. Therefore, realistic worst-case scenarios presented in this draft RIAA may be updated in the RIAA. The design envelope will be refined where possible to retain design flexibility only where it is needed.

Table 9.2 Realistic Worst-Case Scenario for Marine Mammals

Impact	Worst case scenario	Notes and rationale
Construction phase		
Impacts 1 and 2: Underwater noise and vibration from piling	<p>Number of piles for max. 113 wind turbine foundations:</p> <ul style="list-style-type: none">Up to 113 monopiles (14MW turbines); andUp to 904 jacket pin piles (eight pin piles per foundation). <p>Number of piles for two offshore platform (OP) foundations:</p> <ul style="list-style-type: none">Up to 10 monopiles; andUp to 60 pin piles. <p>Total number of piles for wind turbine and OP foundation:</p> <ul style="list-style-type: none">Up to 125 monopiles; andUp to 964 pin piles.	<p>The spatial worst-case scenario is based on the largest hammer energy which is required for monopile foundations.</p> <p>The temporal worst-case scenario is based on the largest number of piling events which is required for pin pile foundations.</p> <p>Full hammer energy is unlikely to be required on all piles, but is assessed for all piles as a worst-case scenario.</p> <p>Suction bucket foundations as an alternative foundation type are an option, but do not represent the worst-case scenario for underwater noise.</p>
	<p>Maximum hammer energy for monopiles:</p> <ul style="list-style-type: none">Up to 8,000kJ. <p>Maximum hammer energy for jacket pin piles</p> <ul style="list-style-type: none">Up to 5,000kJ.	
	<p>Maximum pile diameter for monopiles:</p> <ul style="list-style-type: none">Up to 18m. <p>Maximum pile diameter for jacket piles:</p> <ul style="list-style-type: none">Up to 5m.	
	<p>Duration of wind turbine/ Offshore Platform foundation installation:</p> <ul style="list-style-type: none">Approximately 18 months for wind turbine foundation installation; andApproximately one year for OP installation.	
	<p>Maximum active piling time for wind turbine foundations:</p> <ul style="list-style-type: none">Monopiles (including soft-start and ramp-up):<ul style="list-style-type: none">5 hours & 20 minutes per wind turbine foundation; andUp to 603 hours (25.1 days) for 113 wind turbines.Jacket pin piles (including soft-start and ramp-up):<ul style="list-style-type: none">5 hours & 20 minutes hours per pin pile; andUp to 4,822 hours (200.9 days) for 113 wind turbines (904 total pin piles).	

Impact	Worst case scenario	Notes and rationale
	<p>Maximum active piling time for two OP foundation:</p> <ul style="list-style-type: none">• Monopiles (including soft-start and ramp-up):<ul style="list-style-type: none">○ 5 hours & 20 minutes hours per monopile; and○ Up to 64 hours (2.7 days) for two OPs.• Jacket pin piles (including soft-start and ramp-up):<ul style="list-style-type: none">○ 5 hours & 20 minutes hours per pin pile; and○ Up to 320 hours for two OPs (60 total pin piles).	
	<p>Maximum total active piling time for wind turbine & OP foundations (including soft-start and ramp-up):</p> <ul style="list-style-type: none">• Monopiles for wind turbines and OP:<ul style="list-style-type: none">○ 667 hours (27.8 days).• Monopiles for wind turbines and pin piles for OP:<ul style="list-style-type: none">○ 986 hours (41.1 days).• Pin piles for wind turbines and OP:<ul style="list-style-type: none">○ 5,138 hours (214.1 days).	
	<p>Activation of Acoustic Deterrent Device (ADD):</p> <ul style="list-style-type: none">• 80 minutes per monopile; and• 65 minutes per pin pile.	Activation of ADD is indicative only and the details will be confirmed during the post-consent phase, through the finalisation of the MMMP.
	<p>Concurrent piling for:</p> <ul style="list-style-type: none">• Monopiles.	Cumulative sound exposure levels (SEL _{cum}) have been modelled for a concurrent piling scenario by which two sequential monopiles are installed at the north-west (NW) location and two sequential monopiles are installed at the south-east (SE) location at the same time.
	<p>Potential for sequential piling:</p> <ul style="list-style-type: none">• Up to two monopiles or four pin piles could be installed sequentially in same 24-hour period.	Cumulative sound exposure levels (SEL _{cum}) have been modelled for each piling event under consideration: two monopiles piled sequentially and four pin piles piled sequentially.
	Underwater noise modelling was undertaken for worst case scenarios for piling. See the PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report for parameters and scenarios	

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Impact	Worst case scenario	Notes and rationale
Impacts 3 and 4: Underwater noise from other construction activities and vessels	Seabed clearance methods could include: <ul style="list-style-type: none"> Boulder and sandwave clearance and dredging. Cable & cable protection installation methods: <ul style="list-style-type: none"> Trenching (e.g., jetting or mechanical cutting); Dredging; Ploughing; Cable laying; and Rock placement. 	<p>The exact processes used to prepare the site will depend on the foundation type chosen for the Project.</p> <p>Underwater noise modelling is available for the following activities (see PEIR Volume 2, Appendix 12.3 Underwater Noise modelling Report):</p> <ul style="list-style-type: none"> Dredging (backhoe and suction), drilling, rock placement, suction bucket installation, vessels (</> 100m), cable laying, and trenching. <p>Suction bucket installation, followed by suction dredging, is considered to be the loudest activity in terms of underwater noise levels.</p>
	Array Area: 262km ²	DBD Array Area
	Duration of offshore construction: Five years.	Offshore construction works could require up to five years but is more likely to be between three to four years.
	For detailed information on construction vessel presence see below (Impact 6)	
Impact 5: Barrier effect from underwater noise	<p>Maximum impact range for all potential noise sources from underwater noise assessments (worst-case parameters described above).</p> <p>Closest distance to shore from DBD Array Area: 210km.</p>	The maximum spatial area of potential impact, and duration of impacts, are considered to cause the worst-case barrier effect for underwater noise.
Impact 6: Vessel collision risk	<p>Vessels:</p> <ul style="list-style-type: none"> Site preparation: <ul style="list-style-type: none"> Max. 18 vessels on site at the same time; and 243 round trips. Wind turbine foundation installation: <ul style="list-style-type: none"> Max. 30 vessels on site at the same time; and 1,921 round trips. OP foundation installation: <ul style="list-style-type: none"> Max. 12 vessels on site at the same time; and 60 round trips. OP topside installation: <ul style="list-style-type: none"> Max. 26 vessels on site at the same time; and 86 round trips. Scour, cable protection, and grout installation: <ul style="list-style-type: none"> Max. nine vessels on site at the same time; and 678 round trips. 	<p>Due to construction sequencing, not all vessel types will be on site at the same time. The number of vessels would vary depending on activities taking place within wind farm site.</p> <p>Assessments are based on the worst-case scenario for the maximum number of vessels on site at any one time during the construction period.</p> <p>Construction port(s) would be confirmed prior to the start of construction.</p>

Impact	Worst case scenario	Notes and rationale
	<ul style="list-style-type: none">• Turbine installation:<ul style="list-style-type: none">○ Max. 24 vessels on site at the same time; and○ 2,147 round trips.• Inter-array cables:<ul style="list-style-type: none">○ Max. 13 vessels on site at the same time; and○ 1,884 round trips.• Offshore export cables:<ul style="list-style-type: none">○ Max. 23 vessels on site at the same time; and○ 376 round trips.• Other vessels:<ul style="list-style-type: none">○ Max. four vessels on site at the same time; and○ 132 round trips. <p>Maximum total number of construction vessels in the offshore ECC at any one time = up to 55 vessels</p> <p>Maximum total number of construction vessels in the DBD Array Area at any one time = up to 35 vessels</p> <p>Maximum total number of construction vessels on site at any one time = up to 90 vessels</p> <p>Maximum total number of round trips over construction period = 7,527 (or an average of 1,506 annual round trips over five-year construction period)</p> <p>Vessel types:</p> <ul style="list-style-type: none">• Jack-up vessel;• Heavy lift vessel;• Construction support vessels / service operation vessel;• Rock placement vessels;• Boulder clearance;• Dredgers;• Cable lay vessel;• Pre-lay grapnel run vessel;• Heavy transport vessel;• RO-RO & LO-LO vessels;• Cargo vessels;• Offshore supply vessel;• Anchor handlers;• Support vessel;• Tugs & barges;	

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Impact	Worst case scenario	Notes and rationale
	<ul style="list-style-type: none"> Guard vessels; and Survey & dive vessels. 	
Impact 7: Disturbance at seal haul-out sites	<p>Distance from landfall area and DBD Array Area to seal haul-out sites see PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report Table 12.2-13 and Table 12.2-15.</p> <p>The closest haul-out site to landfall area is 14km (Flamborough Head); the DBD Array Area is 210km from the nearest point to in the coast. Number of vessel trips as outlined below.</p> <p>For detailed information on construction vessel presence see below for MM-C-09.</p>	<p>Construction port(s) would be confirmed prior to the start of construction. However, the assessment considers the potential for in-transit vessels in proximity to the seal haul out sites in the marine mammal Study Area.</p> <p>Movements of construction vessels could occur throughout the year</p>
Impact 8: Changes to prey resources	Prey impacts from temporary habitat loss / physical disturbance within the DBD Array Area is 17,248,642m ² and 16,637,100m ² in the offshore ECC (both within and outside the Array Area) across the duration of the construction phase.	<p>The worst-case scenario for marine mammals is based on the worst-case table (Table 11.6) and conclusions of the assessments presented in PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology:</p> <ul style="list-style-type: none"> Temporary habitat loss / physical disturbance (FSE-C-02); Increased suspended sediment and sediment re-deposition (FSE-C-04); Remobilisation of contaminated sediments if present (offshore ECC) (FSE-C-06); Underwater noise and vibration (FSE-C-07); and Changes in fishing pressure (FSE-C-08).
	Suspended sediment / re-deposition volume within the Project Area is 114,502,365m ³ (drilling and seabed preparation combined). See PEIR Volume 1, Chapter 8 Marine Physical Processes .	
	Contaminated sediments: see surveys in in PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality .	
	Prey impacts from underwater noise as outlined for Impacts MM-C-03 and MM-C-05 and PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling .	
	Changes in fishing pressure outlined in PEIR Volume 1, Chapter 14 Commercial Fisheries .	
Impact 9: Changes to water quality	Changes to water quality: as assessed in PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality .	Worst-case scenario for any potential changes to water quality that could affect marine mammals directly.
Operation and Maintenance phase		
Impacts 1 and 2: Underwater noise from operational turbines	<p>Wind turbine parameters (e.g. size and number) as outlined above.</p> <p>Underwater noise parameters in PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report.</p> <p>Operational life of DBD = 35 years.</p>	Assessment (and underwater noise modelling) based on the largest diameter wind turbines and MW, and largest potential number of wind turbines.
Impacts 3 and 4: Underwater noise from maintenance activities and vessels	<p>Cable repair and replacement could include:</p> <ul style="list-style-type: none"> Trenching; Dredging; Ploughing; Cable laying; and Rock placement. <p>Operational lifetime of DBD = 35 years.</p> <p>Other maintenance activities would require vessels. See below for more details on vessel presence.</p>	Underwater noise modelling undertaken for rock placement as part of a cable-reburial method (PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report).

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Impact	Worst case scenario	Notes and rationale
Impact 5: Barrier effect from underwater noise	<p>Maximum impact range for all potential noise sources from underwater noise assessments during O&M phase.</p> <p>Closest distance to shore from Array Area: 210km.</p>	The maximum spatial area of potential impact, and duration of impacts, are considered to cause the worst-case barrier effect for underwater noise.
Impact 6: Vessel collision	<p>Maximum of O&M vessels at site at any one time: 16</p> <p>Maximum total number of return trips per year = 96</p> <p>Vessel types:</p> <ul style="list-style-type: none"> • Three SOVs; • One platform supply vessel; • Six USVs for surveys; • One Jack-up vessel; • Three cable lay / cable support vessels; • One offshore support vessel; and • One fall pipe vessel. 	Assessments are based on the worst-case scenario for the maximum number of vessels on site at any one time during O&M.
Impact 7: Disturbance at Seal Haul-Out Sites	<p>Maximum of O&M vessels at site at any one time: 16.</p> <p>Location of works:</p> <ul style="list-style-type: none"> • Distance to DBD Array Area: 210km; and • O&M port in North-East England. 	O&M activities could happen at any time of year and throughout the lifetime of the Project.
Impact 8: Changes to prey resources	<p>The worst-case scenario for marine mammals is based on the conclusions of the assessments presented in PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology for all possible effects on prey:</p> <ul style="list-style-type: none"> • Temporary habitat loss / physical disturbance (FSE-O-02); • Habitat loss / alteration (FSE-O-03); • Increased suspended sediment and sediment-redeposition (FSE-O-04); • Remobilisation of contaminated sediments if present - offshore ECC (FSE-O-06); • Underwater noise and vibration (FSE-O-07); • Changes in fishing pressure (FSE-O-08); • Electromagnetic field (EMF) effects (FSE-O-09); • Sediment heating from export cables (FSE-O-10); and • Introduction of hard substrate (FSE-O-11). 	
Impact 9: Barrier effects from physical presence of wind farm	<ul style="list-style-type: none"> • Wind turbine spacing: 862m (center to center); and • Distance to shore: 210km. 	The maximum spatial area of potential impact is considered to cause the worst-case barrier effect, due to the presence of wind farm infrastructure.

Impact	Worst case scenario	Notes and rationale
Decommissioning phase		
<p>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 PEIR Volume 1, Chapter 4 Project Description.</p> <p>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 Programme (see CO21 of the commitments register (PEIR Volume 2, Appendix 6.3 Commitments Register), which will be submitted and agreed with the relevant authorities prior to the commencement of offshore decommissioning works.</p> <p>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.</p>		

9.3.4 Definition of Significance

1614. The potential effects have been assessed for each of the designated sites for marine mammals for the construction, operation, maintenance and decommissioning of the Project.
1615. Assessments of the potential for adverse effects, at the population level, have been based on the JNCC *et al* (2010) draft guidance for effects on EPS, and the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) agreement.
1616. The JNCC *et al* (2010) draft guidance provides some indication on how many animals may be removed from a population without causing detrimental effects to the population at Favourable Conservation Status (FCS). The JNCC *et al* (2010) draft guidance also provides limited consideration of temporary effects, with guidance reflecting consideration of permanent displacement.
1617. JNCC *et al* (2010) draft guidance considered 4% as the maximum potential growth rate in harbour porpoise, and the ‘default’ rate for cetaceans. Therefore, beyond natural mortality, up to 4% of the population could theoretically be permanently removed before population growth could be halted. In assigning 5% to a temporary effect, consideration is given to uncertainty of the individual consequences of temporary disturbance.
1618. Permanent effects with a greater than 1% of the reference population being affected within a single year are considered to result in a significant effect. This is based on ASCOBANS and Defra advice (Defra, 2003; ASCOBANS, 2015) relating to impacts from fisheries by-catch (i.e. a permanent effect) on harbour porpoise. A threshold of 1.7% of the relevant harbour porpoise population above which a population decline is inevitable has been agreed with Parties to ASCOBANS, with an intermediate precautionary objective of reducing the impact to less than 1% of the population (Defra, 2003; ASCOBANS, 2015).
1619. As a precautionary approach, and as there is no current guidance on what determines a significant temporary or permanent effect, the above information on the potential for population level effects has been used to inform the approach to defining potential for adverse effect for harbour porpoise, bottlenose dolphin, grey seal and harbour seal populations. The approach to define the potential for adverse effect on the integrity of the site, based on the potential effect to the overall populations, is therefore as follows:
 - For temporary effects, there would be potential for an adverse effect on the integrity of the site, if there is an effect to 5% or more of the population; and
 - For permanent effects, there would be potential for an adverse effect on the integrity of the site, if there is an effect to 1% or more of the population.

1620. The exception to this approach is the use of the Effective Deterrent Range (EDR) spatial approach for disturbance impacts upon harbour porpoise within the SNS SAC (see **Section 9.4.2.1.2**), following the guidelines provided in JNCC *et al* (2020).

9.4 Southern North Sea SAC

9.4.1 Site Description

1621. The SNS SAC has been recognised as an area with persistent high densities of harbour porpoise (JNCC, 2017; JNCC and Natural England, 2019) and is the largest designated site for harbour porpoise in UK and European waters at the time of designation.
1622. The SNS SAC covers an area of 36,951km², with both winter and summer habitats of importance to harbour porpoise (JNCC, 2017). Approximately 27,028km² of the site is important in the summer period (183 days from April to September inclusive) and 12,696km² of the site is important in the winter period (182 days from October to March inclusive) (JNCC *et al.*, 2020). The majority of the site is less than 40m in depth, reaching up to 75m in the northern most areas.
1623. The SNS SAC nearest distance to the Array Area is 39km (to the summer area) and therefore does not overlap. However, the offshore ECC overlaps with the summer area of the SNS SAC, as seen in **Figure 9-1**. The Array Area is approximately 222km to the winter area and the offshore ECC is approximately 140km from the winter area. Therefore, the SNS SAC winter area has not been assessed further.

9.4.1.1 Qualifying Feature

9.4.1.1.1 Harbour Porpoise

1624. Within the southern North Sea area, harbour porpoise is the most common marine mammal species (Hammond *et al.*, 2021). Heinänen and Skov (2015) identified that within the North Sea, water depth and hydrodynamic variables are the most important factors in harbour porpoise densities in species areas, in both winter and summer seasons. The seabed sediments also play an important role in determining areas of high harbour porpoise density, as well as the number of vessels present in the area.
1625. The Array Area is in the SCANS-IV (Small Cetaceans in the European Atlantic and North Sea) survey block NS-H (Gilles *et al.*, 2023) where:
 - Abundance estimate = 55,691 harbour porpoise (95% Confidence Interval (CI) = 33,836 – 87,685); and
 - Density estimate = 0.8034 harbour porpoise/km² (Coefficient of Variation (CV) = 0.241).

1626. The offshore ECC lies within SCANS-IV block NS-C, where:
- Abundance estimate = 36,286 (95% CL = 23,346 – 56,118); and
 - Density estimate = 0.6027 animals/km² (CV = 0.228).
1627. Data from the Project site specific surveys have also been used to generate abundance and density estimates for the sites with a 4km buffer (for further details see **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report**). The average of the winter months, summer months, and annual density has then been calculated based on the maximum calculated for each month. **Table 9.3** shows the densities for harbour porpoise, based on all individuals that have the potential to be harbour porpoise.

Table 9.3 Maximum Site-Specific Survey Harbour Porpoise Summer, Winter and Annual Density Estimates for the Project

Season	Maximum density estimate (corrected) for whole survey area (animals/km ²)
Average winter	0.825
Average summer	0.842
Average annual	0.833

1628. The site-specific surveys indicate the average maximum densities for the summer or winter seasons over the two years are quite similar (**PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report**). There is no evident pattern of harbour porpoise distribution within the survey area, with no indication of a particular area of importance.
1629. As a precautionary approach, the worst-case average summer density estimate of harbour porpoise from the site specific surveys (0.842 harbour porpoise/km²) have been used in the impact assessments for impacts relating to the Array Area, and the worst-case density of 0.6027/km² (Gilles *et al.*, 2023) for the offshore ECC has been taken forward for any impacts relating to the offshore ECC.
1630. The Inter-Agency Marine Mammal Working Group (IAMMWG, 2023) define three MUs for harbour porpoise. The Array Area and offshore ECC are located in the North Sea (NS) MU. The most recent abundance estimate for the NS Management Unit (MU) was published in the SCANS-IV survey, indicating that there are 338,918 harbour porpoise in the North Sea Assessment Unit (AU) (Gilles *et al.*, 2023).

1631. The SNS SAC Site Selection Report (JNCC, 2017) identifies that the SNS SAC site supports approximately 18,500 individuals (95% CI = 11,864 - 28,889) for at least part of the year (JNCC, 2017). However, JNCC and Natural England (2019) states that because this estimate is from a one-month survey in a single year (the SCANS-II survey in July 2005) it cannot be considered as an estimated population for the site. It is therefore not appropriate to use site population estimates in any assessments of effects of plans or projects on the site (i.e. HRA), as they need to take into consideration population estimates at the MU level, to account for daily and seasonal movements of the animals (JNCC and Natural England, 2019).

9.4.1.2 Conservation Objectives

1632. The Conservation Objectives for the SNS SAC are designed to help ensure that the obligations of the Habitats Directive can be met. Article 6(2) of the Habitats Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely.

1633. The Conservation Objectives (JNCC and Natural England, 2019) for the SNS SAC are:

“To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS for Harbour Porpoise in UK waters.

In the context of natural change, this will be achieved by ensuring that:

- 1. Harbour porpoise is a viable component of the site;*
- 2. There is no significant disturbance of the species; and*
- 3. The condition of supporting habitats and processes, and the availability of prey is maintained”.*

1634. These Conservation Objectives are:

“a set of specified objectives that must be met to ensure that the site contributes in the best possible way to achieving FCS of the designated site feature(s) at the national and biogeographic level” (JNCC and Natural England, 2019)”.

9.4.1.2.1 Conservation Objective 1: The Species is a Viable Component of the Site

1635. This Conservation Objective is designed to minimise the risk of injury and killing or other factors that could restrict the survivability and reproductive potential of harbour porpoise using the SAC. Specifically, this objective is primarily concerned with operations that would result in unacceptable levels of those impacts on harbour porpoise using the SAC. Unacceptable levels can be defined as those having an impact on the FCS of the population of the species in their natural range.

1636. Harbour porpoise are considered to be a viable component of the SAC if they are able to live successfully within it. The SNS SAC has been selected primarily based on the long term, relatively higher densities of porpoise in contrast to other areas of the North Sea. The implication is that the SAC provides relatively good foraging habitat and may also be used for breeding and calving. However, because the number of harbour porpoise using the site naturally varies there is no exact value for the number of animals expected within the site (JNCC and Natural England, 2019).

1637. The Conservation Objectives (JNCC and Natural England, 2019) state that, with regard to assessing impacts, *‘the reference population for assessments against this objective is the MU population in which the SAC is situated’*.

1638. Harbour porpoise are listed as European Protected Species (EPS) under Annex IV of the Habitats Directive, and are therefore protected from the deliberate killing (or injury), capture and disturbance throughout their range. Under the Habitats Regulations, it is an offence if harbour porpoise are deliberately disturbed in such a way as to:

- Impair their ability to survive, to breed or reproduce, or to rear or nurture their young; or
- To affect significantly the local distribution or abundance of that species.

1639. The term deliberate is defined as any action that is shown to be *“by a person who knows, in the light of the relevant legislation that applies to the species involved, and the general information delivered to the public, that his action will most likely lead to an offence against a species, but intends this offence or, if not, consciously accepts the foreseeable results of his action”*.

1640. In addition, Article 12(4) of the Habitats Directive is concerned with incidental capture and killing. It states that Member States *“shall establish a system to monitor the incidental capture and killing of the species listed on Annex IV (all cetaceans). In light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned”*.

9.4.1.2.2 Conservation Objective 2: There Is No Significant Disturbance of The Species

1641. The disturbance of harbour porpoise typically, but not exclusively, originates from operations that cause underwater noise, including activities such as seismic surveys, pile driving and sonar.

1642. Disturbance is considered to be significant if it leads to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. The current SNCBs guidance for the assessment of significant noise disturbance on harbour porpoise in the SNS SAC (JNCC *et al.*, 2020) is that:

“Noise disturbance within an SAC from a plan/project individually or in-combination is considered to be significant if it excludes harbour porpoise from more than:

- *20% of the relevant area of the site in any given day, or*
- *An average of 10% of the relevant area of the site over a season.”*

9.4.1.2.3 Conservation Objective 3: The Condition of Supporting Habitats and Processes, and The Availability of Their Prey Is Maintained

1643. Supporting habitats, in this context, means the characteristics of the seabed and water column. Supporting processes encompass the movements and physical properties of the habitat. The maintenance of these supporting habitats and processes contributes to ensuring prey is maintained within the site and is available to harbour porpoise using the SAC. Harbour porpoise are strongly reliant on the availability of prey species year round due to their high energy demands, and their distribution and condition may strongly reflect the availability and energy density of prey.

1644. This Conservation Objective is designed to ensure that harbour porpoise are able to access food resources year round, and that activities occurring in the SNS SAC will not affect this.

9.4.2 Assessment of Potential Effects of the Project Alone

1645. The Array Area is located 39km from the SNS SAC and the offshore ECC is within the SNS SAC (see **Figure 9-1**), therefore there is potential for LSE on its designated feature, harbour porpoise, during construction, O&M or decommissioning of DBD. This resulted in the SNS SAC being screened into the assessment through the **Annex 2, HRA Screening Report**.

1646. For the purposes of the assessments, the potential effects considered in relation to the SNS SAC Conservation Objectives are outlined in **Table 9.4**.

1647. The potential effects of DBD that are assessed to determine any potential for an adverse effect on the integrity of the SNS SAC in relation to the Conservation Objectives for harbour porpoise are outlined in **Section 4.5.3**.

Table 9.4 Potential Effects of DBD in Relation to the Conservation Objectives of the SNS SAC for Harbour Porpoise

Conservation Objective for harbour porpoise	Potential Effect
Harbour porpoise is a viable component of the site	Physical and permanent auditory injury from underwater noise will be mitigated but in line with current advice this is screened in.
	Significant disturbance and displacement as a result of increased underwater noise levels has the potential to have an adverse effect on harbour porpoise from the SNS SAC and will be considered further.
	Any potential increased collision risk with vessels could cause a potential LSE which will be considered further.
There is no significant disturbance of the species	Significant disturbance and displacement as a result of increased underwater noise levels has the potential to have an adverse effect on harbour porpoise from the SNS SAC and will be considered further.
The condition of supporting habitats and processes, and the availability of prey is maintained	Changes in water quality and prey availability have the potential to affect the harbour porpoise from the SNS SAC and will be considered further.

1648. Assessment of the potential effects on the SNS SAC for harbour porpoise, is based on the current SNCB advice (JNCC *et al.*, 2020); that noise disturbance within an SAC from a plan/project, individually or in-combination, is considered to be significant if it excludes harbour porpoises from more than:

- 20% of the relevant area of the site in any given day; or
- an average of 10% of the relevant area of the site over a season.

1649. The potential effect should be considered in the context of the seasonal components of the SAC area, rather than the SAC area as a whole.

1650. The assessments are based on the current recommended EDRs for assessing the disturbance of harbour porpoise in the SAC from different noise generating activities (JNCC *et al.*, 2020).

9.4.2.1 Potential Effects During Construction

9.4.2.1.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Impact Piling During Construction

1651. The foundation options being considered for the Project include monopiles and jackets (pin piles). As a worst-case scenario for underwater noise, it has been assumed that all foundations could be piled.

1652. Impact piling is a source of high-level underwater noise. Underwater noise can cause both physiological (e.g. lethal, physical injury and auditory injury) and behavioural (e.g. disturbance and masking of communication) impacts on marine mammals.

1653. Underwater noise modelling was carried out by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during noisy activities and determine the potential impacts on marine mammals using the INSPIRE v5.2 (Impulsive Noise Propagation and Impact Estimator) semi-empirical underwater noise propagation model (PEIR Volume 2, Appendix 12-3 Underwater Noise Modelling Report).

1654. The underwater noise modelling was based on the following worst-case scenarios for monopiles and pin piles:

- Two monopiles, with a maximum diameter of up to 18m, a maximum hammer energy of up to 8,000kJ, and a maximum starting hammer energy of 800kJ; and
- Four pin piles, with a maximum diameter of up to 5m, a maximum hammer energy of up to 5,000kJ, and a maximum starting hammer energy of 500kJ.

1655. To determine the potential for permanent auditory injury (PTS) the soft-start, hammer energy profile, total active piling duration, and strike rate are taken into account. The soft-start includes low-energy blows (at the starting hammer energy) for 20 minutes, followed by a gradual increase (ramp-up) for an hour before the maximum hammer energy required to safely install the pile is reached.

1656. As a worst-case scenario, it is assumed that all piles installed will require 100% of the maximum hammer energy, however, maximum hammer energy is only likely to be required at a few of the piling installation locations, and for shorter periods of time.

1657. The low-energy blows, ramp-up, and piling duration used to assess cumulative sound exposure level (SEL_{cum}) for both monopiles and pin piles are summarised in Table 9.5.

1658. The assessments are based on the latest Southall *et al* (2019) thresholds and criteria for marine mammals. The thresholds indicate the onset of PTS, the point at which there is an increase in risk of permanent hearing damage in an underwater receptor (although not all individuals within the maximum PTS range will have permanent hearing damage, this is assumed as a worst-case scenario).

Table 9.5 Hammer Energy, Ramp-Up and Piling Duration for Monopiles

	Starting hammer energy	Ramp-up	Maximum hammer energy
Monopiles			
Monopile hammer energy (%)	10% (800kJ)	Gradual ramp-up	Operational piling (100% (8,000kJ))
Number of hammer strikes	600	1,800	7,200
Duration	20 minutes	1 hour	4 hours
Strikes per minute	30	30	30
Maximum piling in 24 hours	Up to two monopiles (10 hours and 40 minutes maximum of active piling, with each pile installed as per the parameters above)		
Pin pile			
Pin pile hammer energy (%)	10% (500kJ)	Gradual ramp up	100% (5,000kJ)
Number of strikes	600	1,800	7,200
Strikes per minute	20 minutes	1 hour	4 hours
Duration	30	30	30
Maximum piling in 24 hours	Up to four pin piles (21 hours and 20 minutes maximum of active piling, with each pile installed as per the parameters above)		

9.4.2.1.1.1 PTS From a Single Strike

1659. The underwater noise modelling results for the predicted effect ranges and areas for PTS from a single strike of the maximum hammer energy for the worst case location are shown in **Table 9.6**, and have been used to inform the following assessment.

Table 9.6 The Predicted Effect Ranges for PTS, at the Worst Case Modelling Location for Harbour Porpoise, for the Maximum Hammer Energies of Both Monopiles and Pin Piles

Marine mammal species	Potential effect ranges (and areas) for PTS at the maximum hammer energy	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Harbour porpoise	0.69km (1.5km ²)	0.63km (1.2km ²)

1660. An assessment of the maximum number of individuals that could be at risk of instantaneous PTS, due to a single strike at the maximum hammer energy, for both monopiles and jacket pin piles, is presented in **Table 9.7**.

Table 9.7 Assessment of the Potential for Instantaneous PTS Due to a Single Strike of the Maximum Hammer Energy for a Monopile and Jacket Pin Pile

Marine mammal species	Assessment of effect
PTS due to a single strike of a monopile at maximum hammer energy (Sound pressure level (SPL_{peak}))	
Harbour porpoise	2 (0.0006% of NS MU)
PTS due to a single strike of a jacket pin pile at maximum hammer energy (SPL_{peak})	
Harbour porpoise	1 (0.0003% of NS MU)

1661. The maximum potential number of harbour porpoise that could be at possible risk of PTS due to a single strike at the maximum hammer energy, for monopiles, without any mitigation is two individuals (<1% of the NS MU reference population). The maximum potential number of harbour porpoise that could be at possible risk of PTS from due to a single strike at the maximum hammer energy, for jacket pin piles, without any mitigation is one individual (<1% of the NS MU reference population).

9.4.2.1.1.2 PTS from Cumulative Exposure

1662. The SEL_{cum} is a measure of the total received noise over the whole piling operation. The SEL_{cum} range indicates the distance from the piling location that if the receptor were to start fleeing in a straight line from the noise source starting at a range closer than the modelled range it would receive a noise exposure in excess of the criteria threshold, and if the receptor were to start fleeing from a range further than the modelled range it would receive a noise exposure below the criteria threshold.

1663. **Table 9.8** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of monopiles and jacket pin piles at the worst-case location.

1664. It is important to note that the assessment for PTS from cumulative exposure is highly precautionary. There is some variation in the potential impact ranges for SEL_{cum} at each location and between locations, therefore in many cases less individuals would be at risk of exposure than presented here (as the assessments are based on the worst-case location). It is also unlikely that the maximum hammer energy would be required at all piling locations for the entire duration of the piling activity.

Table 9.8 Predicted Effect Ranges (and Areas) for PTS for Harbour Porpoise, at the Worst-Case Modelling Location, for the Cumulative Exposure of Both Monopiles and Pin Piles

Marine mammal species	Potential effect ranges (and areas) for PTS due to cumulative exposure	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Multiple sequential pile installations in a 24 hour period	7km (140km ²)	5.8km (91km ²)

1665. An assessment of the maximum number of harbour porpoise that could be at risk of cumulative PTS, for both sequential monopiles and jacket pin piles, is presented in **Table 9.9**, based on the effect areas as presented in **Table 9.8**.

Table 9.9 Assessment of the Potential for PTS Due to the Cumulative Exposure of Sequential Monopiles or Jacket Pin Piles in a 24-Hour Period for Harbour Porpoise

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of two sequential monopiles in a 24 hour period (SEL _{cum})	118 (0.035% of NS MU)
PTS due to the cumulative exposure of four sequential jacket pin piles in a 24 hour period (SEL _{cum})	77 (0.023% of NS MU)

1666. In the worst case of monopiles, 118 individuals (<1% of the NS MU reference population) could be at risk of cumulative PTS due to the cumulative exposure of two sequential monopiles in a 24-hour period.

9.4.2.1.1.3 PTS from Cumulative Exposure from Multiple Piling Locations

1667. The simultaneous piling scenario assumes that animals are within potential effect ranges for a much longer period (i.e. they would be travelling from one pile location to another which piling is ongoing), and therefore cumulative effect ranges are much larger than for the cumulative exposure ranges of one pile at a time.

1668. The potential effect ranges are not possible to model under this scenario, as there are two starting points for receptors, and it is not possible to determine the potential range at which they need to be in order to not be at risk of effect. Therefore, the following assessment is based on the potential areas of effect only.

1669. Where the potential effect areas are not large enough to interact with each other (i.e. they do not meet), the results for the respective locations and scenarios are used (the results of the modelling for the Southeast (SE) and Northwest (NW) locations are used to inform the assessment, to align with the modelling locations used for the simultaneous modelling).

1670. **Table 9.10** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of simultaneous monopiles at the NW and SE modelling locations. These locations were chosen as they have the potential for the largest ‘spread’ in terms of underwater noise propagation. The modelling includes two monopiles being installed sequentially at each location at the same time.

Table 9.10 Predicted Effect Ranges (and Areas) for PTS for Harbour Porpoise at the NW and SE Modelling Locations, for the Cumulative Exposure of Multiple Monopiles Installations at the Same Time

Marine mammal species	Potential effect areas for PTS due to cumulative exposure of simultaneous pile installations
	Monopile (8,000kJ)
Multiple sequential pile installations in a 24-hour period (for the NW and SE modelling locations together)	600km ²

1671. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for simultaneous monopiles is presented in **Table 9.11**, based on the effect areas as presented in **Table 9.10**.

1672. Up to 505 harbour porpoise (<1% of the NS MU reference population) could be at risk of PTS due to the exposure of two sequential monopiles, at two simultaneous locations, in a 24 hour period.

Table 9.11 Assessment of the Potential for PTS Due to the Cumulative Exposure of Simultaneous Monopiles at the Same Time

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of simultaneous monopile installations (SEL _{cum})	505 (0.15% of NS MU)

1673. There would be **no adverse effect** of PTS in harbour porpoise from pile installation on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise, as less than 1% of the reference population would be at risk of the permanent effect.

1674. In addition, mitigation would be undertaken in line with the **Outline MMMP document reference 8.1)** to reduce the potential for PTS in all marine mammal species.

9.4.2.1.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Impact Piling During Construction

9.4.2.1.2.1 Impact 2a: Disturbance Effects Due to Piling

1675. The range of possible behavioural reactions that may occur as a result of exposure to noise include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases, panic, or stranding, sometimes resulting in injury or death (Southall *et al.*, 2007).

1676. There are currently no agreed thresholds or criteria for the behavioural response and disturbance of marine mammals, therefore it is not possible to conduct underwater noise modelling to predict impact ranges.

1677. The current advice from the SNCBs is that an EDR of 26km (with an area of 2,123.7km²) around piling locations for monopiles (without noise abatement), and 15km (with an area of 706.9km²) for pin piles (with and without noise abatement) is used to determine the area that harbour porpoise may be disturbed from in relevant SAC (JNCC *et al.*, 2020). DBD is located 39km from the SNS SAC, therefore this approach used is highly precautionary. Not all harbour porpoise within these potential disturbance areas based on EDRs will be disturbed, however as a worst-case scenario 100% disturbance of harbour porpoise in the areas has been assumed.

1678. The estimated number of harbour porpoise and percentage of the NS MU reference population that could be disturbed as a result of underwater noise during piling for the Project is presented in **Table 9.12**.

1679. For a single piling event the worst case would be 0.5% of the NS MU reference population to be at risk of disturbance (**Table 9.12**), for monopiles.

1680. For two simultaneous piling events the worst case would be 1.1% of the NS MU reference population to be at risk of disturbance (**Table 9.12**). Again, this would be from monopiles. Note that this does not assume any overlap between disturbance areas from the piling events and is therefore precautionary.

Table 9.12 Assessment of the Potential for Disturbance to Harbour Porpoise Based on the EDR Approach for Monopiles and Jacket Pin Piles, and for Both a Single and Two Simultaneous Piling Events

EDR	Assessment of effect
For a single piling event	
26km for monopiles (2,123.7km ²)	1,789 (0.53% of NS MU)
15km for jacket pin piles (706.9km ²)	596 (0.18% of NS MU)
For two simultaneous piling events	
26km for monopiles, at two simultaneous locations (4,247.4km ²)	3,577 (1.06% of NS MU)
15km for jacket pin piles, at two simultaneous locations (1,413.8km ²)	1,191 (0.35% of NS MU)

9.4.2.1.2.1.1 Spatial Assessment

1681. **Figure 9-1** shows there is no potential overlap from a monopile using the 26km EDR with the SNS SAC in one day. There would therefore be no risk of overlap with a 15km EDR for pin piles.

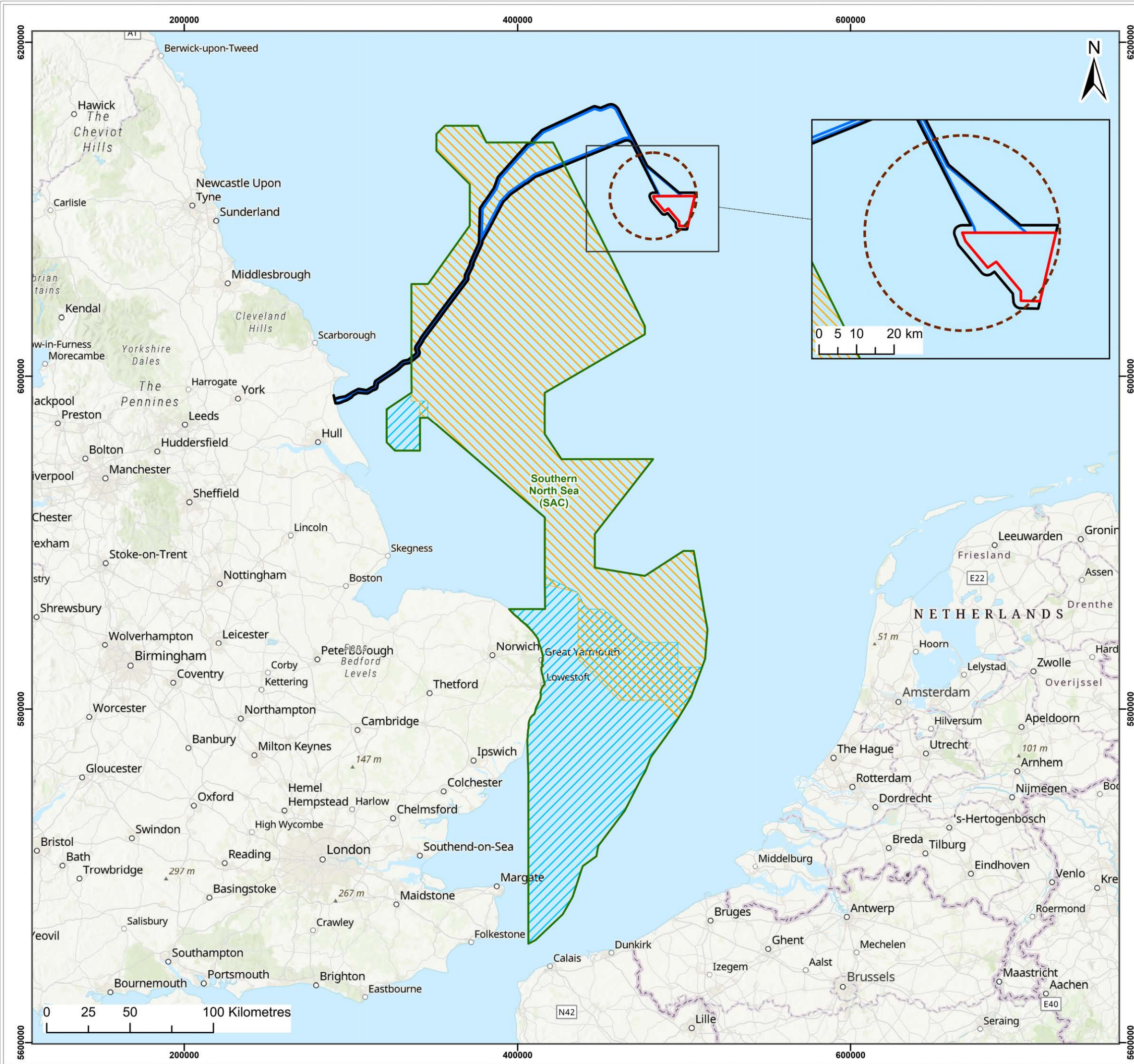
1682. Therefore, for a single piling event or multiple piling events in any one day during the summer season, the spatial threshold (20%) would not be exceeded for either monopiles or jacket pin piles.

9.4.2.1.2.1.2 Seasonal Average

1683. Due to there being no potential for overlap with the SNS SAC, there is no potential for a seasonal effect, Therefore, less than 10% of the seasonal component of the SNS SAC over the duration of that season could be affected during piling for the Project.

9.4.2.1.2.1.3 Summary for Impact 2a

1684. Disturbance of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC summer area on any given day during piling for the Project. Therefore, the seasonal component of the SNS SAC assessment over the duration of that season would also not be affected during piling for the Project, based on the worst-case scenario. In addition, less than 5% of the NS MU population are at risk of disturbance. Therefore, there is **no potential for adverse effect** at the SNS SAC, due to disturbance from piling in the Array Area.



Legend:

- Dogger Bank D Array Area
- Offshore Export Cable Corridor
- Offshore Development Area
- Southern North Sea Special Area of Conservation (SAC)
- Southern North Sea (SAC) Summer Area
- Southern North Sea (SAC) Winter Area
- Maximum Area of Disturbance from Monopile (26km EDR)

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

Project:

Dogger Bank D Offshore Wind Farm

Title:

Overlap of Maximum Potential Disturbance Ranges for Monopiling at DBD within the Southern North Sea SAC

Figure:	9-1	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0523			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:	
01	04/02/2025	FC	KF	A3	1:2,250,000	

Co-ordinate system: WGS 1984 UTM Zone 31N

9.4.2.1.2.2 Impact 2b: Disturbance Effects Due to ADD Activation

1685. The assessments of the potential disturbance during any ADD activation is indicative only, as the final requirements for mitigation in the MMMP will be determined prior to construction.
1686. Mitigation to reduce the risk of PTS could include activation of ADDs prior to the soft-start commencing. The period of time that an ADD is required to be activated for is dependent on the potential PTS ranges for each species, and their known swim speeds, as used within the underwater noise modelling.
1687. During 78 minutes of ADD activation, harbour porpoise would move at least 7.02km from the ADD location (based on a precautionary marine mammal swimming speed of 1.5m/s; Otani *et al.*, 2000), resulting in a potential disturbance area of 69.29km². This is further than the maximum instantaneous PTS range for monopiles predicted for harbour porpoise. For pin piles the ADD activation required would be 65 minutes to cover the maximum PTS range of 5.8km, resulting in a potential disturbance area of 57.7km².
1688. As a worst case, based on an ADD activation time of 78 minutes, up to 60 harbour porpoise (0.02% of the NS MU population) may be disturbed (**Table 9.13**).

Table 9.13 Assessment of the Potential for Disturbance Due to ADD Activation for Both Monopile and Jacket Pin Piles

Piling Scenario	Assessment of effect
Monopiles	60 (0.02% of NS MU)
Pin piles	49 (0.01% of NS MU)

1689. The ADD activation would ensure marine mammals are beyond the maximum impact range for instantaneous PTS due to a single strike of the maximum hammer energy for both monopiles and jacket pin piles, as well as from cumulative exposure. This disturbance area would be within the disturbance area due to piling (as assessed above) and therefore would not be an additive effect to harbour porpoise.

The assessment for the potential for disturbance to harbour porpoise due to ADD activation indicates **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

- 9.4.2.1.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.4.2.1.3.1 Impact 3a: Permanent Auditory Injury (PTS) Due to Other Construction Activities

Table 9.14 presents the underwater noise modelling results for the predicted effect ranges and areas for PTS from the cumulative exposure of other construction activities. For SEL_{cum} calculations, the duration of the noise is also considered, with all sources operating for a worst case of 24-hours in a day.

Table 9.14 The Predicted Effect Ranges for Cumulative PTS for Other Construction Activities in All Marine Mammal Species

Marine mammal species	Potential effect ranges (and areas) for PTS
	Cable laying, suction dredging, cable trenching, and rock placement
Harbour porpoise	<100m (0.031km ²)

1690. The results of the underwater noise modelling do not define effect ranges of <100m, and therefore, where the effect ranges are less than that, it is possible that the actual effect ranges are considerably lower.
1691. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in **Table 9.15**, based on the effect areas as presented in **Table 9.14**.

Table 9.15: Assessment of the Potential for PTS Due to Other Construction Activities, Including Cable Laying, Suction Dredging, Cable Trenching, and Rock Placement, for One Activity Taking Place at Any One Time

Marine mammal species	Assessment of effect	
	Array Area	Offshore ECC
Harbour porpoise	0.03 (0.000009% of NS MU)	0.02 (0.000006% of NS MU)

1692. There is the potential that more than one of these other construction activities could be underway at the Array Area, or within the offshore export cable, at the same time. As a worst case and unlikely scenario, an assessment for all four activities being undertaken simultaneously has also been undertaken.
1693. **Table 9.16** presents the potential areas of PTS for four other construction activities taking place at the same time.

Table 9.16 The Predicted Effect Areas for Cumulative PTS for All Other Construction Activities Taking Place at the Same Time for Harbour Porpoise

Marine mammal species	Potential effect ranges (and areas) for PTS Cable laying, suction dredging, cable trenching, and rock placement at the same time
Harbour porpoise	0.126km ²

1694. An assessment of the maximum number of individuals that could be at risk of PTS, due to all other construction activities undertaken at the same time is presented in **Table 9.17**, based on the effect areas as presented in **Table 9.16**, for either the Array Area or offshore ECC.
1695. Given the small number of individuals affected (<1% of the population), there would be **no adverse effect** of PTS in harbour porpoise from other construction activities either alone or taking place simultaneously on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

Table 9.17 Assessment of the Potential for PTS Due to All Other Construction Activities Taking Place at the Same Time

Marine mammal species	Assessment of effect	
	Array Area	Offshore ECC
Harbour porpoise	0.1 (0.00003% of NS MU)	0.08 (0.00002% of NS MU)

9.4.2.1.3.2 Impact 3b: Permanent Auditory Injury (PTS) Due to Construction Vessels

1696. **Table 9.18** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS from the cumulative exposure of vessels within the site. For SEL_{cum} calculations, the duration of the noise is also considered, with noise present for a worst case of 24-hours in a day.

Table 9.18 The Predicted Effect Ranges for Cumulative PTS for Vessels in All Marine Mammal Species

Marine mammal species	Potential effect ranges (and areas) for PTS Medium or large vessels
Harbour porpoise	<100m (0.031km ²)

1697. The results of the underwater noise modelling do not define effect ranges of <100m, and therefore, where the effect ranges are less than that, it is possible that the actual effect ranges are considerably lower.

1698. The results of the underwater noise modelling (**Table 9.18**) indicate that any harbour porpoise would have to be <100m (precautionary maximum range) from the continuous noise source for 24 hours, to be exposed to noise levels that could induce PTS. It is therefore highly unlikely that any individual would be at risk of PTS due to vessel noise. It should be noted that the predicted impact ranges are the distances which represent the ‘onset’ stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.

1699. An assessment of the maximum number of individuals that could be at risk of PTS, due to the presence of a construction vessel, is presented in **Table 9.19**, based on the effect areas as presented in **Table 9.18**.

Table 9.19 Assessment of the Potential for PTS Due to Medium and Large Vessels

Marine mammal species	Assessment of effect
Harbour porpoise	0.03 (0.000009% of NS MU)

1700. There is the potential that up to 90 vessels may be present in the Offshore Development Area at any one-time during construction (up to 55 in the offshore ECC, and up to 35 in the Array Area). As a worst case and unlikely scenario, an assessment for all 90 vessels has also been undertaken.

1701. **Table 9.20** presents the potential areas of PTS for the maximum construction vessels at any one time of 90 vessels.

Table 9.20 Predicted Effect Areas (Cumulative PTS) for Multiple Construction Vessels for All Marine Mammal Species

Marine mammal species	Potential effect areas for PTS	
	Array Area (35 vessels)	Offshore ECC (55 vessels)
Harbour porpoise	1.1km ²	1.7km ²

1702. An assessment of the maximum number of individuals that could be at risk of PTS, due to the maximum number of construction vessels at any one time is presented in **Table 9.21**, based on the effect areas as presented in **Table 9.20**.

Table 9.21 Assessment of the Potential for PTS Due to Multiple Construction Vessels

Marine mammal species	Assessment of effect	
	Array Area (35 vessels)	Offshore ECC (55 vessels)
Harbour porpoise	0.9 (0.0003% of NS MU)	2 (0.006% of NS MU)

1703. Given the small number of individuals affected (with less than 0.01% of the population at risk), there would be **no adverse effect** of PTS in harbour porpoise from vessels on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.2.1.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.4.2.1.4.1 Impact 4a: Disturbance Effects Due to Other Construction Activities

1704. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

1705. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance impact on marine mammals.

1706. There is limited data on the potential for a behavioural response or disturbance from other construction activities (or other continuous noise sources).

1707. Studies undertaken during the construction of two Scottish OWFs (Beatrice OWF and Moray East OWF) (Benhemma-Le Gall *et al.*, 2021), found that the probability of harbour porpoise being present increased with distance from the vessels and construction activities, and decreased with increasing vessel presence and background noise. During the period of turbine installation at Beatrice OWF, a significant reduction in harbour porpoise presence was detected even while no piling was taking place. Various construction activities were undertaken during this turbine installation phase, including jacket installation, turbine and cable installations, with some activities occurring simultaneously, which led to high levels of vessel traffic within the OWF site.

1708. A reduction in porpoise presence was detected at up to 12km from pile driving, and up to 4km from construction related vessels (Benhemma-Le Gall *et al.*, 2021). With construction vessels at 2km from Cetacean Porpoise Detector (CPOD) locations, harbour porpoise activity decreased by up to 35.2%, with construction vessels at 3km from the CPODs, there was a decrease of up to 24%, and at 4km from construction vessels, there was an increase of 7.2%. Outside of the piling period, the study found that the presence of harbour porpoise decreased by 17% with SPLs of 57dB (above ambient noise). It was not possible to determine what activities were being undertaken by the construction vessels in order to determine what activity was causing this effect (Benhemma-Le Gall *et al.*, 2021).

1709. While the study did not define which activities were taking place to cause the disturbance, it was while a number of construction vessels were on site (Benhemma-Le Gall *et al.*, 2021). Therefore, this reported 4km reduction in harbour porpoise presence has been used as a potential disturbance range for other construction activities in this assessment.

9.4.2.1.4.1.1 Disturbance Due to Other Construction Activities (For A Single Activity)

1710. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities based on the 4km potential disturbance range (with an effect area of 50.3km²) is presented in **Table 9.22**.

Table 9.22 Assessment of the Potential for Disturbance Due to Other Construction Activities, Including Cable Laying, Suction Dredging, Cable Trenching, and Rock Placement, for One Activity Taking Place At Any One Time

Marine mammal species	Assessment of effect	
	Array Area	Offshore ECC
Harbour porpoise	43 (0.01% of NS MU)	31 (0.009% of NS MU)

9.4.2.1.4.1.1.1 Spatial Assessment

1711. Based on a 4km disturbance range for other construction activities, the disturbance of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC summer area on any given day during other construction activities for a single activity for the Project, based on the worst-case scenario (**Table 9.23**).

Table 9.23 Maximum Potential Overlap with SNS SAC Summer Area Based on the Potential Disturbance Range of 4km for the Project

Maximum area of overlap with SNS SAC summer area (% of SNS SAC summer area)	Potential adverse effect on site integrity
50.3km ² (0.19%)	No. Temporary effect. Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during construction works for the Project based on the worst-case scenario.

1712. Therefore, there is **no significant disturbance and no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise due to disturbance from other construction activities during construction, for the Project.

9.4.2.1.4.1.1.2 Seasonal Average

1713. The seasonal averages have been calculated by taking into account the maximum potential overlap with SNS SAC seasonal area on any one day (Table 9.23) by the estimated maximum number of days within the season on which other construction activities could occur. In this case, it is assumed that construction could occur throughout the whole summer season (183 days).

1714. The assessment indicates less than 10% of the seasonal component of the SNS SAC over the duration of that season could be affected during other construction activities for a single activity for the Project, based on the worst-case scenario (Table 9.24).

Table 9.24 Estimated Seasonal Average for SNS SAC Summer Area Based on Disturbance Range of 4km for the Project

Number of disturbance days per season	Maximum seasonal average for SNS SAC summer area	Potential adverse effect on site integrity
183 days	0.19%	No. Temporary effect. Displacement of harbour porpoise would not exceed 10% of the seasonal component of the SNS SAC over the duration of that season during piling for the Project, based on the worst-case scenario.

1715. Therefore, there would be **no significant disturbance and no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise due to disturbance from other construction activities during construction for the Project.

9.4.2.1.4.1.2 Disturbance Due to Other Construction Activities at Multiple Simultaneous Locations

1716. As noted above, there is the potential that more than one of these other construction activities could be underway at the Array Area, or within the offshore export cable, at the same time. As a worst case and unlikely scenario, an assessment for up to four activities being undertaken simultaneously has also been undertaken.

1717. Based on a 4km potential disturbance range, and up to four other construction activities taking place at the same time, there is the potential for a simultaneous disturbance effect area of 201.06km². As noted above, this assumes that the disturbance would only affect the area around the vessel at the time of the activity taking place, and that marine mammals would return to the disturbed area once the activity had either completed or transited to a new location.

1718. An assessment of the maximum number of individuals that could be at risk of disturbance, due to four construction activities undertaken at the same time, is presented in Table 9.25.

Table 9.25 Assessment of the Potential for Disturbance Due to all Other Construction Activities Taking Place at the Same Time

Marine mammal species	Assessment of effect	
	Array Area	Offshore ECC
Harbour porpoise	170 (0.05% of NS MU)	122 (0.04% of NS MU)

9.4.2.1.4.1.2.1 Spatial Assessment

1719. Based on up to four constriction activities being undertaken at the same time, the disturbance of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC summer area on any given day for the Project, based on the worst-case scenario (Table 9.26).

1720. Therefore, under these circumstances, there is **no significant disturbance and no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise due to disturbance from piling during construction, for the Project.

Table 9.26 Maximum Potential Overlap with SNS SAC Summer Area Based on Disturbance Effect Area of 201.06km² for the Project

Maximum area of overlap with SNS SAC summer area (% of SNS SAC summer area)	Potential adverse effect on site integrity
201.06km ² (0.74%)	<p>No.</p> <p>Temporary effect.</p> <p>Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during piling for the Project based on the worst-case scenario.</p>

9.4.2.1.4.1.2.2 Seasonal Average

1721. The seasonal averages have been calculated by taking into account the maximum potential overlap with SNS SAC seasonal areas on any one day (**Table 9.26**) by the estimated maximum number of days within the season on which other construction activities could occur. As above, it is assumed that these activities could take place throughout the summer season.
1722. The assessment indicates less than 10% of the seasonal component of the SNS SAC over the duration of that season could be affected during other construction activities at multiple simultaneous locations for the Project, based on the worst-case scenario (**Table 9.27**).

Table 9.27 Estimated Seasonal Average for SNS SAC Summer Area Based on Disturbance Effect Area of 201.06km² for the Project

Number of disturbance days per season	Maximum seasonal average for SNS SAC summer area	Potential adverse effect on site integrity
183 days	0.74%	<p>No.</p> <p>Temporary effect.</p> <p>Displacement of harbour porpoise would not exceed 10% of the seasonal component of the SNS SAC over the duration of that season during piling for the Project, based on the worst-case scenario.</p>

1723. Therefore, under these circumstances, there would be **no significant disturbance and no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise due to disturbance from other construction activities taking place simultaneously during construction, for the Project.

9.4.2.1.4.2 Impact 4b: Disturbance Effects Due to Construction Vessels

1724. The distance at which animals may react to vessels is challenging to predict, as behavioural responses can vary widely depending on factors such as species, location, vessel type and size, speed, noise levels and frequency, ambient noise levels, and environmental conditions (see **PEIR Volume 2, Appendix 12-6 Information and Modelling Methods for Disturbance, Section 8** for more details).
1725. In coastal waters of SW Wales, vessel type and speed, rather than mere presence, appeared to be critical factors in harbour porpoise reactions to vessel traffic (Oakley *et al.*, 2017). A significant correlation was observed between vessel numbers and porpoise sightings. Over 729 hours of survey (268 total surveys), there were 39 instances of neutral or negative porpoise responses to vessels, with 75% of negative reactions triggered by high-speed, planing-hulled vessels.
1726. As described in **PEIR Volume 2, Appendix 12.6 Information and Modelling Methods for Disturbance**, modelling by Heinänen and Skov (2015) indicated that ship traffic density plays a notable role in determining harbour porpoise density in the North Sea during summer. Specifically, higher traffic levels are linked to lower porpoise densities, with a threshold impact level of approximately 15,000 ships per year (around 50 vessels per day within a 5km grid cell; or approximately two vessels / km²). For context, the maximum of 90 vessels expected on-site during construction would remain below this threshold. For example, 90 vessels over the 262km² Array Area and offshore ECC would amount to less than 0.4 vessels per km².
1727. Brandt *et al.*(2018) found that harbour porpoise detections declined several hours before piling began at seven German OWFs due to increased construction-related activity and vessel presence within a 2km vicinity of the construction sites. Similarly, studies in the Moray Firth during piling at the Beatrice OWF linked higher vessel activity within 1km to a greater likelihood of harbour porpoise responses (Graham *et al.*, 2019).
1728. A precautionary approach has been adopted based on the studies by Brandt *et al.*(2018) and Benhemma-Le Gall *et al.* (2021). Consequently, the following vessel disturbance assessment (see **Table 9.28**) utilises the 4km disturbance range for harbour porpoise (with a disturbance area of 50.27km²). This is considered very precautionary for the following reasons:

- As presented by Benhemma-Le Gall *et al* (2021), at 2km from vessel activities, harbour porpoise activity decreased by up to 35.2%; with construction activities 3km from the CPODs, there was a decrease of up to 24%, and at 4km from construction activities, there was an increase of harbour porpoise detection by 7.2%. Therefore, assuming that all marine mammals will respond within a 4km radius is over-precautionary, as it is likely that only a small proportion would respond at up to 4km;
- Benhemma-Le Gall *et al* (2021) do not differentiate between vessels that are undertaking activities, and those that are transiting. Therefore, assuming the harbour porpoise response is the same in both cases may be overestimating the effect where vessels are transiting only;
- Other research has reported smaller disturbance ranges for vessels, either transiting or undertaking works (e.g. Diederichs *et al* (2010) found that dredging can disturb harbour porpoise up to 600m, and Frankish *et al* (2023) found that harbour porpoise deterrence was mostly observed at close distance to vessels only (<300m), while deterrence of 5-9% of individuals was still recorded for vessels at 2km away); and
- The assessments are undertaken based on the maximum number of vessels being present at any one time, which is only likely to occur occasionally.

Table 9.28 Maximum Number of Harbour Porpoise (and % of Reference Population) That Could Be Disturbed as a Result of Underwater Noise Associated with Construction Vessels at the Project

Harbour porpoise specific density	Maximum number of individuals (% of reference population) for 55 vessels in the offshore ECC (2,500km ²)	Maximum number of individuals (% of reference population) for Array Area, including a 4km buffer (613km ²)	Maximum number of individuals (% of reference population) for all construction vessels in the offshore ECC and Array Area
Array Area	-	517 (0.15% of NS MU)	2,023 (0.60% of NS MU)
Offshore ECC	1,507 (0.44% of NS MU)	-	

1729. The disturbance assessment based on one vessel is equivalent to that for one construction activity. This scenario has already been assessed in **Table 9.22** and has therefore not been repeated here.

1730. While the assessment for PTS from vessel presence provided two different scenarios for vessel distribution over the offshore components, applying the same approach to the disturbance assessment would result in unrealistic scenarios as the overlap in disturbance areas would not be considered. Therefore, an alternative approach to determining the potential disturbance area for multiple vessels has been provided as discussed below.

1731. The disturbance caused by 55 individual vessels within the offshore ECC would cover a total area of 2,764km², not taking into consideration any potential overlap of the 4km disturbance ranges with other nearby vessels. To account for that, 55 vessels were randomly distributed in the offshore ECC, using QGIS v.3.38. If an overlap in the disturbance areas of multiple adjacent vessels was identified, this area was removed from the total area of effect to account for that. Therefore, a potential area of disturbance of 2,500km² has been identified for the worst-case of 55 construction vessels, as shown in **PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise (Section 12.7.1.4.2.2)**.

1732. Assuming the disturbance caused by 35 vessels within the Array Area would not overlap with that of other vessels, the total disturbed area would be 1,759km². This is significantly larger than the Array Area itself, which has a total area of 262km². Therefore, the actual maximum area of effect would be the Array Area with a 4km buffer (equating to an area of 613km²), as all vessels would be within the Array Area. Therefore, the assessment in **Table 9.28** represents the maximum possible disturbance area of the Array Area, including a 4km buffer as shown in **PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise (Section 12.7.1.4.2.2)**.

1733. Whilst short to medium term behavioural responses have been recorded from vessel disturbance, there are no long-term or population level effects recorded to date.

1734. Less than 5% of the reference population is affected, therefore, it is considered that there would be **no adverse effect** from disturbance from underwater noise associated with vessels on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.2.1.4.2.1 Spatial Assessment

1735. A potential area of disturbance of 2,500km² has been identified for the worst-case of 55 construction vessels within the offshore ECC, however using QGIS v.3.38 the overlap of the disturbance area with the SNS SAC summer area was calculated. Of the worst case of 2,500km², the overlap with the SNS SAC was 477.5km². Based on the total potential disturbance area of 477.5km² within the SNS SAC summer area (for the offshore ECC only; the Array Area is not within the SNS SAC), disturbance of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC summer area on any given day during construction vessel presence along the offshore ECC for the Project, based on the worst-case scenario (**Table 9.29**).

Table 9.29 Maximum Potential Overlap with SNS SAC Summer Area Based on Disturbance Effect Areas for Vessels for the Project

Maximum area of overlap with SNS SAC summer area (% of SNS SAC summer area)	Potential adverse effect on site integrity
477.5km ² (1.77%)	<p>No.</p> <p>Temporary effect.</p> <p>Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during piling for the Project based on the worst-case scenario.</p>

1736. Therefore, under these circumstances, there is **no significant disturbance and no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise due to disturbance from piling during construction, for the Project.

9.4.2.1.4.2.2 Seasonal Average

1737. The seasonal averages have been calculated by taking into account the maximum potential overlap with SNS SAC seasonal areas on any one day (**Table 9.29**) by the estimated maximum number of days within the season on which construction vessels could occur.

1738. The assessment indicates less than 10% of the seasonal component of the SNS SAC over the duration of that season could be affected during the time construction vessels could be present within the offshore ECC, based on the worst-case scenario (**Table 9.30**).

Table 9.30 Estimated Seasonal Average for SNS SAC Summer Area Based on Disturbance Effect Areas of Vessels for the Project

Number of disturbance days per season	Maximum seasonal average for SNS SAC summer area	Potential adverse effect on site integrity
183 days	1.77%	<p>No.</p> <p>Temporary effect.</p> <p>Displacement of harbour porpoise would not exceed 10% of the seasonal component of the SNS SAC over the duration of that season during piling for the Project, based on the worst-case scenario.</p>

1739. Therefore, under these circumstances, there would be **no significant disturbance and no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise due to disturbance from construction vessel presence for the Project.

9.4.2.1.5 Impact 5: Barrier Effects from Underwater Noise During Construction

1740. The greatest potential barrier effect for marine mammals could be from underwater noise during piling. Piling would not be constant during the piling phases and construction periods. There will be gaps between the installations of individual piles, and if installed in groups there could be time periods when piling is not taking place as piles are brought out to the site. There will also be potential delays for weather or other technical issues.

1741. The maximum duration of any barrier effects would be for the maximum piling duration, based on worst case scenarios, including soft-start, ramp-up and ADD activation.

1742. There is unlikely to be the potential for any barrier effects from underwater noise for other construction activities and vessels, as it is predicted that harbour porpoise will return once the activity has been completed, and therefore any effects from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of marine mammals.

1743. There is unlikely to be any significant long-term impacts from any barrier effects, as any areas affected would be relatively small in comparison to the range of harbour porpoise and would not be continuous throughout the offshore construction period.

1744. Harbour porpoise have relatively high daily energy demands and need to capture enough prey to meet these requirements. It has been estimated that, depending on the environmental conditions, harbour porpoise can rely on stored energy (primarily blubber) for three to five days, depending on body condition (Kastelein *et al.*, 1997). Therefore, any barrier effect that could restrict harbour porpoise accessing foraging areas could have implications for individuals.

1745. Several studies that modelled harbour porpoise distribution in relation to environmental variables (see **PEIR Volume 2, Appendix 12.2 Marine Mammal Technical Report**), have found that harbour porpoise densities are typically associated with shallow waters of less than 80m water depths (water depths within the wind farm site range from 21.2 – 34.6m relative to Lowest Astronomical Tide (LAT) and with areas of high eddy activity. Furthermore, higher abundances of harbour porpoises were found in areas where habitat was heterogenous with a degree of coarseness of sediments. These environmental features are underlying the presence of prey aggregation that this species favours.

1746. The southern North Sea, where water depth is ranging between 15-30m (Bundesamt für Seeschifffahrt und Hydrographie (BSH), 2024), has high abundances of harbour porpoise year-round (see **PEIR Volume 2, Appendix 12.2 Marine Mammal Technical Report**). Harbour porpoise sightings during the aerial surveys were consistently high (see **PEIR Volume 2, Appendix 12.2 Marine Mammal Technical Report**), in line with research findings.
1747. Considering that construction activities would not be continuous throughout the 5-year construction phase, it is unlikely that harbour porpoises will be significantly restricted. This is due to their diverse range of preferred prey species, and extensive foraging ranges which have been detailed in **PEIR Volume 2, Appendix 12.2 Marine Mammal Technical Report**).
1748. Any potential barrier effects as a result of underwater noise during construction has therefore been assessed as having **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.
- 9.4.2.1.6 Impact 6: Increased Risk of Collision with Vessels During Construction
1749. During the construction phase there would be an increase in the number of vessels transiting to and from the Array Area and within the offshore ECC. However, it is anticipated that vessels would follow an established shipping route to the relevant ports to minimise vessel volume in the area. The **Outline MMMP** (document reference 8.1) provides a protocol for minimising collision risk of marine mammals with vessels.
1750. Harbour porpoises, being small and highly mobile, are generally expected to avoid vessels due to their responses to vessel noise (e.g., Thomsen *et al.*, 2006; Polacheck & Thorpe, 1990). Predictive modelling indicates a negative relationship between the number of ships and the distribution of harbour porpoises in the Irish and Celtic Seas, and North Sea during summer. This suggests that harbour porpoises may exhibit avoidance behaviour (Heinänen & Skov, 2015; Dyndo *et al.*, 2015; Frankish *et al.*, 2023), observed even at long ranges (2-9km; Dyndo *et al.*, 2015; Benhemma-Le Gall *et al.*, 2021; Pigeault *et al.*, 2024), thereby reducing the risk of collisions with vessels. In a study by Robbins (2022), the relative collision risk was calculated using Automatic Identification System (AIS) vessel density data overlaid on the cetacean distribution maps by Waggitt *et al* (2019). The study found that harbour porpoise in the southern North Sea are exposed to high shipping traffic year-round, exposing them to a significant risk of potential ship strikes.
1751. Harbour porpoises exhibit strong avoidance behaviour to vessels due to their sensitivity to noise and movement. Being highly mobile, marine mammals have the potential to avoid vessels but if an individual receptor collides with a vessel, there is the potential for a very limited capacity to recover from the worst-case impact.
1752. Marine mammals can, to some extent, detect and avoid vessels (National Oceanic and Atmospheric Administration (NOAA), 2021). Research shows that larger vessels, such as cruise ships and cargo vessels over 80 meters in length, are more likely to cause severe or fatal injuries to marine mammals (Laist *et al.*, 2001; Keen *et al.*, 2023). High speeds are a key factor in collisions with cetaceans; for instance, the likelihood of a lethal injury to large whales, specifically the North Atlantic right whale in this study, increased from around 20% to 80% when vessel speeds increased from 8 to 15 knots (Vanderlaan & Taggart, 2007). Serious injuries have also been documented at lower speeds of 2 and 5.5 knots (Conn & Silber, 2013). Conversely, vessels traveling at speeds below 10 knots rarely cause serious injuries, making reduced speed one of the most effective mitigation strategies (Laist *et al.*, 2001; Conn & Silber, 2013; Laist *et al.*, 2014; Keen *et al.*, 2023).
1753. The predictability of vessel movements by marine mammals is crucial in minimising the risks posed by vessel traffic (Nowacek *et al.*, 2001, Lusseau, 2003; 2006). Reducing vessel speed not only allows more time for marine mammals to move away, but also significantly reduces emitted vessel noise. This reduction in noise enables marine mammals to hear approaching ships and prevents interference with intra-species communication (Leaper, 2019).
1754. An analysis of the International Whaling Commission (IWC) Ship Strike Database reveals that baleen whales, specifically fin and humpback whales, followed closely by right whales, constitute the majority of ship strike victims (Winkler *et al.*, 2020). However, a significant proportion of reported cases (12.1%) lacked species identification. Reports of collisions involving smaller cetacean species are generally scarce due to reporting biases, such as unnoticed collisions, quickly sinking carcasses, or less concern for smaller species (Schoeman *et al.*, 2020). The IWC report underscores that the lack of species identification and the mis- or underreporting of ship strikes remain global issues, leading to uncertainties in the numbers and species affected (Van Waerebeek *et al.*, 2007; Winkler *et al.*, 2020).
1755. In the UK, approximately 4-6% of stranded small cetaceans (harbour porpoise, common dolphin, white-beaked dolphin and Risso's dolphin) showed evidence of physical trauma during postmortem examinations, potentially attributable to ship strikes. This is compared to 15-20% of stranded whales, based on data from the Cetacean Strandings Investigation Programme (CSIP) database (1990-2010) (Evans *et al.*, 2011).
1756. A review on vessel disturbance, detailed in **Section 12.6.5 of PEIR Volume 2, Appendix 12.6 Information and Modelling Methods for Disturbance**, indicated that most marine mammals are affected by vessel noise. The discussion above highlighted that these animals typically respond to noise by exhibiting avoidance or fleeing behaviours, particularly observed in harbour porpoise (Dyndo *et al.*, 2015, Benhemma-Le Gall *et al.*, 2021 and 2023; Frankish *et al.*, 2023), or by co-existing with ships and seals.

1757. The maximum number of vessels that could be used during the construction phase of the Project at any one time has been estimated to be 90 vessels. The number, type and size of vessels would vary, depending on the activities taking place at any one time.
1758. Marine mammals in the relevant study area(s) are already accustomed to vessels. All vessel movements would be kept to the minimum number that is required to develop the Project. Additionally, vessel operators would use industry best practice to reduce any risk of collisions with marine mammals.

1759. Therefore, any increase in vessel collision risk during construction has been assessed as having **no adverse effect** on the integrity of the SNS SAC.

9.4.2.1.7 Impact 8: Potential Effects of Changes to Prey Resource And Habitat Quality

1760. The potential effects on prey species during construction can result from physical disturbance and loss of seabed habitat; increased SSC and sediment re-deposition; and underwater noise. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms.
1761. During construction activities, the worst-case footprint for disturbance would be 28.85km², constituting only 0.11% of the total SNS SAC area. Predominantly fine sand was the sediment type found (see **PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality**). Increased suspended sediment and sediment re-deposition would only occur for a limited duration at specific locations (e.g. piling location), at any given time. Increases in suspended sediment concentrations and minimal disposal would occur within the 35.4km. The highest suspended sediment concentrations would cover a much smaller area (around 20km from release).
1762. The data and analysis in **PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality** indicates that levels of contaminants within the offshore ECC and Array Area are low and do not contain elevated levels to cause concern.
1763. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of the potential underwater noise impacts on fish and shellfish species and predicts that impacts would be of a temporary nature (see **PEIR Volume 1 Chapter 11 Fish and Shellfish Ecology** for a detailed assessment of underwater noise impacts on fish species). Potential sources of underwater noise and vibration during construction include piling, increased vessel traffic, seabed preparation, rock placement and cable installation. Of these, piling is considered to produce the highest levels of underwater noise and therefore has the greatest potential to result in adverse impacts on fish.

1764. During piling of two sequential monopiles at 8,000kJ, stationary fish with swim bladders involved in hearing could potentially die within a 6km radius or sustain recoverable injuries up to 9.4km away from the piling source (see **Table 11-23 in PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**). Fish species that sustain recoverable injuries, TTS or show behavioural responses would still be available as prey to marine mammals. Like fish, marine mammals would also be displaced from the area. Therefore, these impacts on fish species would not affect the prey resources available to marine mammals.

1765. It is unlikely that there would be significant changes to prey over the entire area. It is more likely that effects would be restricted to an area around the working sites. There is unlikely to be any additional displacement of harbour porpoise as a result of any changes in prey availability during piling as harbour porpoise would also be disturbed from the area.

1766. **PEIR Volume 1, Chapter 14 Commercial Fisheries** provides an assessment of the potential changes of fishing activity by the presence of safety zones associated with the project during construction. The predicted impact would be of negligible impact given the short-term and temporary nature of the construction phase.

1767. The footprint of the project is relatively small with regard to the entire area of the SNS SAC and so the effects of changes to prey, possibly arising during construction activities, would have **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise for the Project.

9.4.2.1.8 Impact 9: Potential Effects of Changes To Water Quality

1768. Potential changes in water quality during construction could occur through:
- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations, and array cables;
 - Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and Offshore Platforms;
 - Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
 - Deterioration in water quality associated with release of sediment bound contaminants.

1769. Marine mammals often inhabit turbid environments and cetaceans utilise sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly. Increased turbidity is unlikely to have a direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely (Todd *et al.*, 2014).
1770. Potential changes in water quality during construction would have **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise for the Project.

9.4.2.2 Potential Effects During O&M

9.4.2.2.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Operational Wind Turbine Noise

1771. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during the operational phase and determine the potential effects on marine mammals (**PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling**).
1772. **Table 9.31** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS from the cumulative exposure of operational WTGs. For SEL_{cum} calculations, the duration of the noise is also considered, with operating WTGs for a worst case of 24-hours in a day.
1773. The results of the underwater noise modelling do not define effect ranges of <100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably lower).

Table 9.31 The Predicted Effect Ranges for Cumulative PTS Due to Operational WTGs

Marine mammal species	Potential effect ranges for PTS
Harbour porpoise	<100m

1774. It is important to note that PTS is unlikely to occur in marine mammals, as the modelling indicates that the marine mammal would have to remain <100m from a WTG for 24 hours for any potential risk of PTS (**Table 9.31**). Therefore, PTS as a result of operational WTG noise is highly unlikely. It should be noted that the predicted impact ranges are the distances which represent the ‘onset’ stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.

1775. The maximum number of individuals that could be at risk of PTS, due to a single operational WTG, is 0.03 harbour porpoise (0.00001% of the NS MU reference population).
1776. More than one WTG will be operating at the same time, and therefore an assessment of the potential for auditory injury, due to all operational WTGs, is required. There is the potential for up to 113 WTGs to be installed for the project. The potential areas of PTS for all operational WTGs for harbour porpoise would therefore be 3.55km².
1777. An assessment of the maximum number of individuals that could be at risk of PTS from all operational WTGs is three harbour porpoise (0.0009% of the NS MU reference population).
1778. There would be **no adverse effect** of PTS in harbour porpoise from operational WTG noise on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.2.2.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Operational Wind Turbine Noise

1779. Currently available data indicates that there is no lasting disturbance or exclusion of harbour porpoise around OWF sites during operation (Diederichs *et al.*, 2008; Lindeboom *et al.*, 2011; Marine Scotland, 2012; McConnell *et al.*, 2012; Russell *et al.*, 2014; Scheidat *et al.*, 2011; Teilmann *et al.*, 2006; Tougaard *et al.*, 2005, 2009a, 2009b). Data collected suggests that any behavioural responses for harbour porpoise may only occur up to a few hundred metres away (Tougaard *et al.*, 2009b; McConnell *et al.*, 2012).
1780. Monitoring was carried out at the Horns Rev and Nysted OWFs in Denmark during the operation between 1999 and 2006 (Diederichs *et al.*, 2008). Numbers of harbour porpoise within Horns Rev were slightly reduced compared to the wider area during the first two years of operation, however, it was not possible to conclude that the OWF was solely responsible for this change in abundance without analysing other dynamic environmental variables (Tougaard *et al.*, 2009a). Later studies by Diederichs *et al.* (2008) recorded no noticeable effect on the abundances of harbour porpoise at varying wind velocities at both of the OWFs studied, following two years of operation.
1781. Harbour porpoise have been shown to forage within operational OWFs (e.g. Lindeboom *et al.*, 2011; Russell *et al.*, 2014), indicating no restriction to movements in operational OWF sites. Part of the Dutch Governmental Offshore Wind Ecological Programme (WOZEP), Leemans & Fijn (2023), included reported observations of harbour porpoise in three OWFs: Luicherduinen, Gemini, and Borssele. The study highlighted that harbour porpoises tend to avoid the immediate vicinity of the turbines, with the closest recorded distance being 500m. Additionally, there was no statistical difference in porpoise densities within the wind farms compared to the borders of the arrays.

1782. For the potential for disturbance due to operational WTGs, the effect significance has been assessed as having **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.2.2.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.4.2.2.3.1 Impact 3a: Permanent Auditory Injury (PTS) Due to Other O&M Activity

1783. The requirements for any potential O&M work, such as additional rock placement or cable re-burial, are currently unknown, however the work required, and associated effects to harbour porpoise would be less than those during construction.

1784. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities at the onset of the activity. Therefore, it is highly unlikely for there to be any PTS due to these activities.

1785. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase.

1786. The effect significance for permanent changes in hearing sensitivity (PTS) due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.2.2.3.2 Impact 3b: Permanent Auditory Injury (PTS) Due to O&M Vessels

1787. During the O&M of the Project, there may be up to 16 vessels in the Offshore Development Area at any one time, compared to the 90 vessels that would be on site during construction. Therefore, the potential effects associated with underwater noise and disturbance from vessels during O&M would be less than of those during construction (as assessed in **Section 9.4.2.1.3.2**). As a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst case scenario.

1788. There would therefore be **no adverse effect** of PTS in harbour porpoise from vessels on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.2.2.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.4.2.2.4.1 Impact 4a: Disturbance Effects Due to Other O&M Activities

1789. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. The requirements for any potential maintenance work are currently unknown, however, the work required, and impacts associated with underwater noise and disturbance from activities during O&M would be less than those during construction. As there is expected to be less noisy activities during the operation phase than is required during construction, it is therefore likely to cause less disturbance to foraging behaviours in harbour porpoise.

1790. Therefore, the potential for adverse effect due to underwater noise from O&M activities is considered to be the same or less than that assessed for underwater noise from other construction activities (including rock placement, trenching and cable laying) (as assessed in **Section 9.4.2.1.4**).

1791. The effect significance for disturbance effects due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.2.2.4.2 Impact 4b: Disturbance Effects Due to O&M Vessels

1792. The requirements for any potential maintenance work are currently unknown, however the work required, and impacts associated with underwater noise and disturbance from vessels during O&M would be less than those during construction.

1793. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be 16, which is less than the 90 vessels that could be on site during construction. However, as a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst case scenario.

1794. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.

1795. There would therefore be **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.2.2.5 Impact 5: Underwater Noise: Barrier Effects During O&M

1796. The indicative minimum separation distance between turbines would be a minimum of 0.826km to 1.416km, depending on WTG size, therefore there would be no overlap in the potential impact range (PTS; **Table 9.31**) of <100m around each turbine, and there would be adequate room for marine mammals to move through the Array Area.
1797. Harbour porpoise are known to be present and forage within operational wind farm areas (**Section 9.4.2.2.2**), and therefore it is concluded that the presence of the Project would not form a barrier to any movement of marine mammal species.
1798. Therefore, no barrier effects as a result of underwater noise during O&M are anticipated, and no further assessment is required.

9.4.2.2.6 Impact 6: Increased Risk of Collision with Vessels During O&M

1799. As noted in **Section 9.4.2.2.1**, it is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be up to 16.
1800. The increased risk of marine mammal collision with operational and maintenance vessels would be the same or less than what was assessed for the construction period (**Section 9.4.2.1.6**), given the number of vessels required would be lower.
1801. Vessel movements, where possible, will be incorporated into recognised vessel routes and hence to areas where harbour porpoise are accustomed to vessels, in order to reduce any increased collision risk. In addition, vessel operators will use best practice to reduce any risk of collisions with harbour porpoise, such as reducing the speed of vessel transits wherever possible.
1802. Any increase in vessel collision risk during operation has been assessed as having **no adverse effect** on the integrity of the SNS SAC. This is in relation to the conservation objectives for harbour porpoise.

9.4.2.2.7 Impact 8: Potential Effects of Changes to Prey Resource

1803. The potential impacts on fish species during O&M can result from temporary habitat loss / disturbance; permanent habitat loss; introduction of wind turbine foundations; scour protection and hard substrate; increased suspended sediments and sediment re-deposition; re-mobilisation of contaminated sediments; underwater noise; and EMF.
1804. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any impacts on prey species have the potential to indirectly affect harbour porpoise. A summary of the key effects to prey species (and their relevance for harbour porpoise) is provided below.

1805. Habitat loss will occur during the lifetime of the Project as a result of structures, scour and external cable protection installed on the seabed. The introduction of hard substrate, such as wind turbine towers, foundations and associated scour protection and cable protection would increase habitat heterogeneity through the introduction of hard structures in an area predominantly characterised by sediment habitats. During operation of the Project, the estimated total permanent habitat loss would be up to 4.06km² in total. In **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** this is considered minor to negligible, depending on the species in the context of the amount of similar available habitat in the wider area.
1806. Increases in SSC within the water column and subsequent deposition onto the seabed may occur as a result of O&M activities. Disturbance caused by jack up vessel legs or anchors, as well as cable reburial and/or repair may result in small volumes of sediment being re-suspended. However, the volumes of sediment disturbed from such activities, as well as the overall duration of the disturbance, would be significantly less compared to construction.
1807. There would be no direct effects of EMF on marine mammals. While demersal fish such as cod, (blue) whiting, and sandeel lack electromagnetic receptors to detect EMF, migratory and pelagic species might experience navigation interference due to EMF, potentially affecting the speed and / or direction of their movements (refer to **Chapter 11 Fish and Shellfish Ecology** for further information).
1808. Common practice is to bury the cables, and by doing so, the magnetic field at the seabed is reduced due to the distance between the cable and the seabed surface as a result of field decay with distance from the cable (CSA Ocean Sciences Inc. and Exponent 2019). Cables would be buried to a depth range of minimum 0.2m to a maximum of 2.5m (with potential for 1m overburial to 3.5m depth) where conditions allow, substantially reducing the levels of EMF in the surrounding area. Where cable burial is not possible, for example due to hard substrate or for cable crossings, protection would be added to reduce the levels of EMF.
1809. The introduction of various man-made structures such as foundations and scour protection in soft sediment areas increases and changes habitat availability and type, resulting in locally altered biodiversity as species are able to establish and thrive in previously hostile environments (Wilhelmsson *et al.*, 2006; Birchenough and Degraer, 2020). Physical structures provide a foundation for settling invertebrates, which increase the organic matter surrounding the structure, and underpin artificial reef ecosystems through ‘bottom-up’ control of productivity. Increasing nutrient availability and biomass presents opportunities for all fish and shellfish species, from top predators to detritivores (Raoux *et al.*, 2017).

1810. The benefit of this potential increase in prey availability to marine mammals has not yet been studied widely. However, the presence of an artificial reef does increase the abundance and biomass of species, and the increase in prey species availability increases the attractiveness of the area to predators (Devault *et al.*, 2017; Paxton *et al.*, 2022). Increasing habitat heterogeneity may benefit harbour porpoise, that have shown to prefer variations in seabed topography (Isojunno *et al.*, 2012, Brookes *et al.*, 2013, Stalder *et al.*, 2020).

1811. The introduction of new hard substrate in areas that are predominantly sandy or soft sediments may cause positive effects through potential habitat enhancement (Roach and Cohen, 2020).

1812. The effects arising during the operational phase of the Project are likely to be the same or less than those assessed for construction. Therefore, the effects of changes to prey during operation would have **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise for the Project.

9.4.2.2.8 Impact 9: Barrier Effects from the Physical Presence of the Wind Farm During O&M

1813. There is unlikely to be the potential for any barrier effects upon the completion of construction, as it is predicted that harbour porpoise will return once the activity has been completed. Monitoring was conducted at the Horns Rev and Nysted OWFs in Denmark in 1999 and 2006 during operation (Diederichs *et al.*, 2008). The data showed that numbers of harbour porpoise within Horns Rev were slightly reduced compared to the wider area during the first two years of operation and found no effect on numbers after two years of operation. Though, it was not possible to conclude that the OWF was solely responsible for this change in abundance without analysing other dynamic environmental variables (Tougaard *et al.*, 2009).

1814. Lindeboom *et al.* (2011) documented that harbour porpoise have been observed to forage within operational wind farm sites indicating that the physical presence of the wind farm does not cause a barrier. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of harbour porpoise in operational OWF sites.

1815. The effect significance for barrier effects due to the physical presence of the wind farm has therefore been assessed as having **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.2.3 Potential Effects During Decommissioning

1816. 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.

1817. Commitment ID CO21 (see **PEIR 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 impacts on harbour porpoise 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.

1818. 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.

1819. 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.

1820. Therefore, the potential effects on harbour porpoise during decommissioning are assumed to be the same or less than those assessed for construction due to the processes of decommissioning potentially being the reverse of the installation, without the need for piling.

9.4.3 Assessment of Potential Effects of The Project In-Combination with Other Plans and Projects

1821. The following in-combination assessment has been undertaken based on findings of the CEA Screening process (**PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**), and the results of the CEA (**Section 12.8 of PEIR Volume 1 Chapter 12 Marine Mammals and Underwater Noise**).

1822. The in-combination assessment considers other schemes and activities where the predicted effects have the potential to combine with the potential effects during construction of the Project. The construction phase has been assessed as the worst case for potential in-combination effects.

1823. The schemes screened into the in-combination assessment for harbour porpoise are those that are located in the NS MU. Full information on the screening of effects considered for the in-combination assessment is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**. The in-combination screening for harbour porpoise considers the same schemes as considered in the cumulative screening, as the SNS SAC is in the NS MU, therefore all schemes occurring in the NS MU have been considered in the assessment. Further screening has been undertaken throughout this section to account for those projects and activities that are taking place within (or near to) the SNS SAC.

1824. The in-combination effects assessed are outlined in **Section 4.5.3**.

1825. Further information is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**.

9.4.3.1 In-Combination Impact 1: Disturbance from Underwater Noise

1826. The commitment to the mitigation measures agreed through the final MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) in harbour porpoise. In light of this, and taking account of the type, scale and extent of potential effects arising from the Project assessment, PTS is not considered further (see **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**).

1827. It is intended that this approach to assessing the potential effects of disturbance from underwater noise will reduce some of the uncertainties and complications in using the different assessments from HRAs, based on different noise models, thresholds and criteria, as well as different approaches to density estimates.

9.4.3.1.1 In-Combination Impact 1a: Assessment of Underwater Noise From Piling at Other OWFs

1828. One of the greatest potential noise source during OWF construction is from pile driving. The in-combination assessment considers the potential disturbance of harbour porpoise during piling for the Project, with the piling at other OWF schemes screened into the in-combination assessment. As the piling for the Project will not overlap with the SNS SAC, this assessment against the SNS SAC summer spatial and seasonal thresholds are not required, and only an assessment against the NS MU is undertaken.

1829. The CEA screening (see **PEIR Volume 2, Appendix 12.5 Cumulative Assessment Screening**) identified twelve projects with the potential for construction to take place at the same time as the construction of DBD. The worst-case scenario would be if the following OWFs were piling at the same time as the Project:

- Dogger Bank South (East);
- Dogger Bank South (West);

- Caledonia;
- Sheringham Shoal Extension;
- Dudgeon Extension;
- Five Estuaries;
- Nordsee Cluster B - N-3.5;
- Nordsee Cluster B - N-3.6;
- North Falls;
- Outer Dowsing;
- Rampion 2; and
- West of Orkney.

1830. The potential piling period the Project has been based on the widest likely range of offshore construction and piling dates, dependent on the construction scenario, as a precautionary approach. It should be noted that while the schemes included within the in-combination have the potential for piling to overlap with the Project, there is a great deal of uncertainty on when OWFs could be piling. This assessment is therefore considered to be a precautionary worst-case.

1831. Where possible, the CEA screening (see **PEIR Volume 2, Appendix 12.5 Cumulative Assessment Screening**) included consideration of the realistic potential for cumulative impacts during construction for the Project.

1832. The assessment for harbour porpoise is based on the approach to disturbance as per the current advice from the SNCBs (JNCC *et al.*, 2020) on the assessment of effect on the harbour porpoise designated SACs.

1833. The potential disturbance area of 2,123.7km² is based on the 26km EDR for harbour porpoise during single pile installation. Project specific assessments have been taken from their own published assessments where possible (based on the EDR approach), and are based on the 26km EDR and relevant SCANS-IV Survey Block where project specific data is not available.

1834. It should be noted that the potential areas of disturbance assume that there is no overlap in the areas of disturbance between different schemes and are therefore highly conservative.

1835. The approach to the in-combination for piling at OWFs is based on the potential for single piling at each OWF at the same time as single piling for the Project. This approach allows for some of the OWFs not to be piling at the same time, while others could be simultaneously piling. This is considered to be the most realistic worst case scenario, as it is highly unlikely that all other OWFs would be simultaneously piling at exactly the same time as piling for the Project. This was agreed through the evidence plan process, at ETG3 one and two (see **Table 12-5 in PEIR Volume 1, Chapter 12 Marine Mammals**).
1836. It is important to note the actual duration for active piling time which could disturb harbour porpoise is only a very small proportion of the potential construction period, of up to approximately 25.1 days the Project (based on 5.33 hours per pile for the Project), based on the estimated maximum duration to install individual piles.
1837. For harbour porpoise, the potential worst case scenario of other OWFs piling at the same time as the Project is assessed in **Table 9.32**. More than 5% of the reference population could potentially be disturbed, therefore, there is **the potential for an adverse affect** due to in-combination piling. However, this is very precautionary, as it is unlikely that all other OWF schemes could be piling at exactly the same time as piling for the Project.

Table 9.32 Quantitative Assessment for the Potential Disturbance of Harbour Porpoise From Single Piling (26km) at Other OWFs At The Same Time As Piling for the Project

Project	Harbour porpoise density (/km²)	Maximum number of individuals potentially disturbed
Single piling at other OWFs that could be piling at the same time as DBD		
DBD	0.842	1,789
DBS (East) ⁵	0.6	1,275
DBS (West) ¹	0.66	1,402
Caledonia ⁶	-	-
Dudgeon Extension Project ⁷	0.888	1,886
Five Estuaries ⁸	1.82	6,583

⁵ RWE Renewables UK Dogger Bank South (East and West) Limited. (2024).
⁶ SNS SAC is screened out of assessment within Caledonia RIAA, therefore not assessed (Caledonia Offshore Wind Farm, 2022).
⁷ Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects (2022).
⁸ Five Estuaries Wind Farm Limited (2024) have not provided an assessment based on the 26km EDR, therefore, assessment is based on their assessment for disturbance as provided within the ES.

Project	Harbour porpoise density (/km²)	Maximum number of individuals potentially disturbed
Nordsee Cluster B - N-3.5 ⁹	0.6158	1,308
Nordsee Cluster B - N-3.6 ⁵	0.6158	1,308
North Falls ¹⁰	3.217	6,832
Outer Dowsing ¹¹	1.63	3,462
Rampion 2 ¹²	-	-
Sheringham Shoal Extension ³	0.888	1,886
West of Orkney ¹³	-	-
Total number of harbour porpoise with DBD		27,731
Percentage of NS MU (with DBD)		8.18%

1838. The **PEIR Outline MMMP** (document reference 8.1) will be updated as required to include the potential for noise reduction methods (such as NAS). The assessments of effect for disturbance from piling at the Project will be undertaken assuming the use of noise reduction technology at the DCO stage, assuming that monopiles remain within the project design and a significant effect is predicted. Updated guidelines will be taken into account regarding the use of noise reduction at the time of DCO submission, and therefore it is likely that it could be concluded there would be no adverse effect prior to DCO submission.

⁹ No values found therefore generic approach used with density from SCANS IV Block NS-I and 26km EDR.
¹⁰ North Falls Offshore Wind Limited (2024).
¹¹ Outer Dowsing Offshore Wind (2024), RIAA refers back to ES so values are from the ES, based on the 26km EDR assessment for UXO disturbance.
¹² Rampion 2 Wind Farm (2023), SNS SAC screened out of RIAA, therefore not assessed.
¹³ Offshore Wind Power Limited (2023), SNS SAC screened out of RIAA, therefore not assessed.

1839. Note that while the Project will further investigate the requirement for the use of NAS prior to DCO submission, the potential for any cumulative in-combination effects to be effectively managed may rely on other OWFs also committing to the use of noise reduction, as the Project reducing noise at source alone may not sufficiently reduce the potential for a significant disturbance effect for all species. However, the use of NAS (or similar) for the Project, along with its likely use for all other projects considered, and the use of SIPs for any OWFs piling with 15km or 26km of the SNS SAC (depending on use of NAS), should reduce the potential for disturbance effect on the harbour porpoise population. In practice, the potential temporary effects would be less than those predicted in this assessment as there is likely to be a great deal of variation in timing, duration, and hammer energies used throughout the various OWF project construction periods. In addition, not all individuals would be displaced over the entire potential disturbance range (26km) used within the assessments. For example, the study of harbour porpoise at Horns Rev (Brandt *et al.*, 2011), indicated that at closer distances (2.5 to 4.8km) there was 100% avoidance, however, this proportion decreased significantly moving away from the pile driving activity and at distances of 10km to 18km avoidance was 32% to 49% and at 21km the abundance was reduced by just 2%.
1840. In line with the conclusions of the Habitats Regulations Assessment (The Crown Estate, 2022) it is expected that all other OWFs that overlap with the SNS SAC will have to produce a SIP to ensure that the spatial threshold is not exceeded and there is no significant disturbance and no adverse effect on the integrity of the SNS SAC. This could include the use of noise abatement and reduction measures (which would reduce the EDR to 15km), and / or seasonal restrictions and agreements on when OWF piling could be undertaken.
1841. It is also important to note that the in-combination assessments are based on the worst case for all possible OWFs. As schemes develop and programmes are established there will be changes to the potential piling periods for each OWF scheme. There will also be limitations on the fabrication of wind turbines and the vessels available to install the wind turbine foundations. Therefore, it is very unlikely that all OWFs would or could be all piling at the same time. Additional assessments using iPCoD modelling were undertaken to predict the harbour porpoise population effect due to cumulative disturbance from piling, using the number at risk of disturbance from each project as provided in **Table 9.32**.

1842. For the in-combination scenario assessed the reference population 338,918 was applied for the NS MU for harbour porpoise, the iPCoD model predicts there to be little effect on the harbour porpoise population over time from disturbance due to piling at all twelve OWF projects (**Table 9.33** and **Figure 9-2**). The median population size was predicted to be 99.97% of the un-impacted population size at the end of 2029 (one year after the piling has commenced in the wider area year after the piling has commenced). By the end of 2034 (the year piling ends) the median population size for the impacted population is predicted to be 99.69% of the un-impacted population size. Beyond 2034, the impacted population is expected to maintain the same stable trajectory as the un-impacted population (as far as 2054 which is the end point of the modelling, at which point the median impacted to un-impacted ratio is 99.69% (**Table 9.33** and **Figure 9-2**).

Table 9.33 Results of the iPCoD Modelling for the Cumulative Assessment, Giving the Mean Population Size of the Harbour Porpoise Population (Wider Reference Population) For Years Up To 2053 For Both Impacted And Un-Impacted Populations In Addition To The Median Ratio Between Their Population Sizes

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start 2029	338,918	338,918	99.92	338,918	338,918	99.97
End 2030	338,908	338,636	99.55	339,264	338,925	99.70
End 2032	338,789	337,214	99.53	338,929	337,320	99.69
End 2034	338,682	337,142	99.53	337,224	335,630	99.69
End 2054	341,857	340,230	99.53	337,342	335,463	99.69

1843. The modelling indicates there would be **no adverse effect** on the integrity of the SNS SAC due to cumulative disturbance from piling, due to there being less than a 1% population level effect on average per year over both the first six years and 25-year modelled periods.

9.4.3.1.1.1 Spatial Assessment

1844. As there is no potential overlap between the Project's piling effect area and the SNS SAC, an assessment for piling arising from the Project against the spatial (20%) is not required.

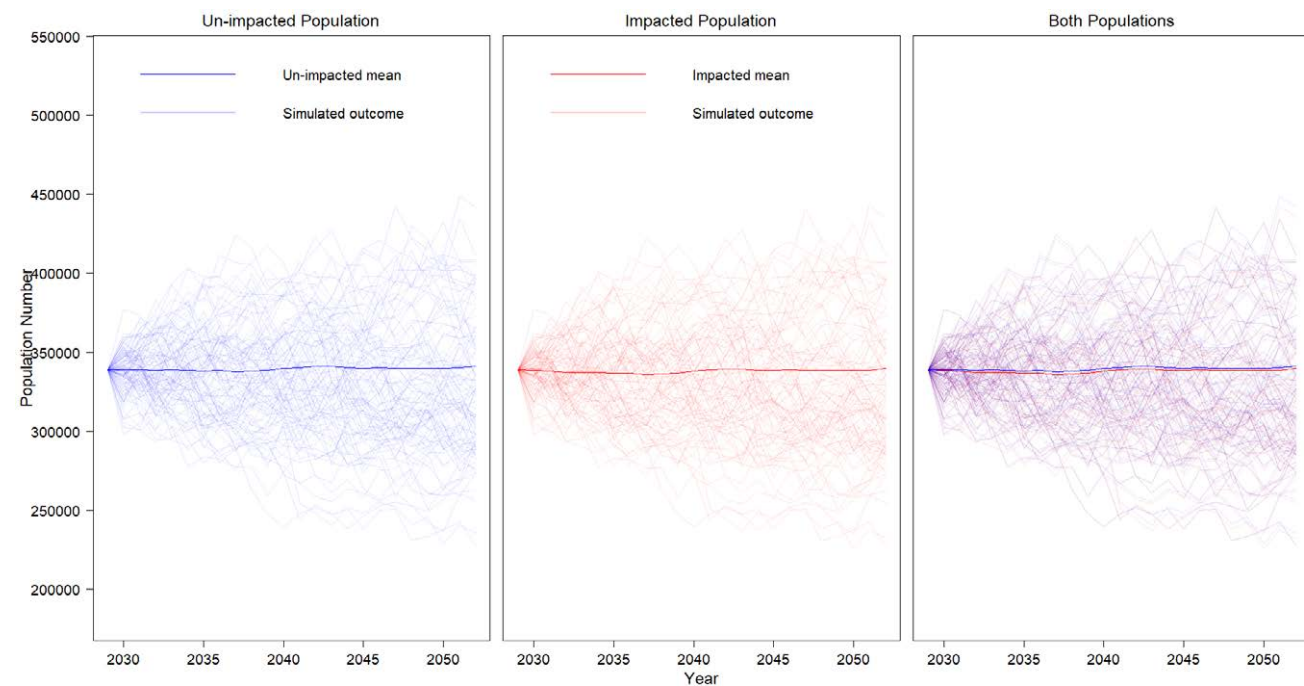


Figure 9-2 Simulated worst-case harbour porpoise population sizes for both the un-impacted and the impacted populations for the in-combination assessment

9.4.3.1.1.2 Seasonal Average

1845. As there is no potential overlap between the Project's piling effect area and the SNS SAC, an assessment for piling for the Project against the seasonal (10%) is not required.

9.4.3.1.2 In-Combination Impact 1b: Assessment of Disturbance from Other Industries and Activities

1846. During the construction period the Project, there is the potential for disturbance to marine mammals associated with other potential noise sources, including:

- Geophysical surveys;
- Aggregate extraction and dredging;
- Seismic surveys;
- UXO clearance; and
- Interlink cable.

1847. For the installation of oil and gas infrastructure, marine renewable schemes, and disposal sites, all potential schemes have been screened out. Further information on the CEA screening (and these results) are provided in **PEIR Volume 2, Appendix 12.5 Cumulative Assessment Screening**.

1848. To represent the presence of harbour porpoise in the wider MU quantitative assessment in this section are based on the estimates of harbour porpoise density from the North Sea Assessment Unit of 0.55 harbour porpoise/ km² (CV = 0.17) (Gilles *et al.*, 2023).

9.4.3.1.2.1 Disturbance from Geophysical Surveys

1849. Assessments for the RoC HRA for the SNS SAC (BEIS, 2020), modelled the potential for disturbance due to the use of a Sub-Bottom Profiler (SBP), and results indicated that there is the potential for a possible behavioural response in harbour porpoise at up to 3.77km (44.65km²) from the source. The current guidance for assessing the significance of noise disturbance for harbour porpoise SACs (JNCC *et al.*, 2020) recommends the use of an EDR of 5km (78.54km²) for geophysical surveys.

1850. Following the current SNCCB guidance for the assessment of geophysical surveys disturbance on harbour porpoise, it should be assessed as a moving source, rather than a stationary one (i.e. the distance at which a survey vessel could travel in one day, with a 5km buffer area). It is difficult to determine what the potential area of effect would be when taking into account it is a moving source (as it is difficult to predict how far a vessel may survey in a day).

1851. Based on survey vessels travelling at a speed of 4.5 to 5 knots, up to 199km could be surveyed in one day. This however does not take into account the survey downtime for line changes, weather, or other technical reason. A review of seismic surveys within the UK indicated that surveys were being undertaken for approximately 52% of the time (BEIS, 2020). Taking this into account, up to 103.5km of surveys could be undertaken in one day, resulting in a potential disturbance area of 1,113.5km² with the 5km EDR buffer applied. For two surveys this would result in a potential disturbance area of 2,227km².

1852. It is currently not possible to estimate the location or number of potential geophysical surveys that could be undertaken at the same time as construction and potential piling activity as the Project. It is therefore assumed, as a worst case scenario, that there could potentially be up to two geophysical surveys in North Sea at any one time, during construction of the Project.

1853. For up to two geophysical surveys undertaken at the same time as construction of the Project, with no other in-combination activities, up to 0.9% of the NS MU population may be disturbed (**Table 9.34**).

Table 9.34 Quantitative Assessment for In-Combination Disturbance of Marine Mammals Due To Two Geophysical Surveys at OWFs

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.842	2,123.71 (26km EDR)	1,789
Two geophysical surveys	0.55	2,227 (1,113.5 per survey),	1,225
Total number of harbour porpoise with DBD			3,014 (0.9% of NS MU)

9.4.3.1.2.2 Disturbance From Aggregate Extraction And Dredging

1854. Seven aggregate/dredging projects have been screened in that could have potential cumulative disturbance impacts with piling taking place at the Project (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**):

- Greenwich Light East 473/1 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);
- Greenwich Light East 473/2 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);
- Inner Dowsing 481/1-2;
- Inner Owers North 488;
- Thames D 524;
- West Bassurelle 458; and
- West Bassurelle 464.

1855. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600m of the activities (Diederichs *et al.*, 2010). As a worst-case assessment, a disturbance range of 600m will be applied for the aggregate schemes at the same time as the Projects' construction. A disturbance range of 600m would result in a potential disturbance area of 1.13km² for each project, or up to 7.91km² for all aggregate schemes screened in.

1856. For the potential for in-combination disturbance from aggregate and dredging schemes undertaken at the same time as construction of DBD, with no other in-combination activities, up to 0.53% of the NS MU population may be disturbed (**Table 9.35**).

Table 9.35 Quantitative Assessment for In-Combination Disturbance Of Harbour Porpoise Due to Aggregate and Dredging Schemes

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.842	2,123.71 (26km EDR)	1,789
Greenwich Light East 473/1	0.55	1.13	1
Greenwich Light East 473/2	0.55	1.13	1
Inner Dowsing 481/1-2	0.55	1.13	1
Inner Owers North 488	0.55	1.13	1
Thames D 524	0.55	1.13	1
West Bassurelle 458	0.55	1.13	1
West Bassurelle 464	0.55	1.13	1
Total number of harbour porpoise with DBD			1,796 (0.53%)

1857. None of the screened in aggregate schemes are within (or within 600m of) the summer area of the SNS SAC. Therefore, an assessment against the spatial and seasonal thresholds has not been undertaken.

9.4.3.1.2.3 Disturbance From Seismic Surveys

1858. It is currently not possible to estimate the number of potential seismic surveys that could be undertaken at the same time as construction and potential piling activity for the Project. As a precautionary approach, the potential for an in-combination effect from oil and gas seismic surveys has been screened into this assessment for further consideration. It is assumed, as a worst-case scenario, that there could potentially be two seismic surveys in the North Sea at any one time during construction (piling) of the Project.

1859. This assessment for the potential disturbance due to seismic surveys is based on the potential impact area during seismic surveys, with an EDR of 12km (452.4km² per survey, or 904.8km² for two surveys). However, as stated above for geophysical surveys, under the JNCC *et al* (2020) guidelines for assessing effects at harbour porpoise designated sites, seismic surveys should be considered as a moving source. Using 12km EDR, the total disturbance area for a seismic survey would be 2,936.4km² (or 5,872.8km² for two surveys).

1860. For two seismic surveys, undertaken at the same time as construction of DBD, up to 1.48% of the NS MU population may be disturbed (**Table 9.36**).

Table 9.36 Quantitative Assessment for In-Combination Disturbance of Harbour Porpoise Due to up to Two Seismic Surveys

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD piling	0.842	2,123.71 (26km EDR)	1,789
Two seismic surveys	0.55	5,872.8	3,231
Total number of harbour porpoise with DBD			5,020 (1.48% of NS MU)

9.4.3.1.2.4 Disturbance From Subsea Cables And Pipelines

1861. Only one subsea pipeline has been screened into the in-combination assessment; Sea Link. This project is currently at scoping stage and therefore there is limited information available on potential effects and disturbance ranges for which to inform the in-combination assessment with DBD.
1862. The disturbance ranges that could be generated during the cabling works and vessels would be up to 4km (with a disturbance area of 50.3km²), for harbour porpoise. This has been used to inform the assessments for pipeline schemes, as activities would be similar, in the absence of any additional information for the schemes screened in for assessment.
1863. For disturbance from Sea Link and DBD piling, up to 0.54% of the NS MU population may be disturbed (**Table 9.37**).

Table 9.37 Quantitative Assessment for In-Combination Disturbance of Marine Mammals Due To Subsea Cable And Pipeline Schemes

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD piling	0.842	2,123.71 (26km EDR)	1,789
Sea Link	0.55	50.3	28
Total number of harbour porpoise with DBD			1,817 (0.54% of NS MU)

9.4.3.1.2.5 Disturbance From UXO Clearance

1864. As for piling, the potential risk of PTS in marine mammals from in-combination effects has been screened out from further consideration in the CEA (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening** if there is the potential for any PTS, suitable mitigation would be put in place to reduce any risk to marine mammals. Therefore, the in-combination effects only consider potential disturbance effects.
1865. This assessment has been based on the potential for disturbance due to UXO clearance activities for other schemes, cumulatively with the construction of DBD.
1866. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity for the Project. In 2021 there were six cases of UXO detonations reported to the MNR in the North Sea, these occurred over a total of 16 days. This amount gives an average of less than one UXO detonation to occur at any one time in the North Sea. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO detonation, even if they had overlapping UXO clearance operation durations. The in-combination assessment is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst-case), and one low-order detonation.
1867. The potential effect area of 2,123.7km² per project, based on 26km EDR for UXO high order detonation, and 78.5km² for low-order detonation, following the current SNCB guidance for the assessment of effect to harbour porpoise in the SNS SAC.
1868. However, as outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO, i.e. each blast lasting for a very short duration, marine mammals, including harbour porpoise, are not predicted to be significantly displaced from an area, any changes in behaviour, if they occur, would be an instantaneous response and short-term. Existing guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010a).
1869. **Table 9.38** presents the potential in combination area and the potential maximum number of harbour porpoises disturbed.

Table 9.38 Quantitative Assessment for In-Combination Disturbance of Harbour Porpoise For up to One Low Order and One High Order UXO Clearance

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD piling	0.842	2,123.71 (26km EDR)	1,789
One high order UXO clearance	0.55	2,123.7	1,168
One low order UXO clearance	0.55	78.5	44
Total number of harbour porpoise with DBD			3,001 (0.89% of NS MU)

9.4.3.1.2.6 Summary of In-Combination Impact 1: Assessment of Disturbance from Piling and Other Activities

1870. Each of the above described noise sources with the potential for disturbance on harbour porpoise are quantitatively assessed together in **Table 9.39**.

Table 9.39 Quantitative Assessment for All Noisy Activities with the Potential for In-Combination Disturbance Effects For Harbour Porpoise

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)	
	Based on population modelling results	Based on quantitative assessment for all activities
<i>DBD piling</i>	<i>Based on iPCoD modelling, <1% of the population disturbed over the first six years</i>	1,789 (0.53%)
Piling at other OWFs		25,942 (7.65%)
Geophysical surveys	1,225 (0.4%)	
Aggregates and dredging	7 (0.011%)	
Seismic surveys	3,231 (1.0%)	
Subsea cables	28 (0.008%)	
UXO clearance	1,212 (0.4%)	

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)	
	Based on population modelling results	Based on quantitative assessment for all activities
Total number of harbour porpoise (percentage of MU)	5,703 (2.7% (including iPCoD %) of NS MU)	33,434 (9.9% of NS MU)

1871. For harbour porpoise, for noisy activities with the potential for in-combination disturbance effects together with piling for the Project, 2.7% of the population is at risk of disturbance (when considering the population modelling results) or up to 9.9% of the population (based on the full quantitative assessment).

1872. More than 5% of the reference population could potentially be disturbed, therefore, there is **the potential for an adverse effect** due to in-combination effects of disturbance. However, this is very precautionary, as it is unlikely that all other activities would be taking place at exactly the same time as piling for the Project.

1873. The **Outline MMMP (document reference 8.1)** will include the potential for noise reduction methods (such as NAS). The assessments of effect for disturbance from piling at the Project will be undertaken assuming the use of noise reduction technology (to include primary and/or secondary) at the DCO stage, assuming that monopiles remain within the project design and a significant effect is predicted. Updated guidelines will be taken into account regarding the use of noise reduction at the time of DCO submission, and therefore it is likely that it could be concluded there would be no adverse effect prior to DCO submission.

1874. Note that while the Project will further investigate the requirement for the use of NAS prior to DCO submission, the potential for any in-combination effects to be effectively managed may rely on other OWFs also committing to the use of noise reduction, as the Project reducing noise at source alone may not sufficiently reduce the potential for a significant disturbance effect for all species. However, the use of NAS (or similar) for the Project, along with its likely use for all other projects considered, and the use of SIPs for any OWFs piling with 15km or 26km of the SNS SAC (depending on use of NAS), should reduce the potential for disturbance effect on the harbour porpoise population.

1875. Behavioural effects from UXO clearance, if they occur, would be an instantaneous response and short-term. Guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010) and therefore could be excluded from the total.

1876. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations. The in-combination is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst case), as well as one low-order clearance event.
1877. It should be noted that while the schemes included within the in-combination assessment for disturbance from other activities and industries were included based on the current knowledge of their possible construction or activity windows, it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the harbour porpoise that could be at risk of disturbance during the offshore construction period of DBD.
1878. Mitigation measures are presented in the Outline Marine Mammal Mitigation Plan and will be reviewed for the final MMMP prior to construction. In conclusion, there would be **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise as a result of DBD with other schemes.

9.4.3.2 In-Combination Impact 2: Barrier Effects

1879. For the assessment of the potential for barrier effects due to underwater noise from schemes undergoing construction, the effect to marine mammal species would be as per the assessments provided in **Section 1739**, for in-combination disturbance effects due to all noisy activities.
1880. It is important to note that the OWFs and other noise sources included in the in-combination assessment are spread over the wider area of the North Sea. Taking into account the locations of the OWFs and other noise sources from the Project, the maximum underwater effect ranges for disturbance at other schemes would not overlap with the maximum underwater effect ranges for disturbance for the Project during piling and construction. Therefore, there is no potential for underwater noise from the Project, other OWFs and noise sources to result in a barrier of movement to marine mammals.
1881. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect, and therefore has not been considered within this in-combination assessment.
1882. Therefore, there would be **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.4.3.3 In-Combination Impact 3: Increased Collision Risk with Vessels

1883. The in-combination effects from an increase in the number of vessels and vessel movements can pose a potential collision risk for harbour porpoise.
1884. As outlined in **Section 9.4.2.1.6** (construction) and **Section 9.4.2.2.6** (operation), vessels would be intermittently present throughout the lifetime of the Project. As vessel movements to and from any port would be incorporated within existing vessel routes as far as possible, there would be no increased collision risk, as the increase in the number of OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas. Once on-site, OWF vessels and other construction-related vessels would be stationary or slow-moving as they undertake their associated activities.
1885. Vessel operators for the Project, North Falls (SSE & RWE, 2024), Sheringham Shoal and Dudgeon Extension (Equinor, 2022) will also follow best practices outlined in the **Outline PEMP (document reference 8.6)** to further reduce collision risks. Hornsea Four (Orsted, 2021) and Outer Dowsing (Outer Dowsing Offshore Wind, 2024) adopt a Vessel Management Plan (VMP) to minimise the potential for any impact. West of Orkney (Offshore Wind Power Limited, 2023), Five Estuaries (Five Estuaries OWF Limited, 2024) and Rampion 2 (Rampion 2 Wind Farm, 2023) adopt a best practice vessel handling protocols such as the WiSe Scheme or Guide to Best Practice for Watching Marine Wildlife. It is expected that other offshore projects and industries will adopt similar measures to mitigate the potential for marine mammal collisions, with Hornsea THREE (Orsted, 2018), Dogger Bank A and B (Forewind, 2014) and South (East and West) (RWE, 2024) also committed to these practices.
1886. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low. Increased collision risk from aggregate extraction and dredging has therefore been screened out from further consideration in the in-combination assessment.
1887. In addition, based on the assumption that harbour porpoise would be disturbed as a result of underwater noise from piling, other construction activities, operational and maintenance activities and vessels, there should be no potential for increased collision risk with vessels.
1888. Therefore, there would be **no adverse effect** on integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise due to an increase in collision risk with construction vessels.

9.4.3.4 In-Combination Impact 4: Changes in Prey Resource

1889. Potential effects on prey species the Project were assessed in **Section 9.4.2.1.7** (construction) and **Section 9.4.2.2.7** (operation). **No adverse effect** on integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise was concluded. Any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat in the surrounding area. This will be the case for all schemes and therefore although the in-combination effects are additive, the effect would be proportionate to the wider range over which effects would occur.
1890. Therefore, there would be **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise arising due to changes in prey availability.

9.4.4 Summary of Potential Effects on Site Integrity

1891. The assessment of the potential effects for the Project has been summarised in relation to the SNS SAC conservation objectives for harbour porpoise.
1892. The **Outline MMMP (document reference 8.1)** will provide mitigation or management measures to reduce the potential for any significant disturbance of harbour porpoise from underwater noise.
1893. There would be **no adverse effect** on integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise, either alone or when in-combination with other schemes, under the assumption that the Project (and other OWFs) would utilise noise reduction techniques (whether primary and /or secondary) for piling. This will be further investigated and confirmed prior to DCO submission.

9.5 Doggersbank SAC

9.5.1 Site Description

1894. The Doggersbank SAC has been recognised as an SAC since June 2016 and is designated by the Netherlands, The SAC is a designated site for the marine mammals harbour porpoise, harbour seal and grey seal (EUNIS, 2019).
1895. The Doggersbank SAC covers an area of 4,735km². The SAC's closest point to the Project is 0km as the Array Area is located alongside the border of the SAC.

9.5.1.1 Qualifying Feature

9.5.1.1.1 Harbour Porpoise

1896. There is no site-specific data on harbour porpoise estimates available. Hence, a wider search approach was applied. More reliable data on abundance data could be derived from data collected in all Dutch waters.
1897. Harbour porpoise densities for the Dutch Delta region were estimated at 0.71 per km² in summer 2019, totalling to 14,713 individuals (Geelhoed *et al.*, 2020).
1898. As a precautionary approach, the worst-case average summer density estimate of harbour porpoise from the site specific surveys (0.842 harbour porpoise/km²) have been used in the impact assessments. The same reference population of 338,918 for the North Sea AU has been used for the Doggersbank SAC assessments, as done for the SNS SAC (Gilles *et al.*, 2023).

9.5.1.1.2 Harbour Seal

1899. A range of 101 and 250 individual harbour seals were counted (Natura 2000). Within the greater area of the Dutch Delta, harbour seal counts ranged from 677- 2581 from (2011-2021) (Central Bureau of Statistics *et al.*, 2023).

9.5.1.1.3 Grey Seal

1900. A maximum of 400 individual grey seals were counted (Natura 2000). Within the greater area of the Dutch Delta, harbour seal counts ranged from 677- 2581 from (2011-2021) (Central Bureau of Statistics *et al.*, 2023).

9.5.2 Assessment of Potential Effects of the Project Alone

1901. For the purposes of the assessments, the potential effects on harbour porpoise considered in relation to the Doggersbank SAC are the same as those discussed in **Section 9.4.2**.
1902. For the other SAC assessments with seal qualifying features (within the UK), density estimates have been gained using Carter *et al* (2022), however, Carter *et al* (2022) data does not have estimates available for the Doggersbank SAC.
1903. Tracking data of harbour seals (Carter *et al.*, 2022; 2020) show some trips from the southeast of the UK and the Belgian-French coastline, although there is a higher level of connectivity with The Wash and North Norfolk Coast SAC. This suggests that harbour seals from the Doggersbank SAC could potentially utilise this corridor as well, possibly becoming affected by activities at the Projects, such as vessel collision and underwater noise.

1904. Grey seal tracking data (Carter *et al.*, 2022, 2020; Vincent *et al.*, 2017) showed grey seals tagged in Britain are more likely to use the wider offshore North Sea area, with limited examples of tracked grey seals swimming to the north coast of France, Belgium, or Germany. Grey seals tagged in France are more likely to travel along the north coast of France and Belgium, although there is movement of seals to south-east England. This suggests that grey seals in Doggersbank SAC are less likely to be connected to the Offshore Development Area than the Humber Estuary (HE) SAC.
1905. Based on the assessments undertaken for the HE for grey seal (**Section 9.6**) and The Wash and North Norfolk Coast SAC for harbour seal (**Section 9.9**, under the assumption that greater connectivity is expected for the sites within the UK, and therefore the greater potential for effect would be present (and assessed) for the UK sites as noted above.
1906. Disturbance from underwater noise for Projects alone and in-combination with other schemes and activities is unlikely to result any significant disturbance or barrier effects for foraging harbour seal or grey seal. Under these circumstances, there is **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for grey seal and harbour seal.

9.5.2.1 Potential Effects During Construction

9.5.2.1.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Impact Piling During Construction

1907. The foundation options and piling parameters being considered the Project are discussed in **Section 9.4.2.1.1**.
1908. Underwater noise modelling was carried out by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during noisy activities and determine the potential impacts on marine mammals using the INSPIRE v5.2 (Impulsive Noise Propagation and Impact Estimator) semi-empirical underwater noise propagation model (**PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report**).
1909. Predicted Effect Ranges (and Areas) for PTS for harbour porpoise are detailed in **Section 9.4.2.1.1** for the SNS SAC assessment and also apply to the Doggersbank SAC assessment for harbour porpoise.
1910. There would be **no adverse effect** of PTS in harbour porpoise from pile installation on the integrity of the Doggersbank SAC in relation to harbour porpoise.

9.5.2.1.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Impact Piling During Construction

9.5.2.1.2.1 Impact 2a: Disturbance Effects Due to Piling

1911. The range of possible behavioural reactions that may occur as a result of exposure to noise include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases, panic, or stranding, sometimes resulting in injury or death (Southall *et al.*, 2007).
1912. There are currently no agreed thresholds or criteria for the behavioural response and disturbance of marine mammals, therefore it is not possible to conduct underwater noise modelling to predict impact ranges.
1913. The current advice from the SNCBs is that an EDR of 26km around piling locations for monopiles (without noise abatement), and 15km for pin piles (with and without noise abatement) is used to determine the area that harbour porpoise may be disturbed from in relevant SAC (JNCC *et al.*, 2020). Not all harbour porpoise within these potential disturbance areas based on EDRs will be disturbed, however as a worst-case scenario 100% disturbance of harbour porpoise in the areas has been assumed.
1914. The estimated number of harbour porpoise and percentage of the North Sea MU reference population that could be disturbed as a result of underwater noise during piling for the Project is presented in **Table 9.40**.

Table 9.40 Assessment of The Potential For Disturbance To Harbour Porpoise Based On The EDR Approach For Monopiles And Jacket Pin Piles, And For Both A Single And Two Simultaneous Piling Events

EDR	Assessment of effect
For a single piling event	
26km for monopiles	1,789 (0.5% of NS MU)
15km for jacket pin piles	596 (0.18% of NS MU)
For two simultaneous piling events	
26km for monopiles, at two simultaneous locations	3,577 (1.1% of NS MU)
15km for jacket pin piles, at two simultaneous locations	1,191 (0.4% of NS MU)

1915. For a single piling event the worst case would be 0.5% of the NS MU reference population (based on the APEM density estimate) to be at risk of disturbance, for monopiles.
1916. For two simultaneous piling events the worst case would be 1.1% of the NS MU reference population (based on the APEM density estimate) to be at risk of disturbance (**Table 9.40**). Again, this would be from monopiles. Note that this does not assume any overlap between disturbance areas from the piling events and is therefore precautionary.
1917. Conservation Objectives are designed to help ensure that the obligations of the Habitats Directive can be met through UK SACs. Article 6(2) of the Habitats Directive requires that there should be no deterioration or significant disturbance of the qualifying species or to the habitats upon which they rely.
1918. For disturbance the UK assessment approach has been applied for assessing the Doggersbank SAC, following the Conservation Objective 2 set for the SNS SAC, as per below.

Conservation Objective 2: There is no significant disturbance of the species

1919. The disturbance of harbour porpoise typically, but not exclusively, originates from operations that cause underwater noise, including activities such as seismic surveys, pile driving and sonar.
1920. Disturbance is considered to be significant if it leads to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. The current SNCBs guidance for the assessment of significant noise disturbance on harbour porpoise in the SNS SAC (JNCC *et al.*, 2020) is that:

“Noise disturbance within an SAC from a plan/project individually or in-combination is considered to be significant if it excludes harbour porpoise from more than:

- *20% of the relevant area of the site in any given day, or*
- *An average of 10% of the relevant area of the site over a season.”*

1921. The Doggersbank SAC doesn’t have further specific seasons within the SAC area like the SNS SAC therefore the average is assessed against a full year of 365 days.

9.5.2.1.2.1.1 Spatial Assessment

1922. **Figure 9-3** and **Figure 9-4** show the potential Doggersbank SAC overlaps for a single monopile or pin pile in one day, or for two monopiles or pin piles in one day, respectively, and as detailed in **Table 9.41**.
1923. For a single piling event or multiple piling events in any one day, the spatial threshold (20%) would not be exceeded for either monopiles or jacket pin piles.

Table 9.41 Maximum Potential Overlap with Doggersbank SAC Areas

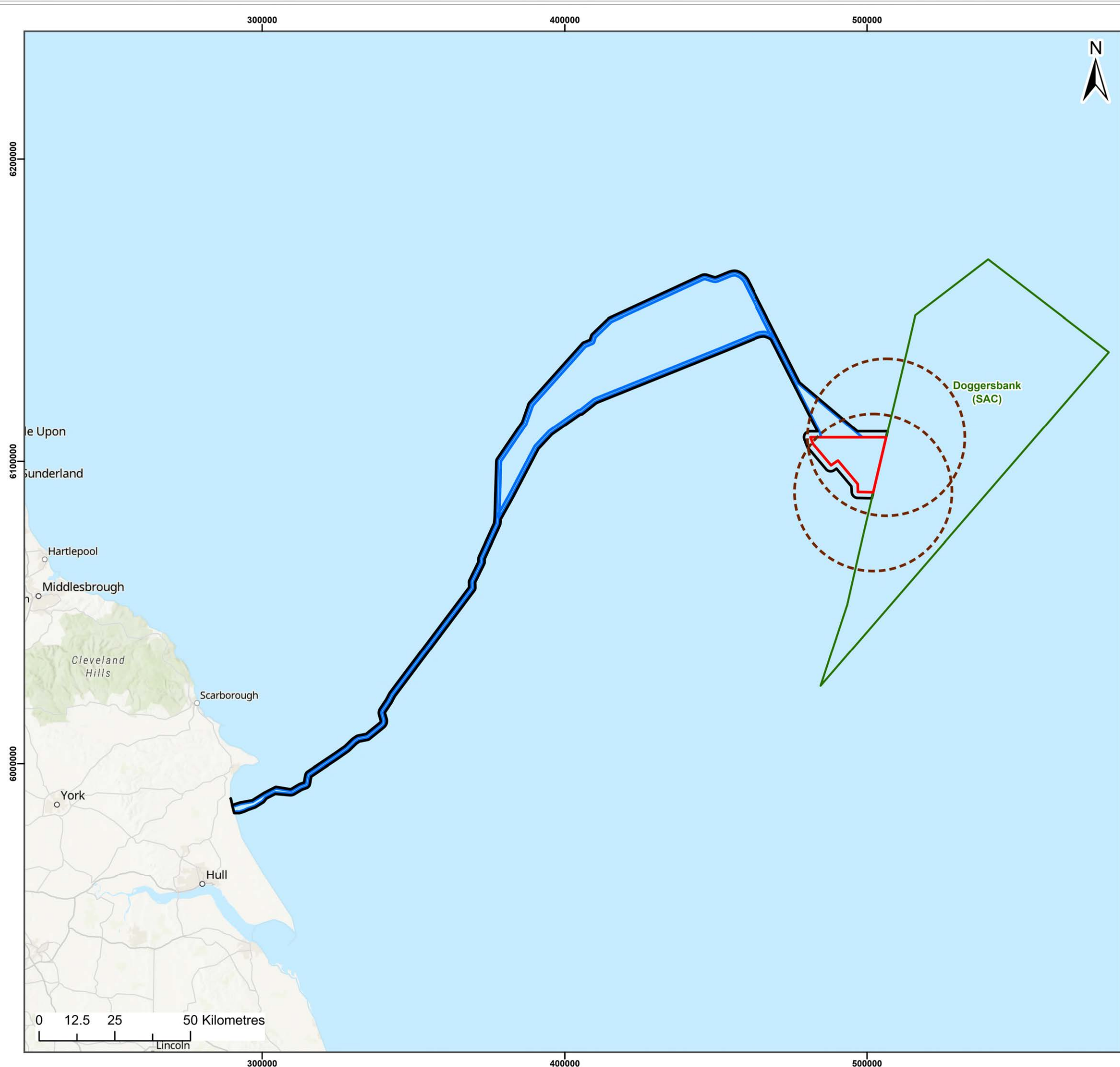
EDR	Maximum area of overlap with Doggersbank SAC area (% of Doggersbank SAC area)	Potential adverse effect on site integrity
26km for monopiles	348.6km ² (7.36%)	No Temporary effect. Displacement of harbour porpoise would not exceed 20% of the spatial threshold of the Doggersbank SAC area on any given day during piling for the Project based on a single pile or two piles per day.
15km for jacket pin piles	117.4km ² (2.48%)	
26km for monopiles, at two locations in one day, with maximum potential separation	604.1km ² (12.76%)	
15km for jacket pin piles, at two locations in one day, with maximum potential separation	231.2km ² (4.88%)	

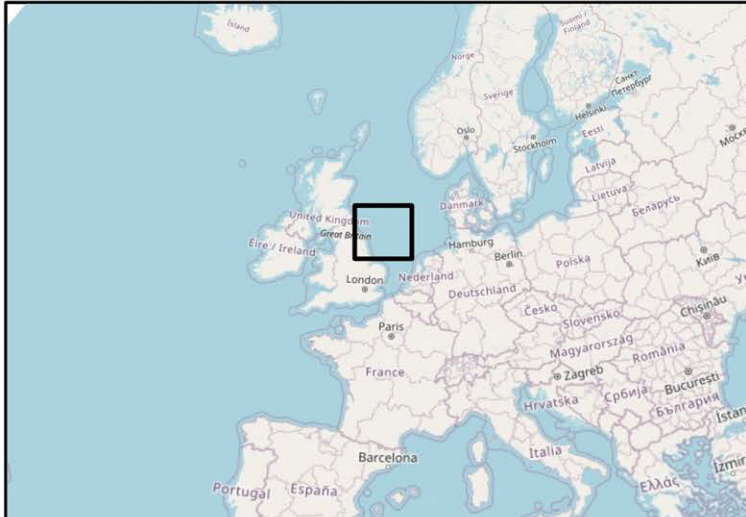
9.5.2.1.2.1.2 Seasonal Average

1924. The seasonal averages have been calculated by multiplying the maximum area on any one day with the number of days the piling is occurring for over a full year. It has been assumed there is the potential for piling to be occurring over 57 days based on two monopiles per day and 226 days based on four pin piles per day. The resulting seasonal average for this would be 3.02% as a worst case.
1925. The assessment indicates that in the case of piling for the Project the potential disturbance is less than 10% of the seasonal threshold of the Doggersbank SAC that could be affected, due to geophysical surveys being undertaken on the same day as other construction activity for the Project (**Table 9.42**).
1926. There would be **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise as a result of disturbance due to piling for the Project.

9.5.2.1.2.1.3 Summary for Impact 2a

1927. Disturbance of harbour porpoise would not exceed 20% of the spatial threshold or 10% of the seasonal threshold of the Doggersbank SAC area on any given day during piling for the Project, based on the worst-case scenario (**Figure 9-3**).





Legend:

- Dogger Bank D Array Area
- Offshore Export Cable Corridor
- Offshore Development Area
- Doggersbank Special Area of Conservation (SAC)
- Maximum Area of Disturbance from Monopile (26km EDR)

Source: © Haskoning DHV UK Ltd, 2025; © European Environment Agency, 2025;
© OpenStreetMap (and) contributors, CC-BY-SA



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

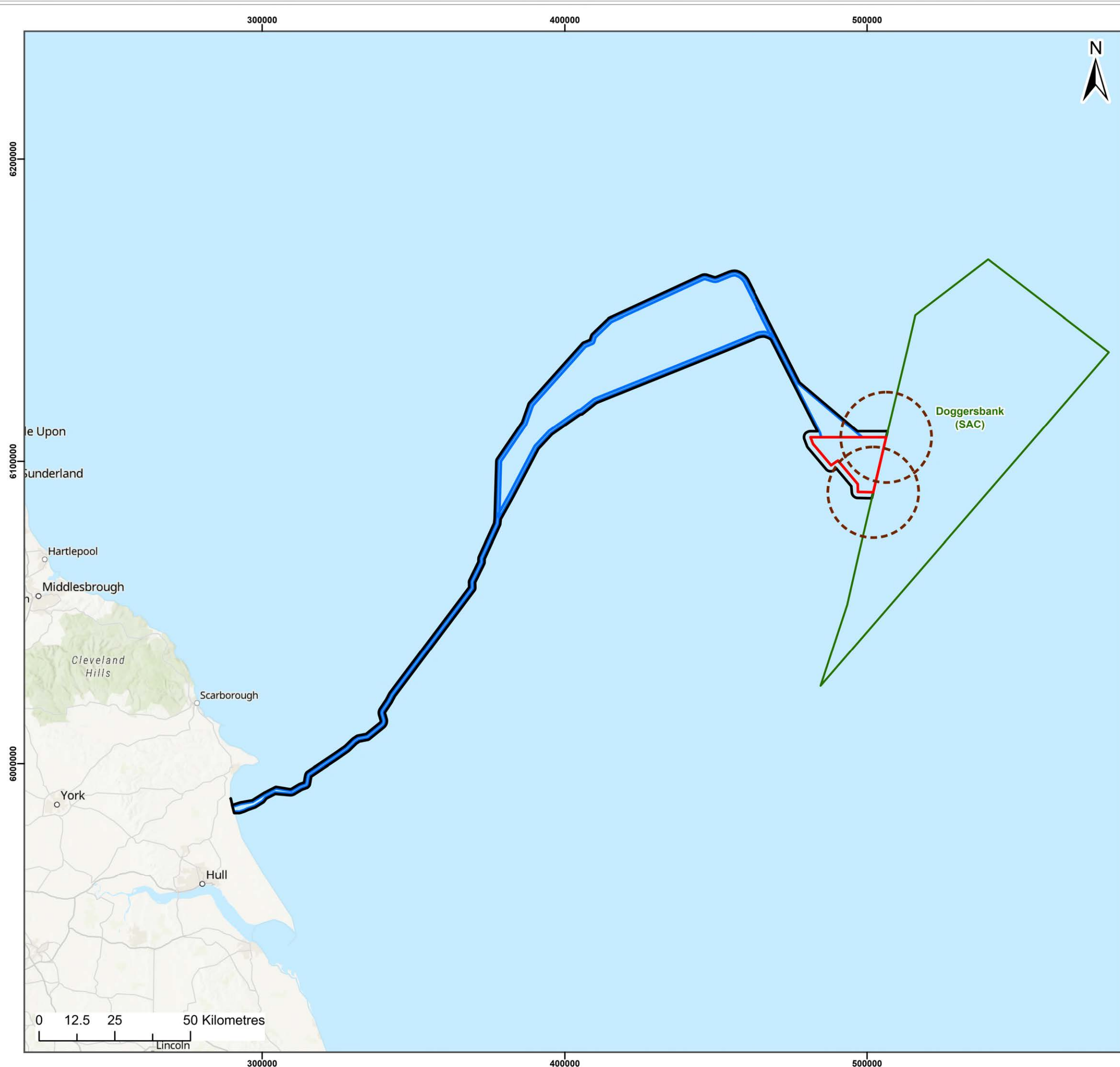
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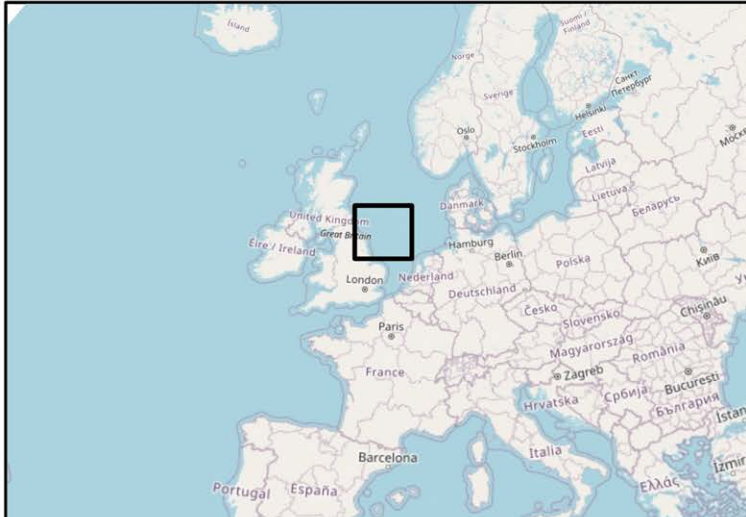
Overlap of Maximum Potential Disturbance Ranges for
Monopiling at DBD within the Doggersbank SAC

Figure:	9-3	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0524			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:	
01	04/02/2025	FC	KF	A3	1:1,250,000	

Co-ordinate system: WGS 1984 UTM Zone 31N







Legend:

- Dogger Bank D Array Area
- Offshore Export Cable Corridor
- Offshore Development Area
- Doggersbank Special Area of Conservation (SAC)
- Maximum Area of Disturbance from Pin-pile (15km EDR)

Source: © Haskoning DHV UK Ltd, 2025; © European Environment Agency, 2025;
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Project:					
Dogger Bank D Offshore Wind Farm	DOGGER BANK WIND FARM				
Title:					
Overlap of Maximum Potential Disturbance Ranges for Pin-piling at DBD within the Doggersbank SAC					
Figure: 9-4	Drawing No: PC6250-RHD-XX-OF-DR-GS-0525				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/02/2025	FC	KF	A3	1:1,250,000
Co-ordinate system: WGS 1984 UTM Zone 31N					
					

Table 9.42 Estimated Seasonal Averages with Doggersbank SAC Area with Piling for The Project

In-combination assessment scenario	Maximum overlap with seasonal area (%)	Maximum number of days	In-combination assessment scenario (%)
26km for monopiles	348.6km ² (7.36%)	57	1.15%
15km for jacket pin piles	117.4km ² (2.48%)	226	1.54%
26km for monopiles, at two locations in one day, with maximum potential separation	604.1km ² (12.76%)	57	1.99%
15km for jacket pin piles, at two locations in one day, with maximum potential separation	231.2km ² (4.88%)	226	3.02%

9.5.2.1.2.2 Impact 2b: Disturbance Effects due to ADD Activation

1928. The assessments of the potential disturbance during any ADD activation is indicative only, as the final requirements for mitigation in the MMMP will be determined prior to construction.
1929. Mitigation to reduce the risk of PTS could include activation of ADDs prior to the soft-start commencing. The period of time that an ADD is required to be activated for is dependent on the potential PTS ranges for each species, and their known swim speeds, as used within the underwater noise modelling.
1930. The predicted effect ranges for ADD activation for harbour porpoise are detailed in **Table 9.13** for the SNS SAC assessment and also apply to the Doggersbank SAC assessment for harbour porpoise.
1931. The assessment for the potential for disturbance to harbour porpoise due to ADD activation indicates **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise.

- 9.5.2.1.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.5.2.1.3.1 Impact 3a: Permanent auditory injury (PTS) Due to Other Construction Activities

1932. The predicted effect ranges for PTS due to other construction activities for harbour porpoise are detailed in **Section 9.4.2.1.3.1** for the SNS SAC assessment and also apply to the Doggersbank SAC assessment for harbour porpoise.

1933. Given the small number of individuals affected, there would be **no adverse effect** of PTS in harbour porpoise from other construction activities either alone or taking place simultaneously on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise.

9.5.2.1.3.2 Impact 3b: Permanent Auditory Injury (PTS) Due to Construction Vessels

1934. The predicted effect ranges for PTS due to construction vessels for harbour porpoise are detailed in **Section 9.4.2.1.3.2** for the SNS SAC assessment and also apply to the Doggersbank SAC assessment for harbour porpoise.

1935. Given the small number of individuals affected, there would be **no adverse effect** of PTS in harbour porpoise from vessels on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise.

- 9.5.2.1.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.5.2.1.4.1 Impact 4a: Disturbance Effects Due to Other Construction Activities

1936. The predicted disturbance effects due to other construction activities for harbour porpoise are detailed in **Section 9.4.2.1.4** for the SNS SAC assessment and also apply to the Doggersbank SAC assessment for harbour porpoise.

9.5.2.1.4.1.1 Disturbance due to other construction activities (for a single activity)

1937. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities based on the 4km potential disturbance range (with an effect area of 50.3km²) is presented in **Table 9.43**.

Table 9.43 Assessment of The Potential For Disturbance Due To Other Construction Activities, Including Cable Laying, Suction Dredging, Cable Trenching, And Rock Placement, For One Activity Taking Place At Any One Time

Marine mammal species	Assessment of effect
Harbour porpoise	42 (0.01% of NS MU)

9.5.2.1.4.1.1.1 Spatial Assessment

1938. Disturbance of harbour porpoise would not exceed 20% of the spatial threshold of the Doggersbank SAC area on any given day during other construction activities for a single activity for the Project, based on the worst-case scenario (**Table 9.44**). Areas where other construction activity can occur will not fully overlap with the Doggersbank SAC, therefore the maximum amount of overlap from the Array Area has been calculated as 8.98km².

Table 9.44 Maximum Potential Overlap with Doggersbank SAC Area Based on the Potential Disturbance Range of 4km for the Project

Maximum area of overlap with Doggersbank SAC area (% of Doggersbank SAC area)	Potential adverse effect on site integrity
8.98km ² (0.19%)	No. Temporary effect. Displacement of harbour porpoise would not exceed 20% of the seasonal component of the SNS SAC area on any given day during piling for the Project based on the worst-case scenario.

1939. There is therefore no significant disturbance and **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise due to disturbance from other construction activities during construction, for the Project.

9.5.2.1.4.1.1.2 Seasonal Average

1940. The seasonal averages have been calculated by multiplying the maximum area on any one day with the amount of days the other construction activity is occurring for over a full year. The resulting seasonal average for this would be 0.19% as a worst case.
1941. The assessment indicates that in the case of other construction activity for the Project, the potential disturbance is less than 10% of the seasonal threshold of the Doggersbank SAC that could be affected, due to construction activity for the Project (**Table 9.45**).

Table 9.45 Estimated seasonal averages with Doggersbank SAC Area with other Construction Activity for the Project

In-combination assessment scenario	Maximum overlap with seasonal area (%)	Maximum number of days	In-combination assessment scenario (%)
Other construction activity for the Project	8.98km ² (0.19%)	365	0.7%

1942. There would be **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise as a result of other construction activity for the Project.

9.5.2.1.4.1.2 Disturbance Due to Other Construction Activities at Multiple Simultaneous Locations

1943. As noted above, there is the potential that more than one of these other construction activities could be underway at the Array Area, or within the offshore export cable, at the same time. As a worst case and unlikely scenario, an assessment for up to four activities being undertaken simultaneously has also been undertaken.
1944. Based on a 4km potential disturbance range, and up to four other construction activities taking place at the same time, there is the potential for a simultaneous disturbance effect area of 201.06km². As noted above, this assumes that the disturbance would only affect the area around the vessel at the time of the activity taking place, and that individuals would return to the disturbed area once the activity had either completed or transited to a new location.
1945. An assessment of the maximum number of harbour porpoise that could be at risk of disturbance, due to all other construction activities undertaken at the same time is presented in **Table 9.46**.

Table 9.46 Assessment of The Potential For Disturbance Due To All Other Construction Activities Taking Place At The Same Time

Marine mammal species	Assessment of effect
Harbour porpoise	169 (0.05% of NS MU)

9.5.2.1.4.1.2.1 *Spatial Assessment*

1946. Disturbance of harbour porpoise would not exceed 20% of the seasonal component of the Doggersbank SAC area on any given day during other construction activities at multiple simultaneous locations for the Project, based on the worst-case scenario. The maximum overlap between the border of the Array Area and Doggersbank SAC has been calculated for the four construction activities taking place at different locations (with maximum separation) at the same time, the maximum overlap is 33.37km² as shown in **Table 9.47**.

Table 9.47 Maximum Potential Overlap with Doggersbank SAC Area Based on Disturbance Effect Area of 201.06km² for the Project

Maximum area of overlap with Doggersbank SAC area (% of Doggersbank SAC area)	Potential adverse effect on site integrity
33.37km ² (0.7%)	<p>No.</p> <p>Temporary effect.</p> <p>Displacement of harbour porpoise would not exceed 20% of the seasonal component of the Doggersbank SAC area on any given day during other construction for the Project based on the worst-case scenario.</p>

1947. Therefore, under these circumstances, there is no significant disturbance and **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise due to disturbance from other construction activities, for the Project.

9.5.2.1.4.1.2.2 *Seasonal Average*

1948. The seasonal averages have been calculated by multiplying the maximum area on any one day with the number of days the other construction activity is occurring for over a full year. The resulting seasonal average for this would be 0.7% as a worst case.

1949. The assessment indicates that in the case of other construction activity for the Project at multiple simultaneous locations, the potential disturbance is less than 10% of the seasonal threshold of the Doggersbank SAC that could be affected, due to construction activity for the Project (**Table 9.48**).

1950. There would be **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise as a result of other construction activity for the Project at multiple simultaneous locations.

Table 9.48 Estimated seasonal averages with Doggersbank SAC area with Other Construction Activity at Multiple Locations for the Project

In-combination assessment scenario	Maximum overlap with seasonal area (%)	Maximum number of days	In-combination assessment scenario (%)
Other construction activity for the Project at multiple simultaneous locations	33.37km ² (0.7%)	365	0.7%

9.5.2.1.4.2 *Impact 4b: Disturbance Effects Due to Construction Vessels*

1951. The predicted effect ranges for disturbance effects due to construction vessels for harbour porpoise are detailed in **Section 9.4.2.1.4** for the SNS SAC assessment and also apply to the Doggersbank SAC assessment for harbour porpoise.

1952. Whilst short to medium term behavioural responses have been recorded from vessel disturbance, there are no long-term or population level effects recorded to date. Less than 5% of the reference population is affected, therefore, it is considered that there would be **no adverse effect** from disturbance from underwater noise associated with vessels on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise.

9.5.2.1.4.2.1 *Spatial Assessment*

1953. Disturbance of harbour porpoise would not exceed 20% of the seasonal component of the Doggersbank SAC area on any given day during construction vessel presence for the Project, based on the worst-case scenario. The maximum overlap between the border of the Array Area, where a 4km buffer is applied for vessel disturbance, and Doggersbank SAC has been calculated for construction vessel presence, the maximum overlap is 118.7km², as shown in **Table 9.49**.

1954. Therefore, under these circumstances, there is no significant disturbance and **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise due to disturbance from other construction activities, for the Project.

Table 9.49 Maximum Potential Overlap with Doggersbank SAC Area Based on Disturbance Effect Area of 118.7km² for the Project

Maximum area of overlap with Doggersbank SAC area (% of Doggersbank SAC area)	Potential adverse effect on site integrity
118.7km ² (2.51%)	<p>No.</p> <p>Temporary effect.</p> <p>Displacement of harbour porpoise would not exceed 20% of the seasonal component of the Doggersbank SAC area on any given day during other construction for the Project based on the worst-case scenario.</p>

9.5.2.1.4.2.2 Seasonal Average

1955. The seasonal averages have been calculated by multiplying the maximum area on any one day with the number of days the other construction activity is occurring for over a full year. The resulting seasonal average for this would be 0.7% as a worst case.
1956. The assessment indicates that in the case of other construction activity for the Project at multiple simultaneous locations, the potential disturbance is less than 10% of the seasonal threshold of the Doggersbank SAC that could be affected, due to construction activity for the Project (**Table 9.50**).

Table 9.50 Estimated seasonal averages with Doggersbank SAC Area with Construction Vessels for the Project

In-combination assessment scenario	Maximum overlap with seasonal area (%)	Maximum number of days	In-combination assessment scenario (%)
Construction vessels	118.7km ² (2.51%)	365	2.51%

1957. There would be **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise as a result of the presence of construction vessels arising from the Project.

9.5.2.1.5 Impact 5: Barrier Effects from Underwater Noise During Construction

1958. The predicted disturbance effects due to barrier effects for harbour porpoise are detailed in **Section 9.4.2.1.5** for the SNS SAC assessment and also apply to the Doggersbank SAC assessment for harbour porpoise.

1959. Any potential barrier effects as a result of underwater noise during construction have been assessed as having **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise.

9.5.2.1.6 Impact 6: Increased Risk of Collision with Vessels During Construction

1960. During the construction phase there would be an increase in the number of vessels transiting to and from the Array Area and within the offshore ECC. However, it is anticipated that vessels would follow an established shipping route to the relevant ports to minimise vessel volume in the area. The **Outline MMMP (document reference 8.1)** provides a protocol for minimising collision risk of marine mammals with vessels.
1961. The increased risk of collision has been assessed in **Section 9.4.2.1.6** for the SNS SAC, the assessment also applies here for the Doggersbank SAC in relation to harbour porpoise.
1962. Harbour porpoise in the relevant study area(s) are already accustomed to vessels. All vessel movements would be kept to the minimum number that is required to develop the Project. Additionally, vessel operators would use industry best practice to reduce any risk of collisions with marine mammals.
1963. Therefore, any increase in vessel collision risk during construction has been assessed as having **no adverse effect** on the integrity of the Doggersbank SAC.

9.5.2.1.7 Impact 8: Potential Effects of Changes to Prey Resource and Habitat quality

1964. The potential effects on prey species during construction can result from physical disturbance and loss of seabed habitat; increased SSC and sediment re-deposition; and underwater noise. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms.
1965. During construction activities, the worst-case footprint for disturbance would be 28.85km², constituting only 0.61% of the total Doggersbank SAC area. The potential effects of changes to prey resource and habitat quality have been assessed further in **Section 9.4.2.1.7** for the SNS SAC in relation to harbour porpoise, the findings also here for the Doggersbank SAC.
1966. It is unlikely that there would be significant changes to prey over the entire area. It is more likely that effects would be restricted to an area around the working sites. There is unlikely to be any additional displacement of harbour porpoise as a result of any changes in prey availability during piling as harbour porpoise would also be disturbed from the area.

1967. The footprint of the project is relatively small with regard to the entire area of the Doggersbank SAC and so the effects of changes to prey, possibly arising during construction activities, would have **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise for the Project.

9.5.2.1.8 Impact 9: Potential Effects of Changes to Water Quality

1968. Potential changes in water quality during construction could occur through:

- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations, and array, cables;
- Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and Offshore Platforms;
- Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
- Deterioration in water quality associated with release of sediment bound contaminants.

1969. Marine mammals often inhabit turbid environments and cetaceans utilise sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly (Todd *et al.*, 2014).

1970. Increased turbidity is unlikely to have a direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely.

1971. Potential changes in water quality during construction would have **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise for the Project.

9.5.2.2 Potential Effects During O&M

9.5.2.2.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Operational Wind Turbine Noise

1972. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during the operational phase and determine the potential effects on marine mammals (**PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report**).

1973. The predicted effect ranges for PTS due to operational wind turbine noise for harbour porpoise are detailed in **Section 9.4.2.2.1** for the SNS SAC assessment and also apply to the Doggersbank SAC assessment for harbour porpoise.

1974. There would be **no adverse effect** of PTS in harbour porpoise from operational WTG noise on the integrity of the Doggersbank SAC in relation to harbour porpoise.

9.5.2.2.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Operational Wind Turbine Noise

1975. The predicted effect ranges for behavioural effects due to operational wind turbine noise for harbour porpoise are detailed in **Section 9.4.2.2.2** for the SNS SAC assessment and also apply to the Doggersbank SAC assessment for harbour porpoise.

1976. For the potential for disturbance due to operational WTGs, the effect significance has been assessed as having **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise.

9.5.2.2.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.5.2.2.3.1 Impact 3a: Permanent Auditory Injury (PTS) Due to Other O&M Activity

1977. The requirements for any potential O&M work, such as additional rock placement or cable re-burial, are currently unknown, however the work required, and associated effects to marine mammals would be less than those during construction.

1978. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities, and if the marine mammal remains within close proximity for 24 hours. Therefore, it is highly unlikely for there to be any PTS due to these activities.

1979. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase.

1980. The effect significance for permanent changes in hearing sensitivity (PTS) due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the SNS SAC in relation to the conservation objectives for harbour porpoise.

9.5.2.2.3.2 Impact 3b: Permanent Auditory Injury (PTS) Due to O&M Vessels

1981. During the O&M for the Project, there may be up to 16 vessels in the Offshore Development Area at any one time, compared to the 35 vessels that would be on site during construction. Therefore, the potential effects associated with underwater noise and disturbance from vessels during O&M would be less than of those during construction (as assessed in **Section 9.5.2.1.3.2**). As a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst-case scenario.

1982. There would therefore be **no adverse effect** of PTS in harbour porpoise from vessels on the integrity of the Doggersbank SAC in relation to harbour porpoise.

9.5.2.2.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.5.2.2.4.1 Impact 4a: Disturbance Effects Due to Other O&M Activities

1983. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. The requirements for any potential maintenance work are currently unknown, however, the work required, and impacts associated with underwater noise and disturbance from activities during O&M would be less than those during construction. As there is expected to be less noisy activities during the operation phase than is required during construction, it is therefore likely to cause less disturbance to foraging behaviours in harbour porpoise.

1984. Therefore, the potential for adverse effect due to underwater noise from O&M activities is considered to be the same or less than that assessed for underwater noise from other construction activities (including rock placement, trenching and cable laying) (as assessed in **Section 9.5.2.1.4**).

1985. The effect significance for disturbance effects due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise.

9.5.2.2.4.2 Impact 4b: Disturbance Effects Due to O&M Vessels

1986. The requirements for any potential maintenance work are currently unknown, however the work required, and impacts associated with underwater noise and disturbance from vessels during O&M, would be less than those during construction.

1987. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be 16, which is less than the 35 vessels that could be on site during construction. However, as a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst-case scenario.

1988. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.

1989. There would therefore be **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise.

9.5.2.2.5 Impact 5: Underwater Noise: Barrier Effects During O&M

1990. The indicative minimum separation distance between turbines would be a minimum of 0.826km to 1.416km, depending on WTG size, therefore there would be no overlap in the potential impact range (PTS; **Table 9.31**) of <100m around each turbine, and there would be adequate room for marine mammals to move through the Array Area.

1991. Harbour porpoise are known to be present and forage within operational wind farm areas (**Section 9.4.2.2.2**), and therefore it is concluded that the presence of the Project would not form a barrier to any movement of marine mammal species.

1992. Therefore, no barrier effects as a result of underwater noise during O&M are anticipated, and no further assessment is required.

9.5.2.2.6 Impact 6: Increased Risk of Collision with Vessels During O&M

1993. As noted in **Section 9.4.2.2.1**, it is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be up to 19.

1994. Vessel movements, where possible, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. In addition, vessel operators will use best practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever possible.

1995. Any increase in vessel collision risk during operation has been assessed as having **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise.

9.5.2.2.7 Impact 8: Potential Effects of Changes to Prey Resource

1996. The potential impacts on fish species during O&M can result from temporary habitat loss / disturbance; permanent habitat loss; introduction of wind turbine foundations; scour protection and hard substrate; increased suspended sediments and sediment re-deposition; re-mobilisation of contaminated sediments; underwater noise; and EMF.

1997. The potential effects of changes to prey resource during O&M has been assessed in **Section 9.4.2.2.7** for the SNS SAC, the assessment also applies here for the Doggersbank SAC in relation to harbour porpoise.

1998. The effects arising during the operational phase of the Project are likely to be the same or less than those assessed for construction. The effects of changes to prey during operation would have **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise for the Project.

9.5.2.2.8 Impact 9: Barrier Effects from the Physical Presence of the Wind Farm During O&M

1999. There is unlikely to be the potential for any barrier effects upon the completion of construction, as it is predicted that harbour porpoise will return once the activity has been completed. Monitoring was conducted at the Horns Rev and Nysted OWFs in Denmark in 1999 and 2006 during operation (Diederichs *et al.*, 2008). The data showed that numbers of harbour porpoise within Horns Rev were slightly reduced compared to the wider area during the first two years of operation and found no effect on numbers after two years of operation. Though, it was not possible to conclude that the OWF was solely responsible for this change in abundance without analysing other dynamic environmental variables (Tougaard *et al.*, 2009).
2000. Lindeboom *et al* (2011) documented that harbour porpoise have been observed to foraging within operational wind farm sites indicating that the physical presence of the wind farm does not cause a barrier. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of harbour porpoise in operational OWF sites.
2001. The effect significance for barrier effects due to the physical presence of the wind farm has therefore been assessed as having **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise.

9.5.2.3 Potential Effects During Decommissioning

2002. 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.
2003. Commitment ID CO21 (see **PEIR 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 impacts on harbour porpoise 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.
2004. 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.

2005. 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.
2006. Therefore, the potential effects on harbour porpoise during decommissioning are assumed to be the same or less than those assessed for construction due to the processes of decommissioning potentially being the reverse of the installation, without the need for piling.

9.5.3 Assessment of Potential Effects of the Project In-Combination with Other Plans and Projects

2007. The following in-combination assessment has been undertaken based on **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**, and **Section 12.8 of PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise**.
2008. The in-combination assessment considers other schemes and activities where the predicted effects have the potential to combine with the potential effects during construction of the Projects. The construction phase has been assessed as the worst case for potential in-combination effects.
2009. The schemes screened into the in-combination assessment for harbour porpoise are those that are located in the relevant MUs. Full information on the screening of effects considered for the in-combination assessment is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**. The in-combination screening for harbour porpoise considers the same schemes as considered in the cumulative screening, as the Doggersbank SAC is in the NS MU, therefore all schemes occurring in the NS MU have been considered in the assessment.
2010. The in-combination effects assessed are:
- Disturbance from underwater noise due to the following sources:
 - Piling at other OWFs;
 - Geophysical surveys for OWFs;
 - Aggregate extraction and dredging;

- Subsea cable and pipelines; and
 - UXO clearance.
 - Barrier effects of other OWFs;
 - Increased collision risk with vessels; and
 - Changes in prey resource.
2011. The in-combination screening identified that there is the potential for cumulative effects on harbour porpoise as a result of disturbance from underwater noise during piling and other construction activities. Due to the low noise levels associated with operational OWFs, as the BEIS (2020) RoC HRA for the SNS SAC stated that there would no potential for significant effect from the operation of OWFs, alongside the construction of OWFs (BEIS, 2020), therefore all operational impacts have been screened out.
2012. Further information is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**.

9.5.3.1 In-Combination Impact 1: Disturbance from Underwater Noise

2013. The commitment to the mitigation measures agreed through the final MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) in harbour porpoise. In light of this, and taking account of the type, scale and extent of potential effects arising from the Projects assessment, it concluded **no adverse effect** on integrity for harbour porpoise due to physical injury or PTS from construction (see **Section 9.4.2.1**).
2014. It is intended that this approach to assessing the potential effects of disturbance from underwater noise will reduce some of the uncertainties and complications in using the different assessments from HRAs, based on different noise models, thresholds and criteria, as well as different approaches to density estimates.
- 9.5.3.1.1 In-Combination Impact 1a: Assessment of Underwater Noise from Piling at Other OWFs
2015. One of the greatest potential noise sources during OWF construction is from pile driving. The in-combination assessment considers the potential disturbance of marine mammals during piling the Project, with the piling at other OWF schemes screened into the in-combination assessment.
2016. In **Section 9.4.2.1.1**, an assessment against the NS MU for underwater noise from piling at other OWFs has been undertaken for the SNS SAC in relation to harbour porpoise. As the density estimate and reference population is the same as that of the Doggersbank SAC, it can be referred back to the aforementioned Section for this assessment.

2017. For harbour porpoise, the potential worst-case scenario of other OWFs piling at the same time as the Project is assessed in **Table 9.32**. More than 5% of the reference population could potentially be disturbed, however, this is very precautionary, as it is unlikely that all other OWF schemes could be piling at exactly the same time as piling for the Project.
2018. In practice, the potential temporary effects would be less than those predicted in this assessment as there is likely to be a great deal of variation in timing, duration, and hammer energies used throughout the various OWF project construction periods. In addition, not all individuals would be displaced over the entire potential disturbance range (26km) used within the assessments. For example, the study of harbour porpoise at Horns Rev (Brandt *et al.*, 2011), indicated that at closer distances (2.5 to 4.8km) there was 100% avoidance, however, this proportion decreased significantly moving away from the pile driving activity and at distances of 10km to 18km avoidance was 32% to 49% and at 21km the abundance was reduced by just 2%.
2019. Additional assessments using iPCoD modelling were undertaken to predict the harbour porpoise population effect due to cumulative disturbance from piling, using the number at risk of disturbance from each project as provided in **Table 9.32**.
2020. For the in-combination scenario assessed the reference population 338,918 was applied for the NS MU for harbour porpoise, the iPCoD model predicts there to be little effect on the harbour porpoise population over time from disturbance due to piling at all twelve OWF projects (**Figure 9-2** and **Table 9.33**).
2021. The median population size was predicted to be 99.91% of the un-impacted population size at the end of 2029 (one year after the piling has commenced in the wider area year after the piling has commenced). By the end of 2034 (the year piling ends) the median population size for the impacted population is predicted to be 99.54% of the un-impacted population size. Beyond 2034, the impacted population is expected to maintain the same stable trajectory as the un-impacted population (as far as 2054 which is the end point of the modelling, at which point the median impacted to un-impacted ratio is 99.5% (**Figure 9-2** and **Table 9.33**).
2022. The modelling indicates there would be **no adverse effect** on the integrity of the Doggersbank SAC due to cumulative disturbance from piling, due to there being less than a 1% population level effect on average per year over both the first six years and 25-year modelled periods.

9.5.3.1.1.1 Spatial and Seasonal Assessment

2023. The other OWFs included in the in-combination assessment have no potential overlap between their piling effect area (assuming a 26km EDR) and the Doggersbank SAC area. Therefore, as no other OWFs need to be included within the spatial assessment, **Section 9.5.2.1.2** can be referred back to as the Project is the only OWF with the potential for the piling effect area to overlap with the Doggersbank SAC.

2024. The potential maximum area of disturbance could be 604.1km² for two monopiles simultaneously piling at the same time for the Project, which would be approximately 12.76% of the Doggersbank SAC area.
2025. The assessment indicates that less than 20% of the spatial threshold and 10% of the seasonal threshold for the Doggersbank SAC area could be affected, based on the maximum potential overlaps from piling for the Project (**Table 9.41** and **Table 9.42**).
2026. There would be **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise as a result of disturbance due to DBD piling and other OWFs piling at the same time.

9.5.3.1.2 In-Combination Impact 1b: Assessment of Disturbance from Other Industries and Activities

2027. During the construction period the Project, there is the potential for disturbance to marine mammals associated with other potential noise sources, including:
- Aggregate extraction and dredging; and
 - Interlink cable.
2028. For the installation of oil and gas infrastructure, marine renewable schemes, and disposal sites, all potential schemes have been screened out. Further information on the CEA screening (and these results) are provided in **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**.
2029. For assessments in UK waters, the potential for geophysical surveys, oil and gas seismic surveys and UXO clearance are based on the average of those activities being undertaken in previous years. As these activities have much shorter consenting lead-in times than that of OWF developments (or other projects such as sub-sea cables), it is not currently known when or where these may take place in UK waters, and therefore an estimate is made based on previous years. However, for these activities in European waters, it is not known when or how often these activities are undertaken. In addition, within Dutch waters, the clearance of UXO is the responsibility of the military, rather than the developer, leading to many unknowns in terms of how many UXO may be cleared per year. Therefore, these indicative activities (geophysical surveys, oil and gas seismic surveys, and UXO clearance) are not included further within the in-combination assessment for Doggersbank SAC.

9.5.3.1.2.1 Disturbance From Aggregate Extraction and Dredging

2030. Seven aggregate/dredging projects have been screened in that could have potential cumulative disturbance impacts with piling taking place at the Project (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**).

2031. The assessment against the NS MU harbour porpoise population for disturbance from aggregate extraction and dredging has already been undertaken in **Section 9.4.3.1.2.2**.
2032. For the potential for in-combination disturbance from aggregate and dredging schemes undertaken at the same time as the Project piling, with no other in-combination activities, up to 0.53% of the NS MU population may be disturbed (**Table 9.35**).
2033. None of the screened in aggregate schemes are within (or within 600m of) the Doggersbank SAC area. Therefore, an assessment against the spatial and seasonal thresholds has not been undertaken.

9.5.3.1.2.2 Disturbance From Subsea Cables and Pipelines

2034. Only one subsea pipeline has been screened into the in-combination assessment; Sea Link. This project is currently at scoping stage and therefore there is limited information available on potential effects and disturbance ranges for which to inform the in-combination assessment with DBD.
2035. The assessment against the NS MU harbour porpoise population for disturbance from subsea cables and pipelines has already been undertaken in **Section 9.4.3.1.1.2**.
2036. For disturbance from Sea Link and DBD piling, up to 0.54% of the NS MU population may be disturbed (**Table 9.37**).

9.5.3.1.2.3 Summary of In-Combination Impact 1: Assessment of Underwater Noise

2037. Each of the above described noise sources with the potential for disturbance on harbour porpoise are quantitatively assessed together in **Table 9.51** against the NS MU harbour porpoise population.
2038. For harbour porpoise, for noisy activities with the potential for in-combination disturbance effects together with piling for the Project, 8.2% of the population is at risk of disturbance.
2039. It should be noted that while the schemes included within the in-combination assessment for disturbance from other activities and industries were included based on the current knowledge of their possible construction or activity windows, it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the harbour porpoise that could be at risk of disturbance during the offshore construction period of the Project.
2040. There would be **no adverse effect** on the integrity of the Doggersbank SAC in relation to the conservation objectives for harbour porpoise as a result of DBD with other schemes.

Table 9.51 Quantitative Assessment for All Noisy Activities with the Potential for In-Combination Disturbance Effects For Harbour Porpoise

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)	
	Based on population modelling results	Based on quantitative assessment for all activities
DBD piling	Based on iPCoD modelling, <1% of the population disturbed over the first six years	1,789 (0.53%)
Piling at other OWFs		25,942 (7.65%)
Aggregates and dredging	7 (0.011%)	
Subsea cables	28 (0.008%)	
Total number of harbour porpoise (percentage of MU)	35 (1.01% (including iPCoD %) of NS MU)	27.766 (8.2% of NS MU)

9.5.3.2 In-Combination Impact 2: Barrier Effects

2041. For the assessment of the potential for barrier effects due to underwater noise from schemes undergoing construction, the effect to marine mammal species would be as per the assessments provided in **Section 9.5.3.1.2** for in-combination disturbance effects due to all noisy activities.
2042. It is important to note that the OWFs and other noise sources included in the in-combination assessment are spread over the wider area of the North Sea. Taking into account the locations of the OWFs and other noise sources from the Project, the maximum underwater effect ranges for disturbance at other schemes would not overlap with the maximum underwater effect ranges for disturbance arising from the Project during piling and construction. Therefore, there is no potential for underwater noise from the Project, other OWFs and noise sources to result in a barrier of movement to marine mammals.
2043. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect and therefore has not been considered within this in-combination assessment.
2044. Therefore, there would be **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise.

9.5.3.3 In-Combination Impact 3: Increased Collision Risk with Vessels

2045. The in-combination effects from an increase in the number of vessels and vessel movements can pose a potential collision risk for harbour porpoise.
2046. As outlined in **Sections 9.5.2.1.6** (construction) and **Section 9.5.2.2.6** (operation), vessels would be intermittently present throughout the lifetime of the Project. As vessel movements to and from any port would be incorporated within existing vessel routes as far as possible, there would be no increased collision risk, as the increase in the number of OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas. Once on-site, OWF vessels and other construction-related vessels would be stationary or slow-moving as they undertake their associated activities.
2047. Vessel operators for the Project, North Falls (SSE & RWE, 2024), Sheringham Shoal and Dudgeon Extension (Equinor, 2022) will also follow best practices outlined in the **Outline PEMP (document reference 8.6)** to further reduce collision risks. Hornsea Four (Orsted, 2021) and Outer Dowsing (Outer Dowsing Offshore Wind, 2024) adopt a Vessel Management Plan (VMP) to minimise the potential for any impact. West of Orkney (Offshore Wind Power Limited, 2023), Five Estuaries (Five Estuaries OWF Limited, 2024) and Rampion 2 (Rampion 2 Wind Farm, 2023) adopt a best practice vessel handling protocols such as the WiSe Scheme or Guide to Best Practice for Watching Marine Wildlife. It is expected that other offshore projects and industries will adopt similar measures to mitigate the potential for marine mammal collisions, with Hornsea THREE (Orsted, 2018), Dogger Bank A and B (Forewind, 2014) and South (East and West) (RWE, 2024) also committed to these practices.
2048. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low. Increased collision risk from aggregate extraction and dredging has therefore been screened out from further consideration in the CEA.
2049. In addition, based on the assumption that harbour porpoise would be disturbed as a result of underwater noise from piling, other construction activities, operational and maintenance activities and vessels, there should be no potential for increased collision risk with vessels.
2050. Therefore, there would be **no adverse effect** on integrity of the Doggersbank SAC in relation to harbour porpoise due to an increase in collision risk with construction vessels.

9.5.3.4 In-Combination Impact 4: Changes in Prey Resource

2051. Potential effects on prey species at the Project were assessed in **Section 9.5.2.1.7** (construction) and **Section 9.5.2.2.7** (operation). **No adverse effect** on integrity of the Doggersbank SAC in relation to harbour porpoise was concluded. Any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat in the surrounding area. This will be the case for all schemes and therefore although the in-combination effects are additive, the effect would be proportionate to the wider range over which effects would occur.
2052. Therefore, there would be **no adverse effect** on the integrity of the Doggersbank SAC in relation to harbour porpoise arising due to changes in prey availability.

9.5.4 Summary of Potential Effects on Site Integrity

2053. The assessment of the potential effects the Project has been summarised in relation to the Doggersbank SAC for harbour porpoise.
2054. The MMMP will provide mitigation or management measures to reduce the potential for any significant disturbance of harbour porpoise as a result of in-combination effects from underwater noise.
2055. There would be **no adverse effect** on integrity of the Doggersbank SAC in relation to harbour porpoise, either alone or when in-combination with other schemes.

9.6 Humber Estuary SAC

9.6.1 Site Description

2056. The Humber is the second largest coastal plain estuary in the UK, and the largest on the east coast of Britain. Grey seal are present as a qualifying feature of the Humber Estuary SAC (Natural England, 2009).
2057. The HE SAC is located, at closest point, 235km from Array Area. Therefore, there is no potential for direct effect on the SAC as a result of the construction, operation, maintenance or decommissioning of the Array Area. However, due to the foraging range of grey seal and the movement of grey seal along the east coast of England, there is the potential for effects on foraging grey seal from the HE SAC in the vicinity of the Array Area.
2058. Note that the SAC is largely coincident with the HE Ramsar site for which grey seal are listed under Ramsar Criterion 3. This criterion states “*A wetland should be considered internationally important if it supports populations of plant and / or animal species important for maintaining the biological diversity of a particular biogeographic region.*”

9.6.1.1 Qualifying Feature

9.6.1.1.1 Grey Seal

2059. There is a considerable amount of movement of grey seals among different areas and regional subunits of the North Sea, and there is no evidence to suggest that grey seals on the North Sea coasts of Denmark, Germany, the Netherlands, or France are independent from those in the UK (SCOS, 2022).
2060. Compared with other times of the year, grey seal in the UK spends longer hauled out during their annual moult (between December and April) and during their breeding season, in eastern England, pupping occurs mainly between early November and mid-December (SCOS, 2022).
2061. Array Area is located approximately 210km offshore (at the closest point to shore). The Donna Nook haul-out site is within the HE SAC and represents the current best grey seal population estimate of the SAC. In August 2021 there were 3,897 grey seal counted at Donna Nook (SCOS, 2022) (see **Table 9.52**).

Table 9.52 Grey Seal Counts and Population Estimates

Population area	Grey seal haul-out count	Source of haul-out count data	Correction factor for seals not available to count	Grey seal SAC population
Humber Estuary SAC population estimate	3,897	SCOS 2022	0.2515	15,495

2062. A relatively low number of grey seal were recorded during the site-specific aerial surveys, with a total of 19 individuals recorded during the 24 surveys for the Project plus a 4km buffer. However, in addition a total of 15 unidentified seal species were recorded for the Array Area plus 4km buffer, a proportion of which are expected to be grey seal.
2063. Throughout the surveys the numbers of grey seal, or individuals that could be grey seal (i.e. seal species) were relatively similar year-round, with a slight peak in spring and winter. Due to the low number of grey seal sightings, absolute density and abundance estimates were not possible to derive from the site-specific surveys.

2064. Carter *et al* (2022) produced habitat-based predictions of at-sea distribution for grey seals in the British Isles. The resultant density of seals at-sea maps shows the relative density of seals in each 5km by 5km grid cell. As well as the total grey seals at-sea densities, Carter *et al* (2022) provide SAC specific densities. These SAC specific densities provide the relative density of grey seal that are associated with each SAC. These SAC specific density estimates have been used to calculate the density of grey seal, associated with the HE SAC, present within the Array Area (**Figure 9-5**). This effectively apportions the potential for effect to only those seals that are affected that are associated with the SAC itself.
2065. The highest mean at sea relative density estimates of grey seal for the Array Area, and all Offshore Export Cable areas calculated from Carter *et al* (2022) are:
- 0.019 individuals per km² for Array Area; and
 - 0.103 individuals per km² for the offshore ECC.
2066. As the density estimate for offshore ECC is the worst case, this will be used within the assessments. The assessments are based on mean relative density estimates for the HE SAC from (Carter *et al.*, 2022) as a worst-case. The corrected SAC grey seal count was used to generate absolute densities from the relative density data of Carter *et al* (2022). This at-sea population number is 15,495 (see **Table 9.52**), based on the total population of grey seal at the HE SAC and calculated against a correction factor of 0.2515 (Carter *et al.*, 2020; to take account of those individuals at sea only).
2067. Assessments are undertaken against the SAC population estimate of 15,495 seals, for both the project alone and in-combination.

9.6.1.2 Conservation Objectives

2068. The Conservation Objectives (Natural England, 2023a) are:

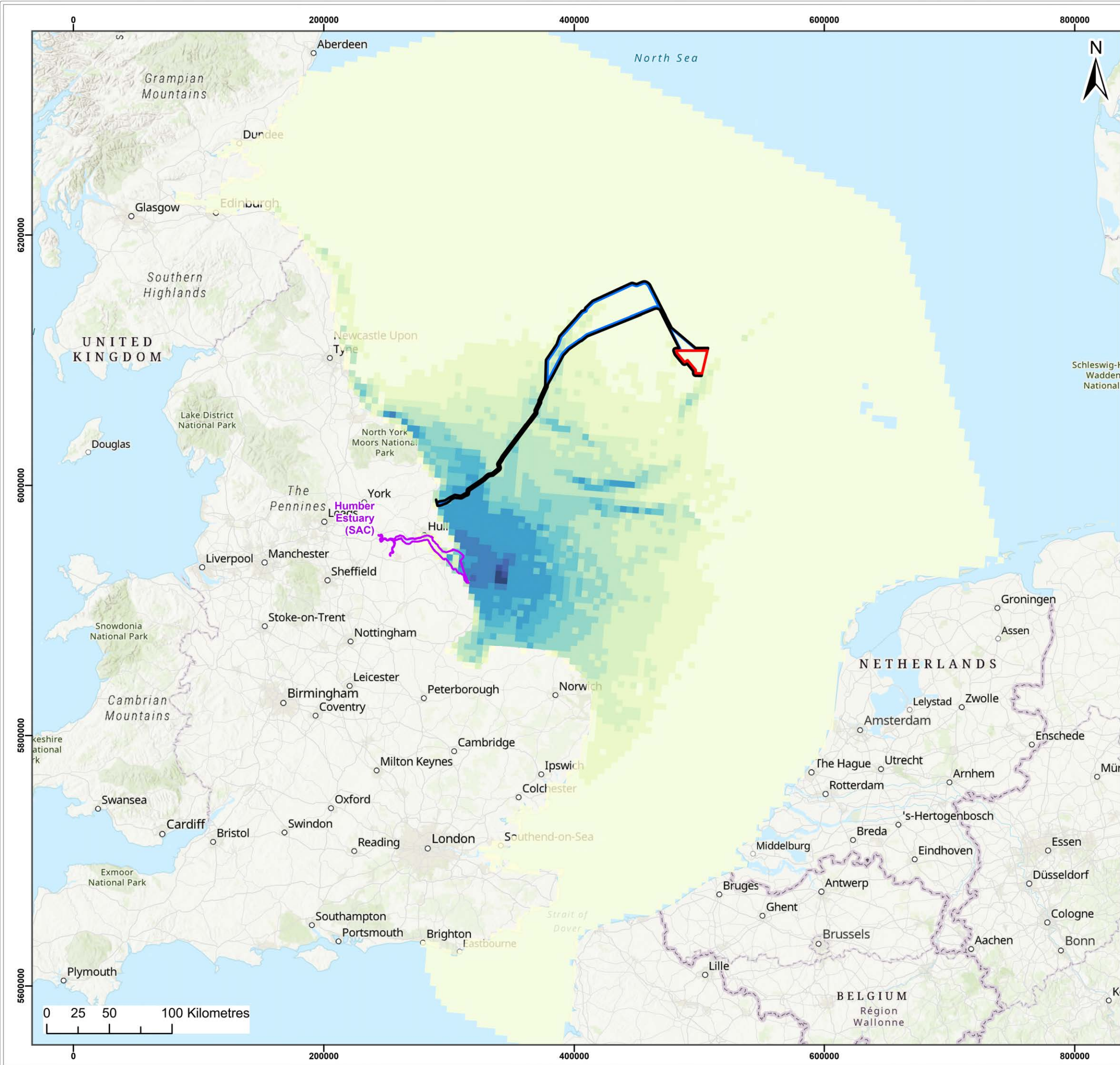
“To ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:

- *The extent and distribution of qualifying natural habitats and habitats of qualifying species;*
- *The structure and function (including typical species) of qualifying natural habitats;*
- *The structure and function of the habitats of qualifying species;*
- *The supporting processes on which qualifying natural habitats and habitats of qualifying species rely;*
- *The populations of qualifying species, and,*
- *The distribution of qualifying species within the site.”*

2069. For grey seal within the HE SAC, the specific targets are to:

- Maintain the population size within the site;
- Maintain the reproductive and recruitment capability of the species;
- Maintain the presence and spatial distribution of the species and their ability to undertake key life stage and behaviours;
- Maintain connectivity of the habitat within sites and the wider environment to allow movement of migratory species;
- Restrict the introduction and spread of non-native species and pathogens, and their impacts;
- Maintain the extent and spatial distribution of the following supporting habitats; foraging and haul out sites;
- Maintain the cover / abundance of preferred food items required by the species;
- Maintain the natural physio-chemical properties of the water;
- Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement is not significantly altered or constrained;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;
- Maintain water quality to mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. suspended concentrations of sediment, plankton and other material) in areas where this species is, or could be present.

2070. Note that with regard to the Ramsar designation, Natural England advice states that for Ramsar sites, a decision has been made by Defra and Natural England not to produce Conservation Advice packages. As the provisions on the Habitats Regulations relating to HRA extend to Ramsar sites, Natural England considers the Conservation Advice packages for the overlapping European Marine Site designations to be, in most cases, sufficient to support the management of the Ramsar interests. Therefore, the conservation objectives listed above cover both the SAC and Ramsar Assessment of Potential Effects of the Project Alone.



Legend:

- Dogger Bank D Array Area
- Offshore Export Cable Corridor
- Offshore Development Area
- Humber Estuary Special Area of Conservation (SAC)

Mean Grey Seal At-Sea Usage (% per 25km²)

0 - 0.005	0.011 - 0.02
0.0051 - 0.01	0.021 - 0.04
	0.041 - 0.06
	0.061 - 0.08
	0.081 - 0.1
	0.11 - 0.2
	0.21 - 0.3
	0.31 - 0.4
	0.41 - 0.5
	0.51 - 0.7

Source: © Haskoning DHV UK Ltd, 2025; © JNCC, 2025; © Carter *et al.*, 2022
© OpenStreetMap (and) contributors, CC-BY-SA

Project:

Dogger Bank D Offshore Wind Farm

Title:

Grey Seal At-Sea Mean Densities for Those Individuals Associated With the Humber Estuary SAC

Figure:	9-5	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0526								
Revision:	01	Date:	04/02/2025	Drawn:	FC	Checked:	KF	Size:	A3	Scale:	1:3,000,000

Co-ordinate system: WGS 1984 UTM Zone 31N

9.6.2 Assessment of Potential Effects of the Project Alone

9.6.2.1 Potential Effects During Construction

2071. Potential effects during construction may arise through disturbance from activities during the installation of offshore infrastructure. Underwater noise during piling, as well as disturbance associated with underwater noise from other construction activities and the presence of vessels offshore, are considered. Potential displacement from important habitat areas and impacts on prey species are also considered.

2072. The potential effects during construction assessed for grey seals are outlined in **Section 4.5.3**.

9.6.2.1.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Impact Piling During Construction

2073. Underwater noise modelling was carried out by Subacoustech Environmental Ltd. to estimate the noise levels likely to arise during piling and determine the maximum potential areas of effect (see **PEIR Volume 2, Appendix 12-3 Underwaters Noise Modelling Report** and **Section 9.4.2.1.1** for further details).

9.6.2.1.1.1 PTS from a single strike

2074. The underwater noise modelling results for the predicted effect ranges and areas for PTS from a single strike of the maximum hammer energy for the worst-case location have been assessed (**Table 9.53**).

Table 9.53 The Predicted Effect Ranges For PTS, At the Worst-Case Modelling Location For Seals, For The Maximum Hammer Energies Of Both Monopiles And Pin Piles

Marine mammal species	Potential effect ranges (and areas) for PTS at the maximum hammer energy	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Grey seal	0.06km (0.01km ²)	0.05km (0.01km ²)

2075. An assessment of the maximum number of individuals that could be at risk of instantaneous PTS, due to a single strike at the maximum hammer energy, for both monopiles and jacket pin piles, is presented in **Table 9.54**.

2076. The maximum potential number of grey seal that could be at possible risk of PTS due to a single strike at the maximum hammer energy, for monopiles and jacket pin piles, without any mitigation is 0.0002 individuals (0.000001% of the HE SAC reference population, based on the array density estimate).

Table 9.54 Assessment of the Potential for Instantaneous PTS Due to a Single Strike of the Maximum Hammer Energy for a Monopile and Jacket Pin Pile

Marine mammal species	Assessment of effect
PTS due to a single strike of a monopile at maximum hammer energy (Sound pressure level (SPL _{peak}))	
Grey seal	0.0002 (0.000001%)
PTS due to a single strike of a jacket pin pile at maximum hammer energy (SPL _{peak})	
Grey seal	0.0002 (0.000001%)

9.6.2.1.1.2 PTS from cumulative exposure

2077. The SEL_{cum} is a measure of the total received noise over the whole piling operation. The SEL_{cum} range indicates the distance from the piling location that if the receptor were to start fleeing in a straight line from the noise source starting at a range closer than the modelled range it would receive a noise exposure in excess of the criteria threshold, and if the receptor were to start fleeing from a range further than the modelled range it would receive a noise exposure below the criteria threshold.

2078. **Table 9.55** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of monopiles and jacket pin piles at the worst-case location.

Table 9.55 Predicted Effect Ranges (and Areas) for PTS for Seals, At the Worst Case Modelling Location, for the Cumulative Exposure of Both Monopiles and Pin Piles

Scenario	Potential effect ranges (and areas) for PTS due to cumulative exposure	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Multiple sequential pile installations in a 24-hour period	0.73km (1.6km ²)	0.43km (0.53km ²)

2079. It is important to note that the assessment for PTS from cumulative exposure is highly precautionary. There is some variation in the potential impact ranges for SEL_{cum} at each location and between locations, therefore in many cases less individuals would be at risk of exposure than presented here (as the assessments are based on the worst-case location). It is also unlikely that the maximum hammer energy would be required at all piling locations for the entire duration of the piling activity.

2080. An assessment of the maximum number of grey seal that could be at risk of cumulative PTS, for both sequential monopiles and jacket pin piles, is presented in **Table 9.56**, based on the effect areas as presented in **Table 9.55**.

Table 9.56 Assessment of the Potential for PTS Due to the Cumulative Exposure of Sequential Monopiles or Jacket Pin Piles in a 24 Hour Period for Seals

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of two sequential monopiles in a 24 hour period (SEL _{cum})	0.03 (0.0002%)
PTS due to the cumulative exposure of four sequential jacket pin piles in a 24 hour period (SEL _{cum})	0.01 (0.00006%)

2081. In the worst case 0.03 individuals 0.0002% of the HE SAC reference population, based on the array density estimate) could be at risk of cumulative PTS due to the cumulative exposure of two sequential monopiles in a 24-hour period.

9.6.2.1.1.3 PTS from cumulative exposure from multiple piling locations

2082. The simultaneous piling scenario assumes that animals are within potential effect ranges for a much longer period (i.e. they would be travelling from one pile location to another which piling is ongoing), and therefore cumulative effect ranges are much larger than for the cumulative exposure ranges of one pile at a time.
2083. The potential effect ranges are not possible to model under this scenario, as there are two starting points for receptors, and it is not possible to determine the potential range at which they need to be in order to not be at risk of effect. Therefore, the following assessment is based on the potential areas of effect only.
2084. Where the potential effect areas are not large enough to interact with each other (i.e. they do not meet), the results for the respective locations and scenarios are used (the results of the modelling for the Southeast and Northwest locations are used to inform the assessment, to align with the modelling locations used for the simultaneous modelling).
2085. **Table 9.57** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of simultaneous monopiles at the NW and SE modelling locations. These locations were chosen as they have the potential for the largest 'spread' in terms of underwater noise propagation. The modelling includes two monopiles being installed sequentially at each location at the same time.

Table 9.57 The Predicted Effect Area for PTS For Seals At The NW And SE Modelling Locations, for the Cumulative Exposure of Multiple Monopiles Installations at the Same Time

Scenario	Potential effect areas for PTS due to cumulative exposure of simultaneous pile installations
	Monopile (8,000kJ)
Multiple sequential pile installations in a 24 hour period (for the NW and SE modelling locations together)	110km ²

2086. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for simultaneous monopiles is presented in **Table 9.58**, based on the effect areas as presented in **Table 9.57**.

Table 9.58 Assessment of the Potential for PTS Due to the Cumulative Exposure of Simultaneous Monopiles at the Same Time

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of simultaneous monopile installations (SEL _{cum})	3 (0.02%)

2087. There would be **no adverse effect** of PTS in grey seal from pile installation on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.1.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Impact Piling During Construction

2088. The range of possible behavioural reactions that may occur as a result of exposure to noise include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases, panic, or stranding, sometimes resulting in injury or death (Southall *et al.*, 2008).
2089. There are currently no agreed thresholds or criteria for the behavioural response and disturbance of grey seal, therefore it is not possible to conduct underwater noise modelling to predict impact ranges.

2090. Disturbance from construction activities (including piling) may have behavioural consequences on grey seal in the study area, including reduced time spent foraging at sea as animals move away from sources of noise, displacement from vessels, etc. Repeated disruptions can have cumulative negative effects on the bioenergetic budget of marine species, with the potential for long-term effects on survival and reproductive rates (Christiansen *et al.*, 2013).
2091. Hastie *et al* (2021) studied the change in foraging behaviour of grey seal when exposed to underwater noise. A high density and low density area of prey was present within an experimental pool, and speakers were located at each prey patch. During the control periods, seals would forage mainly at the high-density patch, but also at the low-density patch for a smaller proportion of time. When the seals were exposed to noise at the low density patch, there was a reduction in foraging of 16-28%, however, when seals were exposed to noise at the high density prey patch, there was no change in foraging in comparison to control periods. This indicates that seals would choose to remain at a noisy environment, if there were good prey resources at the same location.
2092. Russell (2016) has shown that grey seal are present in significantly reduced number up to a distance of 25km during piling (or a disturbance area of 1,963.5km²). This range has therefore been used to determine the number of grey seal that may be disturbed during piling at Array Area (**Table 9.59**).

Table 9.59 Assessment of the Potential for Disturbance to Grey Seal Based on a Disturbance Range of 25km for Both Monopiles and Jacket Pin Piles for the Project

Potential disturbance range and area	Assessment of effect	Potential adverse effect on site integrity
One Monopile		
25km, with a disturbance area of 1,963.5km ²	38 (0.2% of HE SAC)	No. Less than 5% of the population affected.
One Jacket pin pile foundation		
15km, with a disturbance area of 706.86km ²	14 (0.09% of HE SAC)	No. Less than 5% of the population affected.

2093. A distance of 25km during piling Russell (2016) (or a disturbance area of 1,963.5km²) has been used to determine the number of grey seals that may be disturbed during monopiling for the Project. To assess for disturbance of a single jacket pin pile foundation, the recommended EDR of 15km (706.86km²) for harbour porpoise (Graham *et al.*, 2019) has been used as a precautionary impact range for grey seals.

2094. For disturbance based on the known effect ranges, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.1.2.1 Dose-Response Assessment

2095. The application of a dose-response curve allows for an evidence-based estimate of the number of animals disturbed, which accounts for the fact that the likelihood of an animal exhibiting a response to a stressor, or stimulus, will vary according to the dose of stressor or stimulus received (Dunlop *et al.*, 2017). Therefore, unlike the traditional threshold assessments commonly used, a dose-response analysis assumes that not all animals in an impacted area will respond (with behavioural disturbance response in this case).
2096. For the purposes of this assessment, the dose was the received single-strike SEL (SEL_{ss}). The use of SEL_{ss} in a dose-response analysis, where possible, is considered best practice in the latest guidance provided by Southall *et al* (2021). It accounts for the actual behavioural response (i.e. not all individuals would respond to the same level of noise) and is therefore a more realistic approach to assessing the potential for disturbance.
2097. The dose-response methodology is outlined in **Section 13.5 in PEIR Volume 2, Appendix 12.6 Information and Modelling Methods for Disturbance**. The dose-response approach has been undertaken for all piling locations, with the highest resultant number of individuals disturbed presented in this assessment.
2098. The estimated numbers of grey seal and the corresponding percentage of the HE SAC population that could be disturbed as a result of underwater noise during piling, based on the worst-case foundation and location, is presented in **Table 9.60**.

Table 9.60 Number of Individuals (and % of Reference Population) That Could Be Disturbed During Piling of Monopiles Based on the Dose-Response Approach

Number of individuals disturbed (monopiles) (% of reference population)	Number of individuals disturbed (pin-piles) (% of reference population)
0.9 (0.006% of HE SAC)	0.8 (0.005% of HE SAC)

9.6.2.1.2.2 Potential Disturbance from ADD Activation

2099. During 9 minutes of ADD activation, grey seal would move at least 0.81km from the ADD location (based on a precautionary marine mammal swimming speed of 1.5m/s; Otani *et al* (2000)), resulting in a potential disturbance area of 8km². This is further than the maximum instantaneous PTS range for monopiles predicted for grey seal. For pin piles the ADD activation required would be 5 minutes to cover the maximum PTS range of 0.43km, resulting in a potential disturbance area of 4.4km².

2100. The estimated numbers (and percentage of the relevant reference populations) of grey seal disturbed as a result of underwater noise during piling after ADD is presented in **Table 9.61**.

Table 9.61 Assessment of the Potential for Disturbance due to ADD Activation Based for Monopiles or Jacket Pin Piles for the Project

Piling Scenario	Assessment of effect	Potential adverse effect on site integrity
Monopiles	0.2 (0.0005% of the HE SAC)	No. Less than 5% of the population affected.
Pin piles	0.08 (0.001% of the HE SAC)	No. Less than 5% of the population affected.

2101. The population affected by disturbance from underwater noise at the Project is less than 5%. Therefore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal due to disturbance or behaviour effects from increased underwater noise during construction (piling) the Project.

9.6.2.1.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.6.2.1.3.1 Impact 3a: Permanent Auditory Injury (PTS) Due to Other Construction Activities

2102. Potential sources of underwater noise during construction activities, other than piling, include seabed preparation, dredging, rock placement, trenching and cable installation.
2103. Dredging / cable installation activities have the potential to generate underwater noise at sound levels and frequencies for sufficient durations to disturb marine mammals. Reviews of published sources of underwater noise during dredging activity (Theobald *et al.*, 2011; Thomsen *et al.*, 2006; Todd *et al.*, 2015), indicate that the sound levels that grey seals may be exposed to during dredging activities are typically below permanent auditory injury thresholds (PTS) exposure criteria (as defined in Southall *et al* (2019)). Therefore, the potential risk of any auditory injury in marine mammals as a result of dredging activity is highly unlikely.
2104. The noise levels produced by dredging activity / cable installation, could overlap with the hearing sensitives and communication frequencies used by marine mammals (Todd *et al.*, 2015), and therefore have the potential to impact grey seals present in the area.

2105. The potential for PTS effects that could result from underwater noise during other construction activities, including cable laying and protection would be temporary in nature, not consistent throughout the offshore construction period for the Project and would be limited to only part of the overall construction period and area at any one time.

2106. The assessment for impacts from underwater noise resulting from other construction activities is shown in **Table 9.62**.

Table 9.62 Predicted Impact Ranges (and Areas) for Auditory Injury from 24 Hour Cumulative Exposure During Other Construction Activities

Criteria and threshold (Southall <i>et al.</i> , 2019)	Cable laying	Dredging (backhoe and suction (individually))	Trenching	Rock placement	All activities
SEL _{cum} Weighted (153 dB re 1 µPa ² s) Non-impulsive	0.1km (0.03km ²)	<0.1km (<0.03km ²)	<0.1km (<0.03km ²)	<0.1km (<0.03km ²)	0.12km ² (0.09km ²)

2107. The number of grey seal that could be impacted as a result of underwater noise during construction activities other than piling is presented in **Table 9.63**, which has been assessed based on the number of animals that could be present in each of the modelled impact ranges.

2108. The population affected by auditory injury during other construction activities from underwater noise at the Project is less than 1%. Therefore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal due to auditory injury from increased underwater noise during other construction for the Project.

Table 9.63 Maximum Number Of Individuals (And % Of Reference Population) That Could Be Impacted As A Result Of Underwater Noise Associated With Non-Piling Construction Activities

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
PTS for each individual activity			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.0006 (0.000004% of HE SAC) based on array density estimate 0.003 (0.00002% of HE SAC) based on the ECC density estimate	No. Less than 1% of the population affected
PTS for all activities at the same time (4 activities)			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.002 (0.00002% of HE SAC) based on array density estimate 0.01 (0.00008% of HE SAC) based on the ECC density estimate	No. Less than 1% of the population affected

9.6.2.1.3.2 Impact 3b: Permanent Auditory Injury (PTS) Due to Construction Vessels

2109. **Table 9.64** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS from the cumulative exposure of vessels within the site. For SEL_{cum} calculations, the duration of the noise is also considered, with noise present for a worst case of 24-hours in a day.
2110. The results of the underwater noise modelling does not define effect ranges of <100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably lower).

2111. The results of the underwater noise modelling (**Table 9.64**) indicate that PTS is unlikely to occur in grey seal, as grey seal would only be exposed to any potential risk of PTS if they were within less than 100m of the vessel. It is therefore highly unlikely that any individual would be at risk of PTS due to vessel noise. It should be noted that the predicted impact ranges are the distances which represent the ‘onset’ stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.

Table 9.64 The Predicted Effect Ranges for Cumulative PTS for Vessels in All Marine Mammal Species

Marine mammal species	Potential effect ranges (and areas) for PTS Medium of large vessels
Grey seal	<100m (0.031km ²)

2112. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in **Table 9.65**, based on the effect areas as presented in **Table 9.64**.

Table 9.65 Assessment of the Potential for PTS Due to Medium and Large Vessels

Marine mammal species	Assessment of effect
Grey seal	0.0006 (0.000004% of HE SAC) based on array density estimate 0.003 (0.00002% of HE SAC) based on the ECC density estimate

2113. Given the small number of individuals affected, there would be **no adverse effect** of PTS in grey seal from vessels on the integrity of the HE SAC in relation to the conservation objectives for grey seal.
2114. There is the potential that up to 90 vessels may be present in the Offshore Development Area at any one-time during construction. As a worst case and unlikely scenario, an assessment for all 90 vessels has also been undertaken with the assessment split between the Array Area and offshore ECC using the relevant density estimates.
2115. The assessment considers the following assessments:
- Up to 35 vessels within the Array Area;
 - Up to 55 vessels in the offshore ECC; and
 - The combined number of affected animals for 90 vessels.
2116. **Table 9.66** presents the potential areas of PTS for the maximum construction vessels at any one time.

Table 9.66 The Predicted Effect Areas For Cumulative PTS, For Multiple Construction Vessels For All Marine Mammal Species

Area	Potential effect areas for PTS
Array Area	1.1km ²
Offshore ECC	1.7km ²
Combined total	2.79km ²

2117. An assessment of the maximum number of individuals that could be at risk of PTS, due to the maximum number of construction vessels at any one time is presented in **Table 9.67**, based on the effect areas as presented in **Table 9.66**.

Table 9.67 Assessment of the Potential for PTS Due to Multiple Construction Vessels

Area	Assessment of effect
Array Area	0.02 (0.0001% of HE SAC)
Offshore ECC	0.8 (0.001% of HE SAC)
Combined total	0.82 (0.005% of HE SAC)

2118. Given the small number of individuals affected, there would be **no adverse effect** of PTS in grey seal from vessels on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.1.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.6.2.1.4.1 Impact 4a: Disturbance Effects Due to Other Construction Activities

2119. Underwater noise as a result of dredging activity / cable installation has the potential to disturb marine mammals (Pirodda *et al.*, 2014). Therefore, there is the potential for short, perhaps medium-term behavioural reactions and disturbance to grey seal in the area during dredging / cable installation activity. Grey seals may exhibit varying behavioural reactions intensities as a result of exposure to noise (Southall *et al.*, 2008).

2120. Grey seals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

2121. If the response is displacement from the area, it is predicted that grey seals will return once the activity has been completed and therefore any impacts from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on grey seal.

2122. There is limited data on the potential for a behavioural response or disturbance from other construction activities (or other continuous noise sources). A review of various studies was used to determine the maximum potential disturbance range for other construction activities and vessels. As discussed Benhemma-Le Gall *et al* (2021), reported a 4km (50.3km²) reduction in harbour porpoise presence for other construction activities, including vessels. As harbour porpoise are the most sensitive marine mammal species, this 4km potential disturbance range has been used for grey seal as a worst case, in the absence of any other data to inform an assessment.

2123. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities based on the 4km potential disturbance range is presented in **Table 9.68** for one activity occurring or four activities happening at the same time.

Table 9.68 Assessment of the Potential for Disturbance Due to Other Construction Activities, Including Cable Laying, Suction Dredging, Cable Trenching, and Rock Placement, for One Activity Taking Place at Any One Time for the Project

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
Disturbance for each individual activity			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> • Cable laying; • Trenching; • Rock placement; • Dredging; • Drilling; • Vibropiling; and • Suction bucket installation. 	1 (0.006% of HE SAC) based on array density estimate 6 (0.03% of HE SAC) based on the ECC density estimate	No. Less than 5% of the population affected

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
Disturbance for four activities at the same time for the Project			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none">Cable laying;Trenching;Rock placement;Dredging;Drilling;Vibropiling; andSuction bucket installation.	4 (0.02% of HE SAC) based on array density estimate 21 (0.1% of HE SAC) based on the ECC density estimate	No. Less than 5% of the population affected

2124. The population disturbed during other construction activities from underwater noise at the Project is less than 5%. Therefore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal due to disturbance from increased underwater noise during other construction for the Project.

9.6.2.1.4.2 Impact 4b: Disturbance Effects Due to Construction Vessels

2125. The assessment on disturbance effects due to construction vessels has been based on the same methods as described in **Section 9.4.2.1.4**.
2126. The assessments are undertaken based on the maximum number of vessels being present at any one time, which is only likely to occur occasionally.
2127. The disturbance assessment based on one vessel is equivalent to that for one construction activity. This scenario has already been assessed in **Table 9.43** and has therefore not been repeated here.
2128. The disturbance caused by 55 individual vessels within the offshore ECC, would cover a total area of 2,764km², not taking into consideration any potential overlap of the 4km disturbance ranges with other nearby vessels. To account for that, 55 vessels were randomly distributed in the offshore ECC, using QGIS v.3.38. If an overlap in the disturbance areas of multiple adjacent vessels was identified, this area removed from the total area of effect to account for that. Therefore, a potential area of disturbance of 2,500km² has been identified for the worst-case of 55 construction vessels, as shown in the **PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise, Section 12.7.1.4.2.2**.

2129. Assuming the disturbance caused by 35 vessels within the Array Area would not overlap with that of other vessels, the total disturbed area would be 1,759km². This is significantly larger than the Array Area itself, which has a total area of 262km². Therefore, the actual maximum area of effect would be the Array Area with a 4km buffer a 4km buffer (equating to an area of 613km²), as all vessels would be within the Array Area. Therefore, the assessment in **Table 9.69** represents the maximum possible disturbance area of the Array Area, including a 4km buffer.

Table 9.69 Maximum Number of Individuals (and % of Reference Population) That Could Be Disturbed as a Result of Underwater Noise Associated with Construction Vessels at the Project

Component specific density	Maximum number of individuals (% of reference population) for 55 vessels in the offshore ECC (2,500km ²)	Maximum number of individuals (% of reference population) for Array Area, including a 4km buffer (613km ²)	Maximum number of individuals (% of reference population) for all construction vessels in the offshore ECC and Array Area
Array Area	-	12 (0.08% of HE SAC)	270 (1.7% of HE SAC)
Offshore ECC	258 (1.6% of HE SAC)	-	

2130. Whilst short to medium term behavioural responses have been recorded from vessel disturbance, there are no long-term or population level effects recorded to date. Less than 5% of the reference population is affected, therefore, it is considered that there would be **no adverse effect** from disturbance from underwater noise associated with vessels on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.1.5 Impact 5: Barrier Effects from Underwater Noise During Construction

2131. Underwater noise during construction could have the potential to create a barrier effect, preventing movement or migration of grey seals between important feeding and / or breeding areas, or potentially increasing swimming distances if marine mammals avoid the site and go around it. However, the Array Area is not located on any known migration routes for grey seals.
2132. The Array Area is located 210km from the coast at closest point. The nearest seal haul-out site is at Filey Brigg, the haul-out site is 20km from the offshore ECC at the closest point.

2133. The greatest potential barrier effect for grey seal could be from underwater noise during piling. Piling would not be constant during the piling phases and construction periods. Taking into account the distance of the Array Area from the coast and from grey seal haul-out sites, there is no potential for underwater noise at the windfarm site to result in barrier effects to seals moving to and from haul-out sites.
2134. However grey seals have foraging ranges of up to 448km (Carter *et al.*, 2022), with foraging trips lasting up to 30 days (SCOS, 2021). Grey seal could be affected when travelling to foraging areas, and underwater noise could potentially cause a barrier effect to foraging. However, prey consumption on a daily basis is not vital for energy demands, as mature seals undergo a period of starvation during the breeding season, where they loose up to 40% of their body weight (Sparling, 2003). Therefore, if there are any potential barrier effects from underwater noise, grey seals would be able to compensate by travelling to other foraging areas within their range.
2135. However, barrier effects from underwater noise could impact foraging females as this is considered the more energetically expensive period for females (Mellish *et al.*, 2000), if they can't meet the energy demands, it can cause devastating effects to the female and her pup. Due to the fact that piling will occur over 100km away, it is unlikely lactating females will travel that far, so there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of grey seal.
2136. Any disturbance and any barrier effects would be temporary and for a relatively short duration (i.e. during active piling).
2137. As it is predicted that grey seals will return once the activity has been completed, and therefore any effects from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of grey seal.
2138. Therefore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal due to potential barrier effects from increased underwater noise during construction of the Project.
- 9.6.2.1.6 Impact 6: Increased Risk of Collision with Vessels During Construction
2139. During offshore construction, there will be an increase in vessel traffic within the Array Area and offshore ECC. However, it is anticipated that vessels would follow an established shipping route to the relevant ports in order to minimise vessel traffic in the wider area.
2140. Seals in and around the Offshore Development Area and in the wider southern North Sea would typically be habituated to the presence of vessels. Seals are able to detect and avoid vessels. However, vessel strikes are known to occur, possibly due to distraction whilst foraging and socially interacting, or due to the marine mammals' inquisitive nature (Wilson *et al.*, 2007). Therefore, increased vessel movements, especially those outside recognised vessel routes, can pose an increased risk of vessel collision to marine mammals. Studies have shown that larger vessels are more likely to cause the most severe or lethal injuries, with vessels over 80m in length causing the most damage to marine mammals (Laist *et al.*, 2001; Keen *et al.*, 2023).
2141. The predictability of vessel movements by marine mammals is crucial in minimising the risks posed by vessel traffic (Nowacek *et al.*, 2001, Lusseau, 2003; 2006). Reducing vessel speed not only allows more time for marine mammals to move away, but also significantly reduces emitted vessel noise. This reduction in noise enables marine mammals to hear approaching ships and prevents interference with intra-species communication (Leaper, 2019).
2142. For harbour seals a recent UK telemetry study showed there was no evidence of reduced seal presence as a result of vessel traffic. This was despite distributional overlaps (overlaps were most frequently found within 50km of the coast) between seal and vessel presence and high cumulative sound levels (Jones *et al.*, 2017). Another study of grey seal pup tracks in the Celtic Sea and adult grey seals in the English Channel found that no animals were exposed to cumulative shipping noise that exceeded thresholds for temporary threshold shifts (TTS) (using the Southall *et al.* (2019) thresholds) (Trigg *et al.*, 2020). A study of grey seal pupping beaches around Ramsey Island in Pembrokeshire found that disturbance occurred when vessels were closer than 150m to seal locations (Strong and Morris, 2010).
2143. In addition, vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. Vessel operators will use best practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever possible and avoiding close proximity to seal haul-out sites.
2144. Therefore, there would be minimal increase to collision risk of grey seal and **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal due to potential vessel collision risk during construction for the Project.

9.6.2.1.7 Impact 7: Disturbance at Seal Haul-Out Sites

2145. The HE SAC is located, at closest point, 235km from Array Area. The main grey seal haul out site is Donna Nook which is 63km from landfall, 61km from the offshore ECC, 240km from Array Area at closest distance. The closest seal haul-out site is Filey Brigg which is 34km from landfall, 20km from the offshore ECC, 215km from Array Area. Therefore, there would be no effects from construction activities within the Offshore Development Area, only effects from vessels transiting to and from the Offshore Development Area.
2146. Grey seal response to vessels have been reported in several studies. Movement into the water was generally observed to occur at distances of between 20 and 70m, with no detectable disturbance at 150m (Strong and Morris, 2010; Wilson, 2014). However, grey seal has been reported to move into the water when vessels are at a distance of approximately 200m to 300m (Wilson, 2014).
2147. Disturbance to seals from vessel noise and presence has been demonstrated at haul-out sites in the UK up to 500m away (Cates and Acevedo-Gutierrez 2017). In a similar study, harbour seals were 25 times more likely to flee into the water when cruise ships passed 100m from haul-out sites than when ships passed within 500m (Jansen *et al.*, 2010). Beyond 600m, there was no discernible effect on the behaviour of harbour seal.
2148. A study was carried out by Sea Mammal Research Unit (SMRU) (Paterson *et al.*, 2015) using a series of controlled disturbance tests at harbour seal haul-out sites, consisting of regular (every three days) disturbance through direct approaches by vessel and effectively ‘chasing’ the seals into the water. The seal behaviour was recorded via Global Navigation System (GPS) tags and found that even intense levels of disturbance did not cause seals to abandon their haul-out sites more than would be considered normal (for example seals travelling between sites) and the seals were found to haul-out at nearby sites or to undertake a foraging trip in response to the disturbance (but would later return).
2149. In areas of high vessel traffic, there can be habituation effects and disturbance behaviours are generally reduced over time (Strong *et al.*, 2010).
2150. Vessel activity, transiting from the Project to port have the potential to cause disturbance to seal haul-out sites. The construction ports to be used the Project are not yet confirmed. Vessel movements to and from any port will be incorporated within existing vessel routes, where available. If vessels have to transit past Donna Nook, they will keep at least 500m away from the shore (taking in research by Cates and Acevedo-Gutierrez 2017). This would minimise any disturbance on grey seal but as a precautionary approach and if possible, a greater distance of 1km will be applied.
2151. Taking into account the proximity of shipping channels to and from existing ports, it is likely that seals hauled-out along these routes and in the area of the ports would be habituated to the noise, movements and presence of vessels.

2152. It is expected that if there is any disturbance to seals at haul-out sites from construction activities it is a short-term effect. For example, a 2019 study on harbour seals in Scotland found that 30 minutes after a disturbance event, seals return to 52% pre-disturbance levels at haul-out sites and 94% pre-disturbance levels four hours after a disturbance event (Paterson *et al.*, 2019).
2153. As described above, there would only be disturbance if the vessels came within a few hundred metres of a haul out and any effect would be temporary. Taking into account the proximity of shipping channels to and from ports, it is likely that seals hauled-out along these routes and in the area of the ports would be habituated to the noise, movements and presence of vessels. Therefore, the effect on grey seals at haul-out sites to disturbance from vessels moving to and from the port(s) during construction is likely to be limited.
2154. Therefore, if the vessels committed to keep at least a distance of 500m from the shore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal due to disturbance at seal haul-out sites during construction for the Project.

9.6.2.1.8 Impact 8: Potential Effects of Changes to Prey Resource

2155. The potential effects on prey species during construction can result from:
- Physical seabed disturbance;
 - Increased SSC and sediment re-deposition;
 - Remobilisation of contaminated sediments;
 - Underwater noise and vibration; and
 - Changes in fishing activity.
2156. As discussed in the SNS SAC section (**Section 9.4.2.1.7**), **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology (Volume I)** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any reductions in prey availability would be small scale, localised and temporary. It is considered highly unlikely that potential reductions in prey availability as a result of construction activities at the Project would result in detectable changes to grey seal populations.
2157. Grey seal feed on a variety of prey species and are considered to be opportunistic feeders, feeding on a wide range of prey species and they have relatively large foraging ranges (see **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report**).

2158. The potential impacts of physical disturbance, temporary habitat loss, increased SSC, re-mobilisation of contaminated sediment, underwater noise and vibration and changes in fishing activity on changes in prey availability are localised and short in duration. Therefore, there will be **no adverse effect** on the integrity of The HE SAC in relation to the conservation objectives for grey seal due to potential changes in prey availability during construction for the Project.

9.6.2.1.9 Impact 9: Potential Effects of Changes To Water Quality

2159. Potential changes in water quality during construction could occur through:

- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations, and array, cables;
- Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and Offshore Platforms;
- Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
- Deterioration in water quality associated with release of sediment bound contaminants.

2160. Marine mammals often inhabit turbid environments and cetaceans utilise sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly (Todd *et al.*, 2014).

2161. Increased turbidity is unlikely to have a direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely.

2162. Potential changes in water quality during construction would have **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal for the Project.

9.6.2.2 Potential Effects during O&M

2163. The potential effects during O&M that have been assessed for are outlined in **Section 4.5.3**.

9.6.2.2.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Operational Wind Turbine Noise

2164. Underwater noise modelling was undertaken by Subacoustech Environmental Ltd. to estimate the noise levels likely to arise during the operational phase (**PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report**) and determine the potential effects on marine mammals.

2165. The risk of injury (defined as onset of PTS) is given as occurring in a range of <100m (**Table 9.70**), a highly precautionary range, and within which the animal would need to stay for a 24 hour period for sufficient noise exposure to result in an effect. Such an occurrence is extremely unlikely and would be atypical behaviour for such a highly mobile species.

Table 9.70 Predicted Effect Ranges (and Areas) for PTS from 24 hour Cumulative Exposure of Underwater Noise from Operational Turbines

Species	Impact	Operational wind turbine	Area of impact for up to 113 Wind turbines
Grey seal	PTS	<0.1km (0.031km ²)	3.55km ²

2166. The maximum number of individuals that could be at risk of PTS, due to a single operational WTG, is 0.0006 grey seal (0.000004% of the HE SAC reference population), based on the array density estimate.

2167. More than one WTG will be operating at the same time, and therefore an assessment of the potential for auditory injury, due to all operational WTGs, is required. There is the potential for 113 WTGs to be installed for the Project.

2168. The potential areas of PTS for all operational WTGs for grey seal is 3.55km².

2169. An assessment of the maximum number of individuals that could be at risk of PTS from all operational WTGs is 0.07 grey seal (0.0004% of the HE SAC reference population), based on the array density estimate.

2170. There would be **no adverse effect** of PTS in grey seal from operational WTG noise on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.2.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Operational Wind Turbine Noise

2171. Currently available data indicates that there is no lasting disturbance or exclusion of seals around OWF sites during operation (Diederichs *et al.*, 2008; Lindeboom *et al.*, 2011; Marine Scotland, 2012; McConnell *et al.*, 2012; Russell and McConnell, 2014; Scheidat *et al.*, 2011; Teilmann *et al.*, 2006; Tougaard *et al.*, 2009a, 2009b, 2006). Data collected suggests that any behavioural responses for seals may only occur up to a few hundred metres away (McConnell *et al.*, 2012; Tougaard *et al.*, 2009a).
2172. Monitoring studies at Nysted and Rødsand have also indicated that operational activities have had no impact on regional seal populations (McConnell *et al.*, 2012; Teilmann *et al.*, 2006). Seals have been shown to forage within operational OWFs (Lindeboom *et al.*, 2011; Russell and McConnell, 2014), indicating no restriction to movements in operational OWF sites.
2173. Modelling of noise effects of operational offshore wind turbines suggest that marine mammals are not considered to be at risk of displacement by operational wind farms (Marmo *et al.*, 2013). Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.
2174. Aerial surveys of the adjacent seal haul-out sites conducted in the first few months of operation of the Nysted Wind Farm revealed that seals moved between the haul-out sites with the operating wind turbines having no effect on seal movements (Teilman *et al.*, 2004). Seals have been recorded to forage within operating windfarms (Russel *et al.*, 2014) indicating there is no or minimal disturbance from operating turbines to grey seal.
2175. Based on the available literature for examining disturbance of grey seals and operational wind farms, because the noise levels associated with operational wind turbines are low and continuous, a precautionary low significance of effect has been given to all marine mammal species, including grey seals, for the Project.
2176. Therefore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal due to disturbance from operational wind turbine noise arising from the Project.

9.6.2.2.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.6.2.2.3.1 Impact 3a: Permanent Auditory Injury (PTS) Due to Other O&M Activity

2177. The requirements for any potential O&M activities, such as additional rock placement or cable re-burial, are currently unknown, however the work required, and associated effects to grey seal, would be less than those during construction. **Section 9.6.2.1.3** provides an assessment for the same activities during construction, concluding that there is no potential for a significant effect as a result of the Project.
2178. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities, and if the marine mammal is within close proximity at the onset of activity. Therefore, it is highly unlikely for there to be any PTS due to these activities.
2179. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase.
2180. Therefore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal due to physical and auditory injury from underwater noise associated with O&M activities arising from the Project.

9.6.2.2.3.2 Impact 3b: Permanent Auditory Injury (PTS) Due to O&M Vessels

2181. During the O&M of the Project, there may be up to 16 vessels in the Offshore Development Area at any one time, compared to the 35 vessels that would be on site during construction. Therefore, the potential effects associated with underwater noise and disturbance from vessels during O&M would be less than of those during construction (as assessed in **Section 9.6.2.1.3**). As a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst case scenario.
2182. There would therefore be **no adverse effect** of PTS in grey seal from vessels on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.2.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.6.2.2.4.1 Impact 4a: Disturbance Effects Due to Other O&M Activities

2183. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. The requirements for any potential maintenance work are currently unknown, however, the work required, and impacts associated with underwater noise and disturbance from activities during O&M would be less than those during construction. As there is expected to be less noisy activities during the operation phase than is required during construction, it is therefore likely to cause less disturbance to foraging behaviours in grey seal.

2184. Therefore, the potential for adverse effect due to underwater noise from O&M activities is considered to be the same or less than that assessed for underwater noise from other construction activities (including rock placement, trenching and cable laying) (as assessed in **Section 9.6.2.1.4**).

2185. The effect significance for disturbance effects due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.2.4.2 Impact 4b: Disturbance Effects Due to O&M Vessels

2186. The requirements for any potential maintenance work are currently unknown, however the work required, and impacts associated with underwater noise and disturbance from vessels during O&M would be less than those during construction.

2187. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be 16, which is less than the 35 vessels that could be on site during construction. However, as a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst-case scenario.

2188. If the response is displacement from the area, it is predicted that individuals will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on grey seal.

2189. There would therefore be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.2.5 Impact 5: Underwater Noise: Barrier Effects During O&M

2190. The indicative minimum separation distance between turbines would be a minimum of 0.826km to 1.416km, depending on WTG size, therefore there would be no overlap in the potential impact range (PTS; **Table 9.70**) of <100m around each turbine, and there would be adequate room for marine mammals to move through the Array Area.

2191. Therefore, no barrier effects as a result of underwater noise during O&M are anticipated, and no further assessment is required.

9.6.2.2.6 Impact 6: Increased Risk of Collision with Vessels During O&M

2192. The increased risk of marine mammal collision with operational and maintenance vessels would be the same or less than what was assessed for the construction period (**Section 9.6.2.1.6**), given the number of vessels required would be lower.

2193. During the O&M phase, the maximum number of vessels that could be present in the Project offshore components at any one time has been estimated as 16 vessels (**Table 9.2**). The number, type and size of vessels would vary, depending on the activities taking place at any one time and are typically slow moving or stationary.

2194. Given the existing levels of marine traffic, as outlined in **PEIR Volume 1, Chapter 15 Shipping and Navigation**, marine mammals in and around the windfarm site would typically be habituated to the presence of vessels and would be able to detect and avoid vessels.

2195. There would therefore be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.2.7 Impact 7: Disturbance at Seal Haul-Out Sites

2196. The closest seal haul-out sites are listed in **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report Table 12.2-13 and 12.2-15**. As the closest haul out (Filey Brigg) is 34km from landfall, 20km from the export cable corridor, 215km from Array Area, there would be no effects from O&M activities within the Offshore Development Area, only effects from vessels transiting to and from the Project.

2197. The annual vessel traffic that could potentially be passing seal haul-out sites during the O&M phase is projected to be lower than that during the construction period, with a maximum total number of 96 round trips per year during O&M. Vessels would use established vessel routes to the port and, where possible, transiting vessels would maintain distances of 500m or more off the coast, particularly in areas near known seal haul-out sites during sensitive periods.

2198. Therefore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal due to disturbance at seal haul-out sites during the O&M phase.

9.6.2.2.8 Impact 8: Potential Effects of Changes to Prey Resource

2199. The potential impacts on fish species during O&M can result from temporary habitat loss / disturbance; permanent habitat loss; introduction of wind turbine foundations; scour protection and hard substrate; increased suspended sediments and sediment re-deposition; re-mobilisation of contaminated sediments; underwater noise; and EMF.

2200. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any impacts on prey species have the potential to affect marine mammals. A summary of the key effects to prey species (and their relevance for grey seal) is provided below.

2201. Habitat loss will occur during the lifetime of the Project as a result of structures, scour and external cable protection installed on the seabed. The introduction of hard substrate, such as wind turbine towers, foundations and associated scour protection and cable protection would increase habitat heterogeneity through the introduction of hard structures in an area predominantly characterised by sediment habitats. During operation of the Project, the estimated total permanent habitat loss would be up to 4.06km² in total. In **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** this is considered minor to negligible, depending on the species in the context of the amount of similar available habitat in the wider area.

2202. Increases in SSC within the water column and subsequent deposition onto the seabed may occur as a result of O&M activities. Disturbance caused by jack up vessel legs or anchors, as well as cable reburial and/or repair may result in small volumes of sediment being re-suspended. However, the volumes of sediment disturbed from such activities, as well as the overall duration of the disturbance, would be significantly less compared to construction.

2203. The electromagnetic attributes of EMFs have the potential to disrupt organs used for navigation and foraging within a number of fish species. EMFs can have attractive and repulsive effects, that can cause barrier effects dependent on the species and the spatial scale of EMF, for further information, see **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**. The cables will be buried, either within the seabed or under rock protection, resulting in a negligible impact zone for fish and shellfish.

2204. The introduction of various man-made structures such as foundations and scour protection in soft sediment areas increases and changes habitat availability and type, resulting in locally altered biodiversity as species are able to establish and thrive in previously hostile environments (Wilhelmsson *et al.*, 2006; Birchenough and Degraer, 2020). Physical structures provide a foundation for settling invertebrates, which increase the organic matter surrounding the structure, and underpin artificial reef ecosystems through ‘bottom-up’ control of productivity. Increasing nutrient availability and biomass presents opportunities for all fish and shellfish species, from top predators to detritivores (Raoux *et al.*, 2017).

2205. The benefit of this potential increase in prey availability to marine mammals has not yet been studied widely. However, the presence of an artificial reef does increase the abundance and biomass of species, and the increase in prey species availability increases the attractiveness of the area to predators (Devault *et al.*, 2017; Paxton *et al.*, 2022). Increasing habitat heterogeneity may benefit harbour porpoise, that have shown to prefer variations in seabed topography (Isojunno *et al.*, 2012, Brookes *et al.*, 2013, Stalder *et al.*, 2020)

2206. The introduction of new hard substrate in areas that are predominantly sandy or soft sediments may cause positive effects through potential habitat enhancement (Roach and Cohen, 2020).

2207. The effects arising during the operational phase of the Project are likely to be the same or less than those assessed for construction. The effects of changes to prey during operation would have **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal for the Project.

9.6.2.2.9 Impact 9: Barrier Effects from the Physical Presence of the Wind Farm During O&M

2208. There is unlikely to be the potential for any barrier effects upon the completion of construction, as it is predicted that marine mammals will return once the activity has been completed. Monitoring was conducted at the Horns Rev and Nysted OWFs in Denmark in 1999 and 2006 during operation (Diederichs *et al.*, 2008). The data showed that numbers of harbour porpoise within Horns Rev were slightly reduced compared to the wider area during the first two years of operation and found no effect on numbers after two years of operation. Though, it was not possible to conclude that the OWF was solely responsible for this change in abundance without analysing other dynamic environmental variables (Tougaard *et al.*, 2009).

2209. Lindeboom *et al* (2011) documented that harbour porpoise have been observed to foraging within operational wind farm sites indicating that the physical presence of the wind farm does not cause a barrier. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of marine mammals including seals in operational OWF sites.

2210. The effect significance for barrier effects due to the physical presence of the wind farm has therefore been assessed as having **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.2.3 Potential Effects During Decommissioning

2211. 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.
2212. Commitment ID CO21 (see **PEIR 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 impacts on grey seal 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.
2213. 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.
2214. 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.
2215. Therefore, the potential effects on grey seal during decommissioning are assumed to be the same or less than those assessed for construction due to the processes of decommissioning potentially being the reverse of the installation, without the need for piling.

9.6.3 Assessment of Potential Effects of the Project In-Combination

2216. The following in-combination assessment has been undertaken based on **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**, and **Section 12.8 of PEIR Volume 1 Chapter 12 Marine Mammals and Underwater Noise**.
2217. The in-combination assessment considers other schemes and activities where the predicted effects have the potential to combine with the potential effects during construction of the Project. The construction phase has been assessed as the worst case for potential in-combination effects.
2218. The schemes screened into the in-combination assessment for grey seal are those that are located in the relevant MUs. Full information on the screening of effects considered for the in-combination assessment is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**.
2219. The in-combination screening for grey seal considers the same schemes as considered in the cumulative screening. For grey seal at the HE SAC, other OWFs were included in the assessment against the SAC population where the Carter *et al* (2022) densities for the individuals associated with the HE SAC show presence within the 5km x 5km grid cells that overlap with the other OWF (or where there is a presence of seals within the potential disturbance area of the other OWF, e.g. within 25km for other OWFs that may be piling).
2220. The in-combination screening identified that there is the potential for cumulative effects on grey seal as a result of disturbance from underwater noise during piling and other construction activities. Due to the low noise levels associated with operational OWFs, as the BEIS (2020) RoC HRA for the SNS SAC stated that there would no potential for significant effect from the operation of OWFs, alongside the construction of OWFs (BEIS, 2020), therefore all operational impacts have been screened out.
2221. Further information is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**.

9.6.3.1 In-Combination Impact 1: Disturbance from Underwater Noise

2222. The commitment to the mitigation measures agreed through the final MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) in grey seal. In light of this, and taking account of the type, scale and extent of potential effects arising from the Project assessment, it concluded **no adverse effect** on integrity for grey seal due to physical injury or PTS from construction (see **Section 9.6.2.1.1**).

9.6.3.1.1 In-Combination Impact 1a: Assessment of Underwater Noise from Piling at Other OWFs

2223. One of the greatest potential noise sources during OWF construction is from pile driving. The in-combination assessment considers the potential disturbance of marine mammals during piling for the Project, with the piling at other OWF schemes screened into the in-combination assessment.
2224. The CEA screening (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**) identified twelve projects with the potential for construction to take place at the same time as the construction of DBD. Of these twelve, seven of them are shown to have grey seal associated with the HE SAC present within the Offshore Development Area. The worst-case scenario would be if the following OWFs were piling at the same time as the Project:
- Dogger Bank South (East)
 - Dogger Bank South (West);
 - Sheringham Shoal Extension;
 - Dudgeon Extension;
 - Five Estuaries;
 - North Falls; and
 - Outer Dowsing.
2225. The potential piling period the Project has been based on the widest likely range of offshore construction and piling dates, dependent on the construction scenario, as a precautionary approach. It should be noted that while the schemes included within the in-combination have the potential for piling to overlap with the Project, there is a great deal of uncertainty on when OWFs could be piling. This assessment is therefore considered the worst-case.
2226. Where possible, the CEA screening (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**) included consideration of the realistic potential for cumulative impacts during construction for the Project. For example, it is assumed that where OWF developers have more than one OWF, they are unlikely to develop more than one site at a time.
2227. The commitment to the mitigation agreed through the final MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) for all marine mammals.

2228. For grey seal, the Projects own disturbance assessment within the in-combination assessment is based on the reported disturbance range of harbour seal to piling. A potential disturbance range of 25km for seal species, with a potential disturbance area of 1,963.5km² has been used as the worst case.
2229. It should be noted that the potential areas of disturbance assume that there is no overlap in the areas of disturbance between different schemes and are therefore highly conservative.
2230. The approach to the in-combination for piling at OWFs is based on the potential for single piling at each OWF at the same time as single piling for the Project. This approach allows for some of the OWFs not to be piling at the same time, while others could be simultaneously piling. This is considered to be the most realistic worst-case scenario, as it is highly unlikely that all other OWFs would be simultaneously piling at exactly the same time as piling for the Project.
2231. It is important to note the actual duration for active piling time which could disturb marine mammals is only a very small proportion of the potential construction period, of up to approximately 25.1 days the Project (based on 5.33hrs per pile for the Project), based on the estimated maximum duration to install individual piles.
2232. For grey seal, the potential worst-case scenario of other OWFs piling at the same time as the Project is assessed in **Table 9.71** and **Figure 9-6**. More than 5% of the reference population could potentially be disturbed, however, this is very precautionary, as it is unlikely that all other OWF schemes could be piling at exactly the same time as piling for the Project.

Table 9.71 Quantitative Assessment for the Potential Disturbance of Grey Seal from Single Piling (25km) at Other OWFs at the Same Time as Piling For the Project

Project	Grey seal density (/km ²)	Maximum number of individuals potentially disturbed
Single piling at other OWFs that could be piling at the same time as DBD		
DBD	0.019	38
DBS (East) ¹⁴	0.054	63
DBS (West) ¹⁴	0.089	106

¹⁴ <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010125/EN010125-000974-10.52%20Appendix%20C%20Marine%20Mammal%20RIAA%20Update.pdf>

Project	Grey seal density (/km ²)	Maximum number of individuals potentially disturbed
Single piling at other OWFs that could be piling at the same time as DBD		
Dudgeon Extension Project ¹⁵	-	713
Five Estuaries ¹⁶	-	76
North Falls ¹⁷	0.005	10
Outer Dowsing ¹⁸	-	342
Sheringham Shoal Extension ¹⁵	-	827
Total number of grey seal with DBD		2,287
Percentage of HE SAC population (with DBD)		14.76%

2233. In practice, the potential temporary effects would be less than those predicted in this assessment as there is likely to be a great deal of variation in timing, duration, and hammer energies used throughout the various OWF project construction periods. In addition, not all individuals would be displaced over the entire potential disturbance range (25km) used within the assessments.
2234. Additional assessments using iPCoD modelling were undertaken to predict the grey seal population effect due to cumulative disturbance from piling, using the number at risk of disturbance from each project as provided in **Table 9.32**.
2235. For the in-combination scenario assessed the reference population 15,495 was applied for the HE SAC for grey seal, the iPCoD model predicts there to be little effect on the grey seal population over time from disturbance due to piling at all seven OWF projects (**Table 9.72** and **Figure 9-6**).

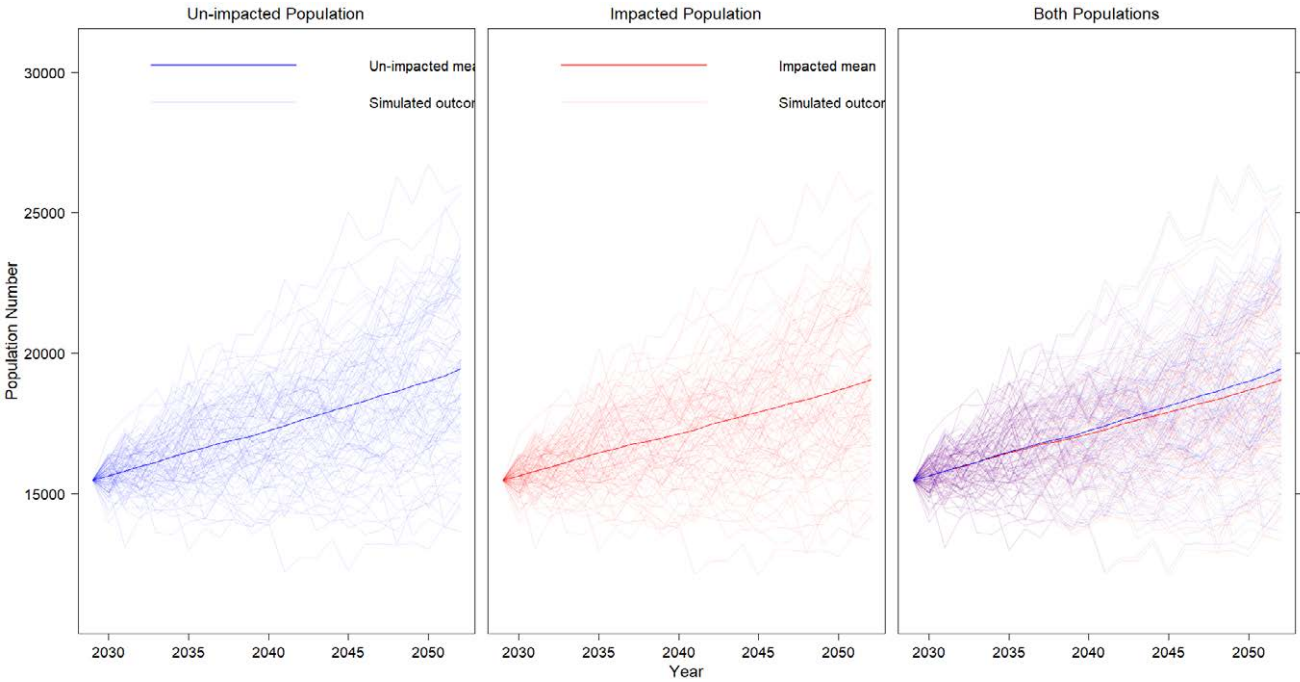


Figure 9-6 Simulated worst-case grey seal population sizes for both the un-impacted and the impacted populations for the in-combination assessment

2236. The median population size was predicted to be 99.89% of the un-impacted population size at the end of 2029 (one year after the piling has commenced in the wider area year after the piling has commenced). By the end of 2034 (the year piling ends) the median population size for the impacted population is predicted to be 98.63% of the un-impacted population size. Beyond 2034, the impacted population is expected to maintain the same stable trajectory as the un-impacted population (as far as 2054 which is the end point of the modelling, at which point the median impacted to un-impacted ratio is 98.04% (**Figure 9-6** and **Table 9.72**).
2237. The modelling indicates there would be **no adverse effect** on the integrity of the HE SAC due to cumulative disturbance from piling, due to there being less than a 1% population level effect on average per year over both the first six years and 25-year modelled periods.

¹⁵ [https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010109/EN010109-002028-16.14%20Marine%20Mammals%20Technical%20Note%20and%20Addendum%20\(R%20Revision%20B\)%20\(Clean\).pdf](https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010109/EN010109-002028-16.14%20Marine%20Mammals%20Technical%20Note%20and%20Addendum%20(R%20Revision%20B)%20(Clean).pdf)

¹⁶ <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010115/EN010115-000715-Five%20Estuaries%20Offshore%20Wind%20Farm%20Ltd%20-%20Any%20other%20submission%20from%20the%20Applicant%207.pdf>

¹⁷ https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010119/EN010119-000371-7.1.3_RIAA_Part%203%20Marine%20Mammals%20Annex%20II%20species.pdf

¹⁸ RIAA refers to ES assessments, therefore, number taken for single piling as presented in ES Chapter 11 <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010130/EN010130-000353-6.1.11%20Chapter%2011%20Marine%20Mammals.pdf>

Table 9.72 Results of the iPCoD Modelling For The Cumulative Assessment, Giving The Mean Population Size Of The Grey Seal Population (Wider Reference Population) For Years Up To 2053 For Both Impacted And Un-Impacted Populations In Addition To The Median Ratio Between Their Population Sizes

Year	Un-impacted population mean	Impacted population mean	Mean impacted as % of un-impacted	Un-impacted population median	Impacted population median	Median impacted as % of un-impacted
Start 2029	15,496	15,496	99.89	15,496	15,496	99.89
End 2030	15,646	15,629	99.91	15,700	15,685	99.93
End 2032	15,981	15,965	99.22	16,072	16,056	99.27
End 2034	16,316	16,301	98.56	16,347	16,329	98.63
End 2054	19,783	19,360	97.93	19,498	19,081	98.04

9.6.3.1.2 In-Combination Impact 1b: Assessment of Disturbance from Other Industries and Activities

2238. During the construction period the Project, there is the potential for disturbance to marine mammals associated with other potential noise sources, including:

- Geophysical surveys;
- Aggregate extraction and dredging;
- Seismic surveys;
- UXO clearance; and
- Interlink cable.

2239. For the installation of oil and gas infrastructure, marine renewable schemes, and disposal sites, all potential schemes have been screened out. Further information on the CEA screening (and these results) are provided in **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**.

2240. To represent the presence of grey seal in the wider HE SAC the quantitative assessments in this section are based on the average density estimate across the Carter *et al* (2022) relative density dataset for the HE SAC of 0.053/km².

9.6.3.1.2.1 Disturbance from Geophysical Surveys

2241. Based on BEIS (2020) as a precautionary worst-case, due to a lack of data on seal disturbance distances, the potential 3.77km disturbance range has been used. This results in a disturbance area of 434.9km² for one survey and 869.7km² for two geophysical surveys. It is currently not possible to estimate the location or number of potential OWF geophysical surveys that could be undertaken at the same time as construction and potential piling activity for the Project. It is therefore assumed, as a worst case scenario, that there could potentially be up to two geophysical surveys in the North Sea at any one time, during construction of the Project.

2242. For up to two geophysical surveys undertaken at the same time as construction of the Project, with no other in-combination activities, up to 0.55% of the HE SAC population may be disturbed (**Table 9.73**).

Table 9.73 Quantitative Assessment for In-Combination Disturbance of Marine Mammals Due to Two Geophysical Surveys at OWFs

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.019	1,963.5 (25km EDR)	38
Two geophysical surveys	0.053	869.7 (434.9 per survey)	47
Total number of grey seal with DBD			85 (0.55%)

2243. There would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal as a result of disturbance due to underwater noise (other than piling) from the Project with geophysical surveys.

Disturbance from Aggregate Extraction and Dredging

2244. Seven aggregate/dredging projects have been screened in that could have potential cumulative disturbance impacts with piling taking place at the Project (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**):

- Greenwich Light East 473/1 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);
- Greenwich Light East 473/2 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);
- Inner Dowsing 481/1-2;

- Inner Owers North 488;
- Thames D 524;
- West Bassurelle 458; and
- West Bassurelle 464.

2245. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600m of the activities (Diederichs *et al.*, 2010). As a worst-case assessment, a disturbance range of 600m will be applied for the aggregate schemes at the same time as the Projects' construction. A disturbance range of 600m would result in a potential disturbance area of 1.13km² for each project.
2246. Inner Dowsing 481/1-2 of the screened in aggregate schemes is the only scheme where the Carter *et al* (2022) densities for the individuals associated with the HE SAC show presence within the 5km x 5km grid cells that overlap with the scheme.
2247. For the potential for in-combination disturbance from aggregate and dredging schemes undertaken at the same time as construction of DBD, with no other in-combination activities, up to 0.25% of the HE SAC population may be disturbed (Table 9.74).

Table 9.74 Quantitative Assessment for In-Combination Disturbance of Grey Seal Due to Aggregate and Dredging Schemes

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.019	1,963.5 (25km EDR)	38
Inner Dowsing 481/1-2	0.053	1.13	0.06
Total number of grey seal with DBD			39 (0.25%)

9.6.3.1.2.2 Disturbance from Seismic Surveys

2248. It is currently not possible to estimate the number of potential seismic surveys that could be undertaken at the same time as construction and potential piling activity for the Project. As a precautionary approach, the potential for cumulative impacts from oil and gas seismic surveys has been screened into the CEA for further consideration. It was assumed, as a worst-case scenario, that there could potentially be two seismic surveys in the North Sea at any one time during construction (piling) of the Project.

2249. There is little available information on the potential for disturbance from seismic surveys for grey seal, however, observations of behavioural changes in other seal species have shown avoidance reactions up to 3.6km from the source for a seismic survey (Harris *et al.*, 2001). A more recent assessment of potential for disturbance to seal species, as a result of seismic surveys, shows potential disturbance ranges from 13.3km to 17.0km from source (BEIS, 2020). These ranges are based on modelled impact ranges, using the National Marine Fisheries Service Level B harassment threshold of 160dB, for a noise source of 3,070 cubic inches, 4,240 cubic inches, or 8,000 cubic inches.
2250. A potential disturbance range of 17.0km (or disturbance area of 4,426.9km² for one survey, and 8,853.8km² for up to two seismic surveys) will therefore be applied to grey seal due to a lack of species-specific information.
2251. For two seismic surveys, undertaken at the same time as construction of DBD, up to 3.28% of the HE SAC population may be disturbed (Table 9.75).

Table 9.75 Quantitative Assessment for In-Combination Disturbance of Grey Seal Due to up to Two Seismic Surveys

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.019	1,963.5 (25km EDR)	38
Two seismic surveys	0.053	8,853.8	470
Total number of grey seal with DBD			508 (3.28%)

9.6.3.1.2.3 Disturbance from Subsea Cables and Pipelines

2252. Only one subsea pipeline has been screened into the in-combination assessment, Sea Link. This project is currently at scoping stage and therefore there is limited information available on potential effects and disturbance ranges for which to inform the in-combination assessment with the Project.
2253. The disturbance ranges that could be generated during the cabling works and vessels would be up to 4km (with a disturbance area of 50.3km²), for all marine mammal species.
2254. The density for the Sea Link project has been estimated based on the Carter *et al* (2022) relative density data for the HE SAC, with an estimated density (for only those grey seals that are associated with the HE SAC) of 0.013/km².
2255. For disturbance from Sea Link and DBD piling, up to 1.32% of the HE SAC population may be disturbed (Table 9.76).

Table 9.76 Quantitative Assessment for In-Combination Disturbance of Grey Seal Due To Subsea Cable And Pipeline Schemes

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.019	1,963.5 (25km EDR)	38
Sea Link	0.013	50.3	1
Total number of grey seal with DBD			39 (0.25%)

9.6.3.1.2.4 Disturbance from UXO Clearance

2256. As for piling, the potential risk of PTS in marine mammals from in-combination effects has been screened out from further consideration in the CEA (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening** if there is the potential for any PTS, suitable mitigation would be put in place to reduce any risk to marine mammals. Therefore, the in-combination effects only consider potential disturbance effects.
2257. This assessment has been based on the potential for disturbance due to UXO clearance activities for other schemes, cumulatively with the construction of the Project.
2258. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity for the Project. In 2021 there were six cases of UXO detonations reported to the MNR in the North Sea, these occurred over a total of 16 days. This amount gives an average of less than one UXO detonation to occur within a year at any one time in the North Sea. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO detonation, even if they had overlapping UXO clearance operation durations. The in-combination assessment is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst-case), and one low-order detonation.
2259. The potential effect area during a single UXO clearance event, based on the modelled worst case effect range for the Project for TTS / fleeing response (weighted SEL) of 24km (1,809.5km²) for high-order clearance and 0.57km (1.02km²) for low-order clearance.

2260. However, as outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO, i.e. each blast lasting for a very short duration, marine mammals, including harbour porpoise, are not predicted to be significantly displaced from an area, any changes in behaviour, if they occur, would be an instantaneous response and short-term. Existing guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010a).

2261. **Table 9.77** presents the potential in combination area and the potential maximum number of grey seal disturbed.

Table 9.77 Quantitative Assessment for In-Combination Disturbance of Grey Seal For up to One Low Order and One High Order UXO Clearance

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.019	1,963.5 (25km EDR)	38
One high order UXO clearance	0.053	1,809.5	96
One low order UXO clearance	0.053	1.02	0.06
Total number of grey seal with DBD			134 (0.87%)

9.6.3.1.2.5 Summary of In-Combination Impact 1: Assessment of Underwater Noise

2262. Each of the above-described noise sources with the potential for disturbance on grey seal are quantitatively assessed together in **Table 9.78**.
2263. For grey seal, for noisy activities with the potential for in-combination disturbance effects together with piling for the Project, 5% of the HE SAC population is at risk of disturbance. Therefore, there would be **no adverse effect** on integrity of the HE SAC in relation to grey seal, either alone or when in-combination with other schemes.
2264. Behavioural effects from UXO clearance, if they occur, would be an instantaneous response and short-term. Guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010) and therefore could be excluded from the total.

Table 9.78 Quantitative Assessment for All Noisy Activities with the Potential for In-Combination Disturbance Effects For Grey Seal

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)	
DBD piling	Based on iPCoD modelling, <1% of the population disturbed over the first six years	38
Piling at other OWFs		2,249
Geophysical surveys	47 (0.3%)	
Aggregates and dredging	0.06 (0.0004%)	
Seismic surveys	470 (3.03%)	
Subsea cables	1 (0.013%)	
UXO clearance	97 (0.63%)	
Total number of grey seal (percentage of HE SAC)	615 (5% (including iPCoD %) of HE SAC)	2,902 (18.7% of HE SAC)

2265. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations. The in-combination is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst case), as well as one low-order clearance event.
2266. It should be noted that while the schemes included within the in-combination assessment for disturbance from other activities and industries were included based on the current knowledge of their possible construction or activity windows, it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the grey seal that could be at risk of disturbance during the offshore construction period of the Project.

9.6.3.2 In-Combination Impact 2: Barrier Effects

2267. For the assessment of the potential for barrier effects due to underwater noise from schemes undergoing construction, the effect to marine mammal species would be as per the assessments provided in **Section 9.6.3.1.2**, for in-combination disturbance effects due to all noisy activities.
2268. It is important to note that the OWFs and other noise sources included in the in-combination assessment are spread over the wider area of the North Sea. Taking into account the locations of the OWFs and other noise sources from the Project, the maximum underwater effect ranges for disturbance at other schemes would not overlap with the maximum underwater effect ranges for disturbance for the Project during piling and construction. Therefore, there is no potential for underwater noise from the Project, other OWFs and noise sources to result in a barrier of movement to marine mammals.
2269. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect, and therefore has not been considered within this in-combination assessment.
2270. Therefore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.6.3.3 In-Combination Impact 3: Increased Collision Risk with Vessels

2271. The in-combination effects from an increase in the number of vessels and vessel movements can pose a potential collision risk for grey seal.
2272. As outlined in **Section 9.6.2.1.6** (construction) and **Section 9.6.2.2.6** (operation), vessels would be intermittently present throughout the lifetime of the Project. As vessel movements to and from any port would be incorporated within existing vessel routes as far as possible, there would be no increased collision risk, as the increase in the number of OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas. Once on-site, OWF vessels and other construction-related vessels would be stationary or slow-moving as they undertake their associated activities.

2273. Vessel operators for the Project, North Falls (SSE & RWE, 2024), Sheringham Shoal and Dudgeon Extension (Equinor, 2022) will also follow best practices outlined in the **Outline PEMP (document reference 8.6)** to further reduce collision risks. Hornsea Four (Orsted, 2021) and Outer Dowsing (Outer Dowsing Offshore Wind, 2024) adopt a Vessel Management Plan (VMP) to minimise the potential for any impact. West of Orkney (Offshore Wind Power Limited, 2023), Five Estuaries (Five Estuaries OWF Limited, 2024) and Rampion 2 (Rampion 2 Wind Farm, 2023) adopt a best practice vessel handling protocols such as the WiSe Scheme or Guide to Best Practice for Watching Marine Wildlife. It is expected that other offshore projects and industries will adopt similar measures to mitigate the potential for marine mammal collisions, with Hornsea THREE (Orsted, 2018), Dogger Bank A and B (Forewind, 2014) and South (East and West) (RWE, 2024) also committed to these practices.
2274. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low. Increased collision risk from aggregate extraction and dredging has therefore been screened out from further consideration in the CEA.
2275. In addition, based on the assumption that grey seal would be disturbed as a result of underwater noise from piling, other construction activities, operational and maintenance activities and vessels, there should be no potential for increased collision risk with vessels.
2276. Therefore, there would be **no adverse effect** on integrity of the HE SAC in relation to the conservation objectives for grey seal due to an increase in collision risk with construction vessels.

9.6.3.4 In-Combination Impact 4: Changes in Prey Resource

2277. Potential effects on prey species the Project were assessed in **Section 9.6.2.1.8** (construction) and **Section 9.6.2.2.8** (operation). **No adverse effect** on integrity of the HE SAC in relation to the conservation objectives for grey seal was concluded. Any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat in the surrounding area. This will be the case for all schemes and therefore although the in-combination effects are additive, the effect would be proportionate to the wider range over which effects would occur.
2278. Therefore, there would be **no adverse effect** on the integrity of the HE SAC in relation to the conservation objectives for grey seal arising due to changes in prey availability.

9.6.4 Summary of Potential Effects on Site Integrity

2279. The assessment of the potential effects for the Project has been summarised in relation to the HE SAC conservation objectives for grey seal.
2280. The MMMP will provide mitigation or management measures to reduce the potential for any significant disturbance of grey seal as a result of in-combination effects from underwater noise.
2281. There would be **no adverse effect** on integrity of the HE SAC in relation to the conservation objectives for grey seal, either alone or when in-combination with other schemes.

9.7 Berwickshire and North Northumberland Coast SAC

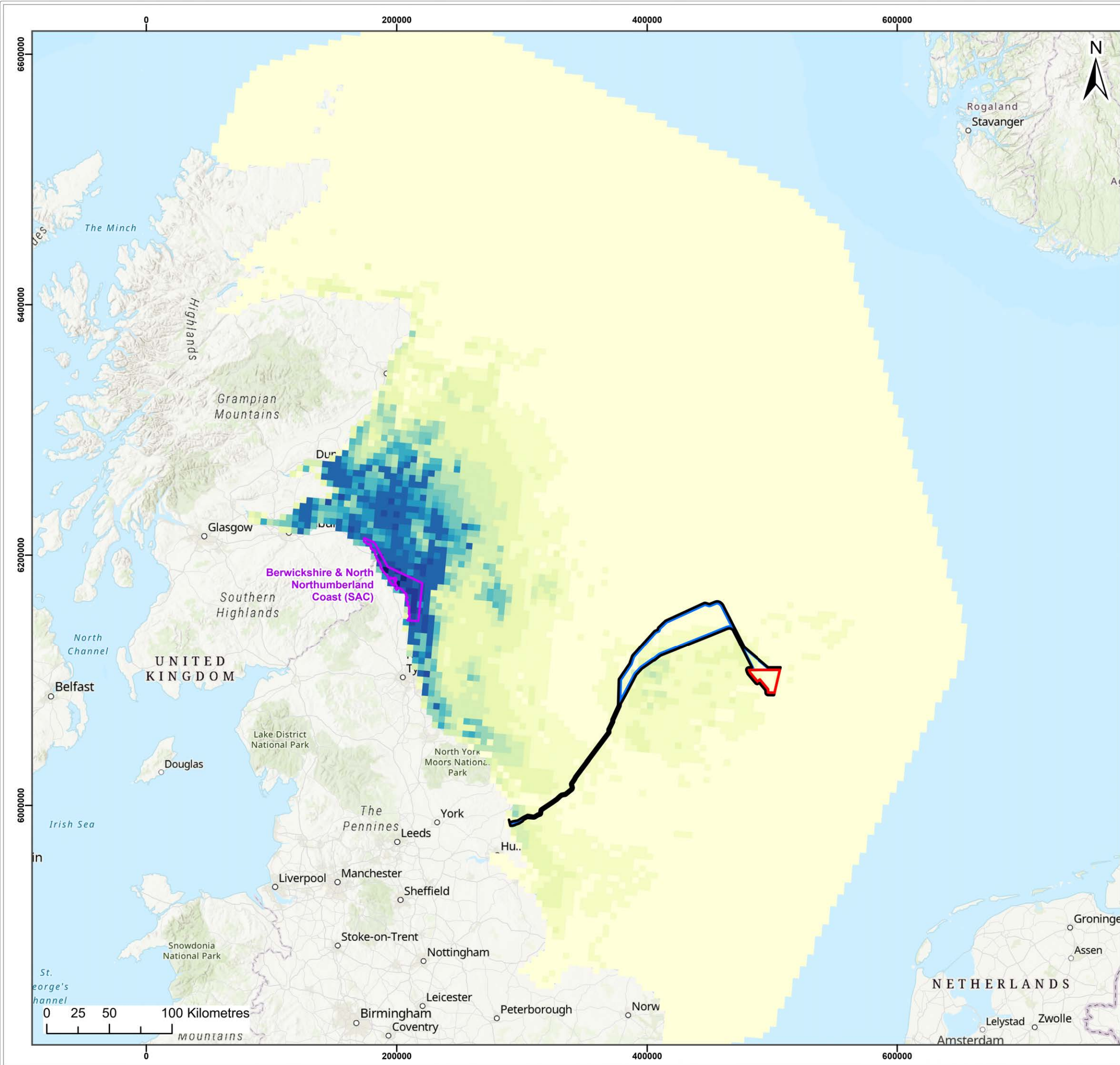
9.7.1 Site Description

2282. The Berwickshire and North Northumberland Coast (BNNC) SAC is one of the most biologically diverse marine areas in Europe, with its range of intertidal and subtidal habitats along with the internationally significant population of grey seals. The SAC lies in between England and Scotland.
2283. The Berwickshire and North Northumberland Coast SAC is 267km from the Array Area at closest point. Therefore, there is no potential for direct effect on the SAC as a result of the construction, operation, maintenance or decommissioning of Array Area. However, due to the foraging range of grey seal and the movement of grey seal along the east coast of England, there is the potential for effects on foraging grey seal from the Berwickshire and North Northumberland Coast SAC in the vicinity of the Array Area.

9.7.1.1 Qualifying Feature

9.7.1.1.1 Grey Seal

2284. Carter *et al* (2022) produced habitat-based predictions of at-sea distribution for grey seals in the British Isles. The resultant density of seals at-sea maps shows the relative density of seals in each 5km by 5km grid cell. As well as the total grey seals at-sea densities, Carter *et al* (2022) provide SAC specific densities. These SAC specific densities provide the relative density of grey seal that are associated with each SAC. These SAC specific density estimates have been used to calculate the density of grey seal, associated with the Berwickshire and North Northumberland Coast SAC, present within the Array Area (**Figure 9-7; Table 9.79**). This effectively apportions the potential for effect to only those seals that are affected that are associated with the SAC itself.



Legend:

- Dogger Bank D Array Area
- Offshore Export Cable Corridor
- Offshore Development Area
- Berwickshire and North Northumberland Coast Special Area of Conservation (SAC)

Mean Grey Seal At-Sea Usage (% per 25km²)

0 - 0.005	0.031 - 0.04
0.0051 - 0.01	0.041 - 0.05
0.011 - 0.02	0.051 - 0.06
0.021 - 0.03	0.061 - 0.07
	0.071 - 0.08
	0.081 - 0.09
	0.091 - 0.1
	0.11 - 0.25
	0.251 - 0.50
	0.51 - 0.75
	0.751 - 1.0
	1.01 - 2.0

Source: © Haskoning DHV UK Ltd, 2025; © JNCC, 2025; © Carter *et al.*, 2022
© OpenStreetMap (and) contributors, CC-BY-SA

Project:

Dogger Bank D Offshore Wind Farm

Title:

Grey Seal At-Sea Mean Densities for Those Individuals Associated With The Berwickshire and North Northumberland Coast SAC

Figure: 9-7

Drawing No: PC6250-RHD-XX-OF-DR-GS-0527

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/02/2025	FC	KF	A3	1:3,000,000

Co-ordinate system: WGS 1984 UTM Zone 31N

Table 9.79 Grey Seal Counts and Population Estimates

Population area	Grey seal haul-out count	Source of haul-out count data	Correction factor for seals not available to count	Grey seal SAC population
BNNC SAC	6,427	SCOS (2022)	0.2515	16,903

2285. The highest mean at sea relative density estimates of grey seal for Array Area, and the offshore ECC, calculated from Carter *et al* (2022) are:

- 0.03 individuals per km² for Array Area;
- 0.038 individuals per km² for the offshore ECC.

2286. The assessments are based on mean relative density estimates for the BNNC SAC from (Carter et al., 2022) as a worst-case. The corrected SAC grey seal count was used to generate absolute densities from the relative density data of Carter et al (2022) (**Figure 9-7**). This at-sea population number is 14,563, based on the total population of grey seal at the Berwickshire and North Northumberland Coast SAC (of 16,903, as provided in **Table 9.79**), and calculating against a correction factor of 0.2515 to take account of those individuals at sea only.

2287. Assessments are undertaken against the SAC population estimate of 16,903 seals, for both the project alone and in-combination.

9.7.1.2 Conservation Objectives

2288. The Conservation Objectives (Natural England, 2023c) are “to ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The structure and function (including typical species) of qualifying natural habitats;
- The structure and function of the habitats of qualifying species;
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely;
- The populations of qualifying species, and,
- The distribution of qualifying species within the site.”

9.7.2 Assessment of Potential Effects of the Project Alone

9.7.2.1 Potential Effects During Construction

2289. Potential effects during construction may arise through disturbance from activities during the installation of offshore infrastructure. Underwater noise during piling, as well as disturbance associated with underwater noise from other construction activities and the presence of vessels offshore, are considered. Potential displacement from important habitat areas and impacts on prey species are also considered.

2290. The potential effects during construction assessed for grey seals are outlined in **Section 4.5.3**.

9.7.2.1.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Impact Piling During Construction

2291. Underwater noise modelling was carried out by SubAcoustech to estimate the noise levels likely to arise during piling and determine the maximum potential areas of effect (see **PEIR Volume 2, Appendix 12-3 Underwaters Noise Modelling Report** and **Section 9.4.2.1.1** for further details).

9.7.2.1.1.1 PTS From a Single Strike

2292. The underwater noise modelling results for the predicted effect ranges and areas for PTS from a single strike of the maximum hammer energy for the worst case location have been assessed (**Figure 9-7** and Error! Reference source not found.).

Table 9.80: The Predicted Effect Ranges For PTS, At The Worst Case Modelling Location For Seals, For The Maximum Hammer Energies Of Both Monopiles And Pin Piles

Marine mammal species	Potential effect ranges (and areas) for PTS at the maximum hammer energy	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Grey seal	0.06km (0.01km ²)	0.05km (0.01km ²)

2293. An assessment of the maximum number of individuals that could be at risk of instantaneous PTS, due to a single strike at the maximum hammer energy, for both monopiles and jacket pin piles, is presented in **Table 9.81**.

2294. The maximum potential number of grey seal that could be at possible risk of PTS due to a single strike at the maximum hammer energy, for monopiles and pin piles, without any mitigation is 0.0003 individuals (0.000002% of the BNNC SAC reference population, based on the array density estimate).

Table 9.81 Assessment of the Potential for Instantaneous PTS Due to a Single Strike of the Maximum Hammer Energy for a Monopile and Jacket Pin Pile

Marine mammal species	Assessment of effect
PTS due to a single strike of a monopile at maximum hammer energy (Sound pressure level (SPL _{peak}))	
Grey seal	0.0003 (0.000002%)
PTS due to a single strike of a jacket pin pile at maximum hammer energy (SPL _{peak})	
Grey seal	0.0003 (0.000002%)

9.7.2.1.1.2 PTS From Cumulative Exposure

2295. The SEL_{cum} is a measure of the total received noise over the whole piling operation. The SEL_{cum} range indicates the distance from the piling location that if the receptor were to start fleeing in a straight line from the noise source starting at a range closer than the modelled range it would receive a noise exposure in excess of the criteria threshold, and if the receptor were to start fleeing from a range further than the modelled range it would receive a noise exposure below the criteria threshold.

2296. **Table 9.82** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of monopiles and jacket pin piles at the worst case location.

Table 9.82 Predicted Effect Ranges (and Areas) for PTS for Seals, At the Worst Case Modelling Location, for the Cumulative Exposure of Both Monopiles and Pin Piles

Scenario	Potential effect ranges (and areas) for PTS due to cumulative exposure	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Multiple sequential pile installations in a 24-hour period	0.73km (1.6km ²)	0.43km (0.53km ²)

2297. It is important to note that the assessment for PTS from cumulative exposure is highly precautionary. There is some variation in the potential impact ranges for SEL_{cum} at each location and between locations, therefore in many cases less individuals would be at risk of exposure than presented here (as the assessments are based on the worst-case location). It is also unlikely that the maximum hammer energy would be required at all piling locations for the entire duration of the piling activity.

2298. An assessment of the maximum number of grey seal that could be at risk of cumulative PTS, for both sequential monopiles and jacket pin piles, is presented in **Table 9.83**, based on the effect areas as presented in **Table 9.82**.

Table 9.83 Assessment of the Potential for PTS Due to the Cumulative Exposure of Sequential Monopiles or Jacket Pin Piles in a 24 Hour Period for Seals

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of two sequential monopiles in a 24 hour period (SEL _{cum})	0.05 (0.0003% of BNNC SAC)
PTS due to the cumulative exposure of four sequential jacket pin piles in a 24 hour period (SEL _{cum})	0.02 (0.0001% of BNNC SAC)

2299. In the worst case 0.05 individuals 0.0003% of the BNNC SAC reference population, based on the array density estimate) could be at risk of cumulative PTS due to the cumulative exposure of two sequential monopiles in a 24 hour period.

9.7.2.1.1.3 PTS from Cumulative Exposure from Multiple Piling Locations

2300. The simultaneous piling scenario assumes that animals are within potential effect ranges for a much longer period (i.e. they would be travelling from one pile location to another which piling is ongoing), and therefore cumulative effect ranges are much larger than for the cumulative exposure ranges of one pile at a time.

2301. The potential effect ranges are not possible to model under this scenario, as there are two starting points for receptors, and it is not possible to determine the potential range at which they need to be in order to not be at risk of effect. Therefore, the following assessment is based on the potential areas of effect only.

2302. Where the potential effect areas are not large enough to interact with each other (i.e. they do not meet), the results for the respective locations and scenarios are used (the results of the modelling for the Southeast and Northwest locations are used to inform the assessment, to align with the modelling locations used for the simultaneous modelling).

2303. **Table 9.84** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of simultaneous monopiles at the NW and SE modelling locations. These locations were chosen as they have the potential for the largest 'spread' in terms of underwater noise propagation. The modelling includes two monopiles being installed sequentially at each location at the same time.

Table 9.84 The Predicted Effect Area For PTS For Seals at the NW and SE Modelling Locations, for the Cumulative Exposure of Multiple Monopiles Installations at the Same Time

Scenario	Potential effect areas for PTS due to cumulative exposure of simultaneous pile installations
	Monopile (8,000kJ)
Multiple sequential pile installations in a 24-hour period (for the NW and SE modelling locations together)	110km ²

2304. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for simultaneous monopiles is presented in **Table 9.85**, based on the effect areas as presented in **Table 9.84**.

Table 9.85 Assessment of the Potential for PTS Due to the Cumulative Exposure of Simultaneous Monopiles at the Same Time

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of simultaneous monopile installations (SEL _{cum})	4 (0.02% of BNNC SAC)

2305. There would be **no adverse effect** of PTS in grey seal from pile installation on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

9.7.2.1.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Impact Piling During Construction

2306. The range of possible behavioural reactions that may occur as a result of exposure to noise include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases, panic, or stranding, sometimes resulting in injury or death (Southall *et al.*, 2008).
2307. There are currently no agreed thresholds or criteria for the behavioural response and disturbance of grey seal, therefore it is not possible to conduct underwater noise modelling to predict impact ranges.

2308. Disturbance from construction activities (including piling) may have behavioural consequences on grey seal in the study area, including reduced time spent foraging at sea as animals move away from sources of noise, displacement from vessels, etc. Repeated disruptions can have cumulative negative effects on the bioenergetic budget of marine species, with the potential for long-term effects on survival and reproductive rates (Christiansen *et al.*, 2013).

2309. Hastie *et al* (2021) studied the change in foraging behaviour of grey seal when exposed to underwater noise. An area of high and low prey density was present within an experimental pool, and speakers were located at each prey patch. During the control periods, seals would forage mainly at the high-density patch, but also at the low-density patch for a smaller proportion of time. When the seals were exposed to noise at the low density patch, there was a reduction in foraging of 16-28%, however, when seals were exposed to noise at the high density prey patch, there was no change in foraging in comparison to control periods. This indicates that seals would choose to remain at a noisy environment, if there were good prey resources at the same location.

2310. Russell (2016) have shown that grey seal are present in significantly reduced number up to a distance of 25km during piling (or a disturbance area of 1,963.5km²). This range has therefore been used to determine the number of grey seal that may be disturbed during piling at Array Area (**Table 9.86**).

Table 9.86 Assessment of the Potential for Disturbance to Grey Seal Based on a Disturbance Range of 25km for Both Monopiles and Jacket Pin Piles for the Project

Potential disturbance range and area	Assessment of effect	Potential adverse effect on site integrity
One Monopile		
25km, with a disturbance area of 1,963.5km ²	59 (0.3% of BNNC SAC)	No Less than 5% of the population affected.
One Jacket pin pile foundation		
15km, with a disturbance area of 706.86km ²	22 (0.1% of BNNC SAC)	No Less than 5% of the population affected.

2311. A distance of 25km during piling Russell (2016) (or a disturbance area of 1,963.5km²) has been used to determine the number of grey seals that may be disturbed during monopiling for the Project. To assess for disturbance of a single jacket pin pile foundation, the recommended EDR of 15km (706.86km²) for harbour porpoise (Graham *et al.*, 2019) has been used as a precautionary impact range for grey seals.

2312. For disturbance based on the known effect ranges, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

9.7.2.1.2.1 Dose-Response Assessment

2313. The dose-response methodology is outlined in **Section 13.5** in **PEIR Volume 2, Appendix 12.6 Information and Modelling Methods for Disturbance**. The dose-response approach has been undertaken for all piling locations, with the highest resultant number of individuals disturbed presented in this assessment.

2314. The estimated numbers of grey seal and the corresponding percentage of the BNNC SAC population that could be disturbed as a result of underwater noise during piling, based on the worst-case foundation and location, is presented in **Table 9.87**.

Table 9.87 Number of Individuals (and % of Reference Population) That Could Be Disturbed During Piling of Monopiles Based on the Dose-Response Approach

Number of individuals disturbed (monopiles) (% of reference population)	Number of individuals disturbed (pin-piles) (% of reference population)
2 (0.01% of BNNC SAC)	2 (0.01% of BNNC SAC)

9.7.2.1.2.2 Potential Disturbance from ADD Activation

2315. During 9 minutes of ADD activation, grey seal would move at least 0.81km from the ADD location (based on a precautionary marine mammal swimming speed of 1.5m/s; Otani *et al.*, 2000), resulting in a potential disturbance area of 8km². This is further than the maximum instantaneous PTS range for monopiles predicted for grey seal. For pin piles the ADD activation required would be 5 minutes to cover the maximum PTS range of 0.43km, resulting in a potential disturbance area of 4.4km².

2316. The estimated numbers (and percentage of the relevant reference populations) of grey seal disturbed as a result of underwater noise during piling after ADD is presented in **Table 9.88**.

Table 9.88 Assessment of the Potential for Disturbance due to ADD Activation Based for Monopiles or Jacket Pin Piles for the Project

Piling Scenario	Assessment of effect	Potential adverse effect on site integrity
Monopiles	0.2 (0.001% of the BNNC SAC)	No
Pin piles	0.1 (0.0008% of the BNNC SAC)	Less than 5% of the population affected

2317. The population affected by disturbance from underwater noise at the Project is less than 5%. Therefore, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to disturbance or behaviour effects from increased underwater noise during construction (piling) for the Project.

9.7.2.1.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.7.2.1.3.1 Impact 3a: Permanent auditory injury (PTS) Due to Other Construction Activities

2318. Potential sources of underwater noise during construction activities, other than piling, include seabed preparation, dredging, rock placement, trenching and cable installation.

2319. Dredging / cable installation activities have the potential to generate underwater noise at sound levels and frequencies for sufficient durations to disturb marine mammals. Reviews of published sources of underwater noise during dredging activity (Theobald *et al.*, 2011; Thomsen *et al.*, 2006; Todd *et al.*, 2015), indicate that the sound levels that grey seals may be exposed to during dredging activities are typically below permanent auditory injury thresholds (PTS) exposure criteria (as defined in Southall *et al* (2019)). Therefore, the potential risk of any auditory injury in marine mammals as a result of dredging activity is highly unlikely.

2320. The noise levels produced by dredging activity / cable installation, could overlap with the hearing sensitives and communication frequencies used by marine mammals (Todd *et al.*, 2015), and therefore have the potential to impact grey seals present in the area.

2321. The potential for PTS effects that could result from underwater noise during other construction activities, including cable laying and protection would be temporary in nature, not consistent throughout the offshore construction period for the Project and would be limited to only part of the overall construction period and area at any one time.

Table 9.89 Predicted Impact Ranges (and Areas) for Auditory Injury from 24 Hour Cumulative Exposure During Other Construction Activities

Criteria and threshold (Southall <i>et al.</i> , 2019)	Cable laying	Dredging (backhoe and suction (individually))	Trenching	Rock placement	All activities
SEL _{cum} Weighted (153 dB re 1 µPa ² s) Non-impulsive	0.1km (0.03km ²)	<0.1km (<0.03km ²)	<0.1km (<0.03km ²)	<0.1km (<0.03km ²)	0.12km ²

2322. The assessment for impacts from underwater noise resulting from other construction activities is shown in **Table 9.90**.
2323. The number of grey seal that could be impacted as a result of underwater noise during construction activities other than piling is presented in **Table 9.90** has been assessed based on the number of animals that could be present in each of the modelled impact ranges.

Table 9.90 Maximum Number of Individuals (and % of Reference Population) That Could be Impacted as a Result of Underwater Noise Associated with Non-Piling Construction Activities

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
PTS for each individual activity			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.0009 (0.00001% of BNNC SAC based on array density estimate) 0.001 (0.00001% of BNNC SAC based on ECC density estimate)	No. Less than 1% of the population affected
PTS for all activities at the same time (4 activities)			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.004 (0.00002% of BNNC SAC based on array density estimate) 0.005 (0.00003% of BNNC SAC based on ECC density estimate)	No. Less than 1% of the population affected

2324. The population affected by auditory injury during other construction activities from underwater noise at the Project is less than 1%. Therefore, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to auditory injury from increased underwater noise during other construction for the Project.

9.7.2.1.3.2 Impact 3b: Permanent auditory injury (PTS) Due to Construction Vessels

2325. **Table 9.91** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS from the cumulative exposure of vessels within the site. For SEL_{cum} calculations, the duration of the noise is also considered, with noise present for a worst case of 24-hours in a day.

Table 9.91 The Predicted Effect Ranges for Cumulative PTS for Vessels in All Marine Mammal Species

Marine mammal species	Potential effect ranges (and areas) for PTS Medium of large vessels
Grey seal	<100m (0.031km ²)

2326. The results of the underwater noise modelling do not define effect ranges of <100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably lower).
2327. The results of the underwater noise modelling (**Table 9.91**) indicate that any grey seal would have to be <100m (precautionary maximum range) from the continuous noise source for 24 hours, to be exposed to noise levels that could induce PTS. It is therefore highly unlikely that any individual would be at risk of PTS due to vessel noise. It should be noted that the predicted impact ranges are the distances which represent the ‘onset’ stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.
2328. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in **Table 9.92**, based on the effect areas as presented in **Table 9.91**.

Table 9.92 Assessment of the Potential for PTS Due to Medium and Large Vessels

Marine mammal species	Assessment of effect
Grey seal	0.0009 (0.00001% of BNNC SAC based on array density estimate) 0.001 (0.00001% of BNNC SAC based on ECC density estimate)

2329. Given the small number of individuals affected, there would be **no adverse effect** of PTS in grey seal from vessels on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.
2330. There is the potential that up to 90 vessels may be present in the Offshore Development Area at any one-time during construction. As a worst case and unlikely scenario, an assessment for all 90 vessels has also been undertaken with the assessment split between the Array Area and offshore ECC using the relevant density estimates.
2331. The assessment considers the following assessments:
- Up to 35 vessels within the Array Area;
 - Up to 55 vessels in the offshore ECC; and
 - The combined number of affected animals for 90 vessels.
2332. **Table 9.93** presents the potential areas of PTS for the maximum construction vessels at any one time.

Table 9.93 Predicted Effect Areas (Cumulative PTS) for Multiple Construction Vessels for All Marine Mammal Species

Area	Potential effect areas for PTS
Array Area	1.1km ²
Offshore ECC	1.7km ²
Combined total	2.79km ²

2333. An assessment of the maximum number of individuals that could be at risk of PTS, due to the maximum number of construction vessels at any one time is presented in **Table 9.94**, based on the effect areas as presented in **Table 9.93**.

Table 9.94 Assessment of the Potential for PTS Due to Multiple Construction Vessels

Area	Assessment of effect
Array Area	0.03 (0.0002% of BNNC SAC)
Offshore ECC	0.06 (0.0004% of BNNC SAC)
Combined total	0.09 (0.0005% of BNNC SAC)

2334. Given the small number of individuals affected, there would be **no adverse effect** of PTS in grey seal from vessels on the integrity of the HE SAC in relation to the conservation objectives for grey seal.

9.7.2.1.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.7.2.1.4.1 Impact 4a: Disturbance Effects Due to Other Construction Activity

2335. Underwater noise as a result of dredging activity / cable installation has the potential to disturb marine mammals (Pirotta *et al.*, 2014). Therefore, there is the potential for short, perhaps medium-term behavioural reactions and disturbance to grey seal in the area during dredging / cable installation activity. Grey seals may exhibit varying behavioural reactions intensities as a result of exposure to noise (Southall *et al.*, 2008).
2336. Grey seals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.
2337. If the response is displacement from the area, it is predicted that grey seals will return once the activity has been completed and therefore any impacts from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on grey seal.
2338. There is limited data on the potential for a behavioural response or disturbance from other construction activities (or other continuous noise sources). A review of various studies was used to determine the maximum potential disturbance range for other construction activities and vessels. As discussed Benhemma-Le Gall *et al* (2021), reported a 4km (50.3km²) reduction in harbour porpoise presence for other construction activities, including vessels. As harbour porpoise are the most sensitive marine mammal species, this 4km potential disturbance range has been used for grey seal as a worst case, in the absence of any other data to inform an assessment.
2339. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities based on the 4km potential disturbance range is presented in **Table 9.95** for one activity occurring or four activities happening at the same time.
2340. The population disturbed during other construction activities from underwater noise at the Project is less than 5%. Therefore, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to disturbance from increased underwater noise during other construction for the Project.

Table 9.95 Assessment of the Potential for Disturbance Due to Other Construction Activities, Including Cable Laying, Suction Dredging, Cable Trenching, and Rock Placement, for One Activity Taking Place at Any One Time for the Project

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
Disturbance for each individual activity			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	2 (0.01% of BNNC SAC based on both the array and ECC density estimate)	No. Less than 5% of the population affected
Disturbance for four activities at the same time at the Project			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	7 (0.04% of BNNC SAC based on the array density estimate) 8 (0.05% of BNNC SAC based on the ECC density estimate)	No. Less than 5% of the population affected

9.7.2.1.4.2 Impact 4b: Disturbance effects due to construction vessels

2341. The assessment on disturbance effects due to construction vessels has been based on the same methods as described in **Section 9.4.2.1.4 Impact 4b**.
2342. The assessments are undertaken based on the maximum number of vessels being present at any one time, which is only likely to occur occasionally.

2343. The disturbance assessment based on one vessel is equivalent to that for one construction activity. This scenario has already been assessed in **Table 9.95** and has therefore not been repeated here.
2344. The disturbance caused by 55 individual vessels within the offshore ECC, would cover a total area of 2,764km², not taking into consideration any potential overlap of the 4km disturbance ranges with other nearby vessels. To account for that, 55 vessels were randomly distributed in the offshore ECC, using QGIS v.3.38. If an overlap in the disturbance areas of multiple adjacent vessels was identified, this area removed from the total area of effect to account for that. Therefore, a potential area of disturbance of 2,500km² has been identified for the worst-case of 55 construction vessels, as shown in the **PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise, Section 12.7.1.4.2.2**.
2345. Assuming the disturbance caused by 35 vessels within the Array Area would not overlap with that of other vessels, the total disturbed area would be 1,759km². This is significantly larger than the Array Area itself, which has a total area of 262km². Therefore, the actual maximum area of effect would be the Array Area with a 4km buffer a 4km buffer (equating to an area of 613km²), as all vessels would be within the Array Area. Therefore, the assessment in represents the maximum possible disturbance area of the Array Area, including a 4km buffer.
2346. Whilst short to medium term behavioural responses have been recorded from vessel disturbance, there are no long-term or population level effects recorded to date. Less than 5% of the reference population is affected (**Table 9.96**), therefore, it is considered that there would be **no adverse effect** from disturbance from underwater noise associated with vessels on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

Table 9.96 Maximum Number of Individuals (and % of Reference Population) That Could Be Disturbed as a Result of Underwater Noise Associated with Construction Vessels at the Project

Component specific density	Maximum number of individuals (% of reference population) for 55 vessels in the offshore ECC (2,500km ²)	Maximum number of individuals (% of reference population) for Array Area, including a 4km buffer (613km ²)	Maximum number of individuals (% of reference population) for all construction vessels in the offshore ECC and Array Area
Array Area	-	19 (0.1% of BNNC SAC)	114 (0.7% of BNNC SAC)
Offshore ECC	95 (0.6% of BNNC SAC)	-	

9.7.2.1.5 Impact 5: Barrier Effects from Underwater Noise During Construction

2347. Underwater noise during construction could have the potential to create a barrier effect, preventing movement or migration of grey seals between important feeding and / or breeding areas, or potentially increasing swimming distances if marine mammals avoid the site and go around it. However, the Array Area is not located on any known migration routes for grey seals.
2348. The predicted barrier effects from underwater noise during construction for grey seal are detailed in **Section 9.6.2.1.5** for the HE SAC assessment and also apply to the BNNC SAC assessment for grey seal.
2349. Therefore, there would be no significant disturbance of grey seal and **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to potential barrier effects from increased underwater noise during construction of the Project.

9.7.2.1.6 Impact 6: Increased Risk of Collision with Vessels during construction

2350. During offshore construction, there will be an increase in vessel traffic within the Array Area and offshore ECC. However, it is anticipated that vessels would follow an established shipping route to the relevant ports in order to minimise vessel traffic in the wider area.
2351. The predicted effects from increased risk of collision for grey seal are detailed in **Section 9.5.2.1.7** for the HE SAC assessment and also apply to the BNNC SAC assessment for grey seal.
2352. Therefore, there would be minimal increase to collision risk of grey seal and **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to potential vessel collision risk during construction for the Project.

9.7.2.1.7 Impact 7: Disturbance at Seal Haul-Out Sites

2353. The BNNC SAC is located, at closest point, 267km from Array Area. The main grey seal haul out site is Donna Nook which is 63km from landfall, 61km from the offshore ECC, 240km from Array Area at closest distance. The closest seal haul-out site is Filey Brigg which is 34km from landfall, 20km from the offshore ECC, 215km from Array Area. Therefore, there would be no effects from construction activities within the Offshore Development Area, only effects from vessels transiting to and from the Offshore Development Area.
2354. The predicted effects from disturbance at seal haul-out sites for grey seal are detailed in **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report Table 12.2-13 and Table 12.2-15** for the HE SAC assessment and also apply to the BNNC SAC assessment for grey seal.

2355. Therefore, if the vessels committed to keep at least a distance of 500m from the shore, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to disturbance at seal haul-out sites during construction for the Project.

9.7.2.1.8 Impact 8: Potential Effects of Changes to Prey Resource

2356. The potential effects on prey species during construction can result from:
- Physical seabed disturbance;
 - Increased SSC and sediment re-deposition;
 - Remobilisation of contaminated sediments;
 - Underwater noise and vibration; and
 - Changes in fishing activity.
2357. As discussed in the SNS SAC section (**Section 9.4.2.1.7**), **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any reductions in prey availability would be small scale, localised and temporary. It is considered highly unlikely that potential reductions in prey availability as a result of construction activities at the Project would result in detectable changes to grey seal populations.
2358. Grey seal feed on a variety of prey species and are considered to be opportunistic feeders, feeding on a wide range of prey species and they have relatively large foraging ranges (see **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report**).
2359. The potential impacts of physical disturbance, temporary habitat loss, increased SSC, re-mobilisation of contaminated sediment, underwater noise and vibration and changes in fishing activity on changes in prey availability are localised and short in duration. Therefore, there will be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to potential changes in prey availability during construction for the Project.

9.7.2.1.9 Impact 9: Potential Effects of Changes to Water Quality

2360. Potential changes in water quality during construction could occur through:
- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations, and array, cables;

- Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and Offshore Platforms;
- Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
- Deterioration in water quality associated with release of sediment bound contaminants.

2361. Marine mammals often inhabit turbid environments and cetaceans utilise sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly (Todd *et al.*, 2014).
2362. Increased turbidity is unlikely to have a direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely.
2363. Potential changes in water quality during construction would have **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal for the Project.

9.7.2.2 Potential Effects During O&M

2364. The potential effects during O&M that have been assessed for are outlined in **Section 4.5.3**.

9.7.2.2.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Operational Wind Turbine Noise

2365. Underwater noise modelling was undertaken by Subacoustech to estimate the noise levels likely to arise during the operational phase (**PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report**) and determine the potential effects on marine mammals.
2366. The risk of injury (defined as onset of PTS) is given as occurring in a range of <100m (**Table 9.97**), a highly precautionary range, and within which the animal would need to stay for a 24 hour period for sufficient noise exposure to result in an effect. Such an occurrence is extremely unlikely and would be atypical behaviour for such a highly mobile species.
2367. The maximum number of individuals that could be at risk of PTS, due to a single operational WTG, is 0.0009 grey seal (0.000006% of the BNNC SAC reference population), based on the array density estimate.

Table 9.97 Predicted Effect Ranges (and Areas) for PTS from 24 hour Cumulative Exposure of Underwater Noise from Operational Turbines

Species	Impact	Operational wind turbine	Area of impact for up to 113 Wind turbines
Grey seal	PTS	<0.1km (0.031km ²)	3.55km ²

2368. More than one WTG will be operating at the same time, and therefore an assessment of the potential for auditory injury, due to all operational WTGs, is required. There is the potential for 113 WTGs to be installed for the Project.
2369. The potential areas of PTS for all operational WTGs for grey seal is 3.55km².
2370. An assessment of the maximum number of individuals that could be at risk of PTS from all operational WTGs is 0.1 grey seal (0.0006% of the BNNC SAC reference population), based on the array density estimate.
2371. There would be **no adverse effect** of PTS in grey seal from operational WTG noise on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

9.7.2.2.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Operational Wind Turbine Noise

2372. The predicted behavioural effects from operational wind turbine noise for grey seal are detailed in **Section 9.6.2.2.2** for the HE SAC assessment and also apply to the BNNC SAC assessment for grey seal.
2373. Therefore, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to disturbance from operational wind turbine noise arising from the Project.

9.7.2.2.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.7.2.2.3.1 Impact 3a: Permanent Auditory Injury (PTS) Due to Other O&M Activity

2374. The requirements for any potential O&M activities, such as additional rock placement or cable re-burial, are currently unknown, however the work required, and associated effects to grey seal, would be less than those during construction. **Section 9.7.2.1.3** provides an assessment for the same activities during construction, concluding that there is no potential for a significant effect as a result of the Project.

2375. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities, and if the marine mammal remains within close proximity for 24 hours. Therefore, it is highly unlikely for there to be any PTS due to these activities.
2376. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase.
2377. Therefore, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to physical and auditory injury from underwater noise associated with O&M activities for the Project.

9.7.2.2.3.2 Impact 3b: Permanent Auditory Injury (PTS) Due to O&M Vessels

2378. During the O&M of the Project, there may be up to 19 vessels in the Offshore Development Area at any one time, compared to the 35 vessels that would be on site during construction. Therefore, the potential effects associated with underwater noise and disturbance from vessels during O&M would be less than of those during construction (as assessed in **Section 9.7.2.1.3**). As a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst case scenario.
2379. There would therefore be **no adverse effect** of PTS in grey seal from vessels on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

9.7.2.2.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.7.2.2.4.1 Impact 4a: Disturbance Effects Due to Other O&M Activities

2380. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. The requirements for any potential maintenance work are currently unknown, however, the work required, and impacts associated with underwater noise and disturbance from activities during O&M would be less than those during construction. As there is expected to be less noisy activities during the operation phase than is required during construction, it is therefore likely to cause less disturbance to foraging behaviours in grey seal.
2381. Therefore, the potential for adverse effect due to underwater noise from O&M activities is considered to be the same or less than that assessed for underwater noise from other construction activities (including rock placement, trenching and cable laying) (as assessed in **Section 9.7.2.1.4**).

2382. The effect significance for disturbance effects due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

9.7.2.2.4.2 Impact 4b: Disturbance Effects Due to O&M Vessels

2383. The requirements for any potential maintenance work are currently unknown, however the work required, and impacts associated with underwater noise and disturbance from vessels during O&M would be less than those during construction.
2384. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be 19, which is less than the 35 vessels that could be on site during construction. However, as a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst-case scenario.
2385. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.
2386. There would therefore be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

9.7.2.2.5 Impact 5: Underwater Noise: Barrier Effects During O&M

2387. The indicative minimum separation distance between turbines would be a minimum of 0.826km to 1.416km, depending on WTG size, therefore there would be no overlap in the potential impact range (PTS; **Table 9.6**) of <100m around each turbine, and there would be adequate room for marine mammals to move through the Array Area.
2388. Therefore, no barrier effects as a result of underwater noise during O&M are anticipated, and no further assessment is required.

9.7.2.2.6 Impact 6: Increased Risk of Collision with Vessels During O&M

2389. The increased risk of marine mammal collision with operational and maintenance vessels would be the same or less than what was assessed for the construction period (**Section 9.7.2.1.6**), given the number of vessels required would be lower.
2390. During the O&M phase, the maximum number of vessels that could be present in the Project offshore components at any one time has been estimated as 16 vessels (**Table 9.2**). The number, type and size of vessels would vary, depending on the activities taking place at any one time and are typically slow moving or stationary.

2391. Given the existing levels of marine traffic, as outlined in **PEIR Volume 1, Chapter 15 Shipping and Navigation**, marine mammals in and around the windfarm site would typically be habituated to the presence of vessels and would be able to detect and avoid vessels.

2392. There would therefore be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

9.7.2.2.7 Impact 7: Disturbance at Seal Haul-Out Sites

2393. The closest seal haul-out sites are listed in **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report Table 12.2-13 and 12.2-15**. As the closest haul out (Filey Brigg) is 34km from landfall, 20km from the export cable corridor, 215km from Array Area, there would be no effects from O&M activities within the Array Area, only effects from vessels transiting to and from the Array Area.

2394. The annual vessel traffic that could potentially be passing seal haul-out sites during the O&M phase is projected to be lower than that during the construction period, with a maximum total number of 96 round trips per year during O&M. Vessels would use established vessel routes to the port and, where possible, transiting vessels would maintain distances of 500m or more off the coast, particularly in areas near known seal haul-out sites during sensitive periods.

2395. Therefore, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to disturbance at seal haul-out sites during the O&M phase.

9.7.2.2.8 Impact 8: Potential Effects of Changes to Prey Resource

2396. The potential impacts on fish species during O&M can result from temporary habitat loss / disturbance; permanent habitat loss; introduction of wind turbine foundations; scour protection and hard substrate; increased suspended sediments and sediment re-deposition; re-mobilisation of contaminated sediments; underwater noise; and EMF.

2397. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any impacts on prey species have the potential to affect marine mammals. A summary of the key effects to prey species (and their relevance for grey seal) is provided below.

2398. Habitat loss will occur during the lifetime of the Project as a result of structures, scour and external cable protection installed on the seabed. The introduction of hard substrate, such as wind turbine towers, foundations and associated scour protection and cable protection would increase habitat heterogeneity through the introduction of hard structures in an area predominantly characterised by sediment habitats. During operation of the Project, the estimated total permanent habitat loss would be up to 3.888km² in total. In **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** this is considered minor to negligible, depending on the species in the context of the amount of similar available habitat in the wider area.

2399. Increases in SSC within the water column and subsequent deposition onto the seabed may occur as a result of O&M activities. Disturbance caused by jack up vessel legs or anchors, as well as cable reburial and/or repair may result in small volumes of sediment being re-suspended. However, the volumes of sediment disturbed from such activities, as well as the overall duration of the disturbance, would be significantly less compared to construction.

2400. The electromagnetic attributes of EMFs have the potential to disrupt organs used for navigation and foraging within a number of fish species. EMFs can have attractive and repulsive effects, that can cause barrier effects dependent on the species and the spatial scale of EMF, for further information, see **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**. The cables will be buried, either within the seabed or under rock protection, resulting in a negligible impact zone for fish and shellfish.

2401. The introduction of various man-made structures such as foundations and scour protection in soft sediment areas increases and changes habitat availability and type, resulting in locally altered biodiversity as species are able to establish and thrive in previously hostile environments (Wilhelmsson *et al.*, 2006; Birchenough and Degraer, 2020). Physical structures provide a foundation for settling invertebrates, which increase the organic matter surrounding the structure, and underpin artificial reef ecosystems through 'bottom-up' control of productivity. Increasing nutrient availability and biomass presents opportunities for all fish and shellfish species, from top predators to detritivores (Raoux *et al.*, 2017).

2402. The benefit of this potential increase in prey availability to marine mammals has not yet been studied widely. However, the presence of an artificial reef does increase the abundance and biomass of species, and the increase in prey species availability increases the attractiveness of the area to predators (Devault *et al.*, 2017; Paxton *et al.*, 2022). Increasing habitat heterogeneity may benefit harbour porpoise, that have shown to prefer variations in seabed topography (Isojunno *et al.*, 2012, Brookes *et al.*, 2013, Stalder *et al.*, 2020).

2403. The introduction of new hard substrate in areas that are predominantly sandy or soft sediments may cause positive effects through potential habitat enhancement (Roach and Cohen, 2020).

2404. The effects arising during the operational phase of the Project are likely to be the same or less than those assessed for construction. The effects of changes to prey during operation would have **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal for the Project.

9.7.2.2.9 Impact 9: Barrier Effects from the Physical Presence of the Wind Farm During O&M

2405. There is unlikely to be the potential for any barrier effects upon the completion of construction, as it is predicted that marine mammals will return once the activity has been completed. Monitoring was conducted at the Horns Rev and Nysted OWFs in Denmark in 1999 and 2006 during operation (Diederichs *et al.*, 2008). The data showed that numbers of harbour porpoise within Horns Rev were slightly reduced compared to the wider area during the first two years of operation and found no effect on numbers after two years of operation. Though, it was not possible to conclude that the OWF was solely responsible for this change in abundance without analysing other dynamic environmental variables (Tougaard *et al.*, 2009).

2406. Lindeboom *et al* (2011) documented that harbour porpoise have been observed to foraging within operational wind farm sites indicating that the physical presence of the wind farm does not cause a barrier. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of marine mammals including seals in operational OWF sites.

2407. The effect significance for barrier effects due to the physical presence of the wind farm has therefore been assessed as having **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

9.7.2.3 Potential Effects During Decommissioning

2408. 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.

2409. Commitment ID CO21 (see **PEIR 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 impacts on grey seal 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.

2410. 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.

2411. 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.

2412. Therefore, the potential effects on grey seal during decommissioning are assumed to be the same or less than those assessed for construction due to the processes of decommissioning potentially being the reverse of the installation, without the need for piling.

9.7.3 Assessment of Potential Effects of the Project In-Combination

2413. The following in-combination assessment has been undertaken based on **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**, and **Section 12.8 of PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise**.

2414. The in-combination assessment considers other schemes and activities where the predicted effects have the potential to combine with the potential effects during construction of the Project. The construction phase has been assessed as the worst case for potential in-combination effects.

2415. The schemes screened into the in-combination assessment for grey seal are those that are located in the relevant MUs. Full information on the screening of effects considered for the in-combination assessment is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**. The in-combination screening for grey seal considers the same schemes as considered in the cumulative screening. For grey seal at the BNNC SAC, other OWFs were included in the assessment against the SAC population where the Carter *et al* (2022) densities for the individuals associated with the BNNC SAC show presence within the 5km x 5km grid cells that overlap with the other OWF (or where there is a presence of seals within the potential disturbance area of the other OWF, e.g. within 25km for other OWFs that may be piling).

2416. The in-combination effects assessed are outlined in **Section 4.5.3**.

2417. The in-combination screening identified that there is the potential for cumulative effects on grey seal as a result of disturbance from underwater noise during piling and other construction activities. Due to the low noise levels associated with operational OWFs, as the BEIS (2020) RoC HRA for the SNS SAC stated that there would no potential for significant effect from the operation of OWFs, alongside the construction of OWFs (BEIS, 2020), therefore all operational impacts have been screened out.

2418. Further information is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**.

9.7.3.1 In-Combination Impact 1: Disturbance from Underwater Noise

2419. The commitment to the mitigation measures agreed through the final MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) in grey seal. In light of this, and taking account of the type, scale and extent of potential effects arising from the Project assessment, it concluded **no adverse effect** on integrity for grey seal due to physical injury or PTS from construction (see **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**).

9.7.3.1.1 In-Combination Impact 1a: Assessment of Underwater Noise from Piling at Other OWFs

2420. One of the greatest potential noise sources during OWF construction is from pile driving. The in-combination assessment considers the potential disturbance of marine mammals during piling the Project, with the piling at other OWF schemes screened into the in-combination assessment.

2421. The CEA screening (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**) identified twelve projects with the potential for construction to take place at the same time as the construction of DBD. Of these twelve, five of them are shown to have grey seal associated with the BNNC SAC present within the relevant project areas. The worst-case scenario would be if the following OWFs were piling at the same time as the Project:

- Dogger Bank South East and West;
- Sheringham Shoal Extension;
- Dudgeon Extension; and
- Outer Dowsing.

2422. The potential piling period for the Project has been based on the widest likely range of offshore construction and piling dates, dependent on the construction scenario, as a precautionary approach. It should be noted that while the schemes included within the in-combination have the potential for piling to overlap with the Project, there is a great deal of uncertainty on when OWFs could be piling. This assessment is therefore considered the worst-case.

2423. Where possible, the CEA screening (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**) included consideration of the realistic potential for cumulative impacts during construction for the Project. For example, it is assumed that where OWF developers have more than one OWF, they are unlikely to develop more than one site at a time.

2424. The commitment to the mitigation agreed through the final MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) for all marine mammals.

2425. For grey seal, the Projects own disturbance assessment within the in-combination assessment is based on the reported disturbance range of harbour seal to piling. A potential disturbance range of 25km for seal species, with a potential disturbance area of 1,963.5km² has been used as the worst case.

2426. It should be noted that the potential areas of disturbance assume that there is no overlap in the areas of disturbance between different schemes and are therefore highly conservative.

2427. The approach to the in-combination for piling at OWFs is based on the potential for single piling at each OWF at the same time as single piling for the Project. This approach allows for some of the OWFs not to be piling at the same time, while others could be simultaneously piling. This is considered to be the most realistic worst-case scenario, as it is highly unlikely that all other OWFs would be simultaneously piling at exactly the same time as piling for the Project.

2428. It is important to note the actual duration for active piling time which could disturb marine mammals is only a very small proportion of the potential construction period, of up to approximately 25.1 days for the Project (based on 5.33hrs per pile for the Project), based on the estimated maximum duration to install individual piles.
2429. For grey seal, the potential worst-case scenario of other OWFs piling at the same time as the Project is assessed in **Table 9.98**. Less than 5% of the reference population could potentially be disturbed, therefore, there would be **no adverse effect** on the integrity of the BNNC SAC due to cumulative disturbance from piling.

Table 9.98 Quantitative Assessment for the Potential Disturbance of Grey Seal from Single Piling (25km) at Other OWFs at the Same Time as Piling For the Project

Project	Grey seal density (/km ²)	Maximum number of individuals potentially disturbed
Single piling at other OWFs that could be piling at the same time as DBD		
DBD	0.03	59
DBS (East)	0.032	63
DBS (West)	0.054	106
Dudgeon Extension Project ¹⁹	-	-
Outer Dowsing	-	342
Sheringham Shoal Extension ²¹	-	-
Total number of grey seal with DBD		570
Total number of grey seal without DBD		511
Percentage of BNNC SAC population (with DBD)		3.37%
Percentage of BNNC SAC population (without DBD)		3.02%

4. ¹⁹ SAC not screened in for the SEP & DEP RIAA therefore not included in the assessment here <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010109/EN010109-000432-5.4%20Report%20to%20Inform%20Appropriate%20Assessment.pdf>

2430. In practice, the potential temporary effects would be less than those predicted in this assessment as there is likely to be a great deal of variation in timing, duration, and hammer energies used throughout the various OWF project construction periods. In addition, not all individuals would be displaced over the entire potential disturbance range (25km) used within the assessments.

9.7.3.1.2 In-Combination Impact 1b: Assessment of Disturbance from Other Industries and Activities

2431. During the construction period for the Project, there is the potential for disturbance to marine mammals associated with other potential noise sources, including:
- Geophysical surveys;
 - Aggregate extraction and dredging;
 - Seismic surveys;
 - UXO clearance; and
 - Interlink cable.
2432. For the installation of oil and gas infrastructure, marine renewable schemes, and disposal sites, all potential schemes have been screened out. Further information on the CEA screening (and these results) are provided in **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**.
2433. To represent the presence of grey seal in the wider BNNC SAC the quantitative assessments, where the location of activities are unknown, this section are based on the average density estimate across the Carter *et al* (2022) relative density dataset for the BNNC SAC of 0.028/km².

9.7.3.1.2.1 Disturbance from Geophysical Surveys

2434. Based on BEIS (2020) as a precautionary worst-case, due to a lack of data on seal disturbance distances, the potential 3.77km disturbance range has been used. This results in a disturbance area of 434.9km² for one survey and 869.7km² for two geophysical surveys. It is currently not possible to estimate the location or number of potential OWF geophysical surveys that could be undertaken at the same time as construction and potential piling activity for the Project. It is therefore assumed, as a worst-case scenario, that there could potentially be up to two geophysical surveys in the North Sea at any one time, during construction of the Project.

2435. For up to two geophysical surveys undertaken at the same time as construction of the Project, with no other in-combination activities, up to 0.5% of the BNNC SAC population may be disturbed (**Table 9.99**).

Table 9.99 Quantitative Assessment for In-Combination Disturbance of Marine Mammals Due to Two Geophysical Surveys at OWFs

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.03	1963.495 (25km EDR)	59
Two geophysical surveys	0.028	869.7 (434.9 per survey)	25
Total number of grey seal with DBD			84 (0.5% of BNNC SAC)
Total seasonal effect area without DBD			25 (0.15% of BNNC SAC)

2436. There would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal as a result of disturbance due to underwater noise (other than piling) from the Project with geophysical surveys.

9.7.3.1.2.2 Disturbance from Aggregate Extraction and Dredging

2437. Seven aggregate/dredging projects have been screened in that could have potential cumulative disturbance impacts with piling taking place at the Project (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**):

- Greenwich Light East 473/1 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);
- Greenwich Light East 473/2 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);
- Inner Dowsing 481/1-2;
- Inner Owers North 488;
- Thames D 524;
- West Bassurelle 458; and
- West Bassurelle 464.

2438. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600m of the activities (Diederichs *et al.*, 2010). As a worst-case assessment, a disturbance range of 600m will be applied for the aggregate schemes at the same time as the Projects’ construction. A disturbance range of 600m would result in a potential disturbance area of 1.13km² for each project.

2439. Inner Dowsing 481/1-2 of the screened in aggregate schemes is the only scheme where the Carter *et al* (2022) densities for the individuals associated with the BNNC SAC show presence within the 5km x 5km grid cells that overlap with the scheme.

2440. For the potential for in-combination disturbance from aggregate and dredging schemes undertaken at the same time as construction of DBD, with no other in-combination activities, up to 0.4% of the BNNC SAC population may be disturbed (**Table 9.100**).

Table 9.100 Quantitative Assessment for In-Combination Disturbance of Grey Seal Due to Aggregate and Dredging Schemes

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.03	1963.495 (25km EDR)	59
Inner Dowsing 481/1-2	0.028	1.13	0.03
Total number of grey seal porpoise with DBD			59 (0.4%)
Total number of grey seal without DBD			0.03 (0.0002%)

9.7.3.1.2.3 Disturbance from Seismic Surveys

2441. It is currently not possible to estimate the number of potential seismic surveys that could be undertaken at the same time as construction and potential piling activity for the Project. As a precautionary approach, the potential for cumulative impacts from oil and gas seismic surveys has been screened into the CEA for further consideration. It was assumed, as a worst-case scenario, that there could potentially be two seismic surveys in the North Sea at any one time during construction (piling) of the Project.

2442. There is little available information on the potential for disturbance from seismic surveys for grey seal, however, observations of behavioural changes in other seal species have shown avoidance reactions up to 3.6km from the source for a seismic survey (Harris *et al.*, 2001). A more recent assessment of potential for disturbance to seal species, as a result of seismic surveys, shows potential disturbance ranges from 13.3km to 17.0km from source (BEIS, 2020). These ranges are based on modelled impact ranges, using the National Marine Fisheries Service Level B harassment threshold of 160dB, for a noise source of 3,070 cubic inches, 4,240 cubic inches, or 8,000 cubic inches.
2443. A potential disturbance range of 17.0km (or disturbance area of 4,426.9km² for one survey, and 8,853.8km² for up to two seismic surveys) will therefore be applied to grey seal due to a lack of species-specific information.
2444. For two seismic surveys, undertaken at the same time as construction of the Project, up to 1.82% of the BNNC SAC population may be disturbed (**Table 9.101**).

Table 9.101 Quantitative Assessment for In-Combination Disturbance of Grey Seal Due to up to Two Seismic Surveys

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.03	1963.495 (25km EDR)	59
Two seismic surveys	0.028	8,853.8	248
Total number of grey seal with DBD			307 (1.82%)
Total number of grey seal without DBD			248 (1.5%)

9.7.3.1.2.4 Disturbance From Subsea Cables and Pipelines

2445. Only one subsea pipeline has been screened into the in-combination assessment, Sea Link. This project is currently at scoping stage and therefore there is limited information available on potential effects and disturbance ranges for which to inform the in-combination assessment with the Project.
2446. However, this scheme is not located in the area identified to have connectivity with the BNNC SAC (based on the Carter *et al* (2022) BNNC SAC density mapping). Therefore, subsea cable and pipeline schemes are not considered further for the BNNC SAC.

9.7.3.1.2.5 Disturbance from UXO Clearance

2447. As for piling, the potential risk of PTS in marine mammals from in-combination effects has been screened out from further consideration in the CEA (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening** if there is the potential for any PTS, suitable mitigation would be put in place to reduce any risk to marine mammals. Therefore, the in-combination effects only consider potential disturbance effects.
2448. This assessment has been based on the potential for disturbance due to UXO clearance activities for other schemes, cumulatively with the construction of the Project.
2449. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity for the Project. In 2021 there were six cases of UXO detonations reported to the MNR in the North Sea, these occurred over a total of 16 days. This amount gives an average of less than one UXO detonation to occur within a year at any one time in the North Sea. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO detonation, even if they had overlapping UXO clearance operation durations. The in-combination assessment is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst-case), and one low-order detonation.
2450. The potential effect area during a single UXO clearance event, based on the modelled worst case effect range for the Project for TTS / fleeing response (weighted SEL) of 24km (1,809.5km²) for high-order clearance and 0.57km (1.02km²) for low-order clearance.
2451. However, as outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO, i.e. each blast lasting for a very short duration, marine mammals, including harbour porpoise, are not predicted to be significantly displaced from an area, any changes in behaviour, if they occur, would be an instantaneous response and short-term. Existing guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010a).
2452. **Table 9.102** presents the potential in combination area and the potential maximum number of grey seal disturbed.

Table 9.102 Quantitative Assessment for In-Combination Disturbance of Grey Seal For up to One Low Order and One High Order UXO Clearance

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.03	1963.495 (25km EDR)	59
One high order UXO clearance	0.028	1,809.5	51
One low order UXO clearance	0.028	1.02	0.03
Total number of grey seal with DBD			111 (0.65%)
Total number of grey seal without DBD			52 (0.3%)

9.7.3.1.2.6 Summary of In-Combination Impact 1: Assessment of Underwater Noise

2453. Each of the above described noise sources with the potential for disturbance on grey seal are quantitatively assessed together in **Table 9.103**.

Table 9.103 Quantitative Assessment for All Noisy Activities with the Potential for In-Combination Disturbance Effects for Grey Seal

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)
DBD piling	59 (0.4%)
Piling at other OWFs	511 (3.02%)
Geophysical surveys	25 (0.2%)
Aggregates and dredging	0.03 (0.0002%)
Seismic surveys	248 (1.5%)
Subsea cables	Screened out
UXO clearance	52 (0.3%)
Total number of grey seal with DBD (percentage of BNNC SAC)	895 (5.3%)

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)
Total number of grey seal without DBD (percentage of BNNC SAC)	836 (4.9%)

2454. For grey seal, for noisy activities with the potential for in-combination disturbance effects together with piling for the Project, 5.3% of the BNNC SAC population is at risk of disturbance. Therefore, there **is the potential for an adverse effect** on integrity of the BNNC SAC in relation to grey seal, either alone or when in-combination with other schemes.

2455. Behavioural effects from UXO clearance, if they occur, would be an instantaneous response and short-term. Guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010) and therefore could be excluded from the total.

2456. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations. The in-combination is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst case), as well as one low-order clearance event.

2457. It should be noted that while the schemes included within the in-combination assessment for disturbance from other activities and industries were included based on the current knowledge of their possible construction or activity windows, it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the grey seal that could be at risk of disturbance during the offshore construction period of the Project.

9.7.3.2 In-Combination Impact 2: Barrier Effects

2458. For the assessment of the potential for barrier effects due to underwater noise from schemes undergoing construction, the effect to marine mammal species would be as per the assessments provided in **Section 9.7.3.1.2**, for in-combination disturbance effects due to all noisy activities.

2459. It is important to note that the OWFs and other noise sources included in the in-combination assessment are spread over the wider area of the North Sea. Taking into account the locations of the OWFs and other noise sources from the Project, the maximum underwater effect ranges for disturbance at other schemes would not overlap with the maximum underwater effect ranges for disturbance for the Project during piling and construction. Therefore, there is no potential for underwater noise from the Project, other OWFs and noise sources to result in a barrier of movement to marine mammals.
2460. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect, and therefore has not been considered within this in-combination assessment.
2461. Therefore, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal.

9.7.3.3 In-Combination Impact 3: Increased Collision Risk with Vessels

2462. The in-combination effects from an increase in the number of vessels and vessel movements can pose a potential collision risk for grey seal.
2463. As outlined in **Sections 9.7.2.1.6** (construction) and **Section 9.7.2.2.6** (operation), vessels would be intermittently present throughout the lifetime of the Project. As vessel movements to and from any port would be incorporated within existing vessel routes as far as possible, there would be no increased collision risk, as the increase in the number of OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas. Once on-site, OWF vessels and other construction-related vessels would be stationary or slow-moving as they undertake their associated activities.
2464. Vessel operators for the Project, North Falls (SSE & RWE, 2024), Sheringham Shoal and Dudgeon Extension (Equinor, 2022) will also follow best practices outlined in the **Outline PEMP (document reference 8.6)** to further reduce collision risks. Hornsea Four (Orsted, 2021) and Outer Dowsing (Outer Dowsing Offshore Wind, 2024) adopt a Vessel Management Plan (VMP) to minimise the potential for any impact. West of Orkney (Offshore Wind Power Limited, 2023), Five Estuaries (Five Estuaries OWF Limited, 2024) and Rampion 2 (Rampion 2 Wind Farm, 2023) adopt a best practice vessel handling protocols such as the WiSe Scheme or Guide to Best Practice for Watching Marine Wildlife. It is expected that other offshore projects and industries will adopt similar measures to mitigate the potential for marine mammal collisions, with Hornsea THREE (Orsted, 2018), Dogger Bank A and B (Forewind, 2014) and South (East and West) (RWE, 2024) also committed to these practices.

2465. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low. Increased collision risk from aggregate extraction and dredging has therefore been screened out from further consideration in the CEA.
2466. In addition, based on the assumption that grey seal would be disturbed as a result of underwater noise from piling, other construction activities, operational and maintenance activities and vessels, there should be no potential for increased collision risk with vessels.
2467. Therefore, there would be **no adverse effect** on integrity of the BNNC SAC in relation to the conservation objectives for grey seal due to an increase in collision risk with construction vessels.

9.7.3.4 In-Combination Impact 4: Changes in Prey Resource

2468. Potential effects on prey species for the Project were assessed in **Section 9.7.2.1.8** (construction) and **Section 9.7.2.2.8** (operation). **No adverse effect** on integrity of the BNNC SAC in relation to the conservation objectives for grey seal was concluded. Any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat in the surrounding area. This will be the case for all schemes and therefore although the in-combination effects are additive, the effect would be proportionate to the wider range over which effects would occur.
2469. Therefore, there would be **no adverse effect** on the integrity of the BNNC SAC in relation to the conservation objectives for grey seal arising due to changes in prey availability.

9.7.4 Summary of Potential Effects on Site Integrity

2470. The assessment of the potential effects for the Project has been summarised in relation to the BNNC SAC conservation objectives for grey seal.
2471. The MMMP will provide mitigation or management measures to reduce the potential for any significant disturbance of grey seal as a result of in-combination effects from underwater noise.
2472. There would be **no adverse effect** on integrity of the BNNC SAC in relation to the conservation objectives for grey seal, either alone or when in-combination with other schemes.

9.8 Isle of May SAC

9.8.1 Site Description

2473. The Isle of May (IoM) SAC has been recognised as an SAC since March 2005 and is designated by the UK. The SAC is a designated site for the marine mammals grey seal (Natura 2000, 2015).
2474. The IoM SAC covers an area of 356.64km². The SAC’s closest point to the Array Area is 350km.

9.8.1.1 Qualifying Feature

9.8.1.1.1 Grey Seal

2475. Carter *et al* (2022) produced habitat-based predictions of at-sea distribution for grey seals in the British Isles. The resultant density of seals at-sea maps shows the relative density of seals in each 5km by 5km grid cell. As well as the total grey seals at-sea densities, Carter *et al* (2022) provide SAC specific densities. These SAC specific densities provide the relative density of grey seal that are associated with each SAC. These SAC specific density estimates have been used to calculate the density of grey seal, associated with the IoM SAC, present within the Array Area (**Figure 9-8**). This effectively apportions the potential for effect to only those seals that are affected that are associated with the SAC itself.
2476. The highest mean at sea relative density estimates of grey seal for Array Area, and the offshore ECC, calculated from Carter *et al* (2022) are:
- 0.00027 individuals per km² for Array Area;
 - 0.00029 individuals per km² for the offshore ECC.
2477. The assessments are based on mean relative density estimates for the IoM SAC from (Carter et al., 2022) as a worst-case. The corrected SAC grey seal count was used to generate absolute densities from the relative density data of Carter et al (2022) (**Figure 9-8**). This at-sea population number is 332, based on the total population of grey seal at the IoM SAC (of 386, as provided in **Table 9.104**), and calculating against a correction factor of 0.2515 to take account of those individuals at sea only.

Table 9.104 Grey Seal Counts and Population Estimates

Population area	Grey seal haul-out count	Source of haul-out count data	Correction factor for seals not available to count	Grey seal SAC population
IoM SAC	97	SCOS (2022)	0.2515	386

2478. Assessments are undertaken against the SAC population estimate of 386 seals, for both the project alone and in-combination.

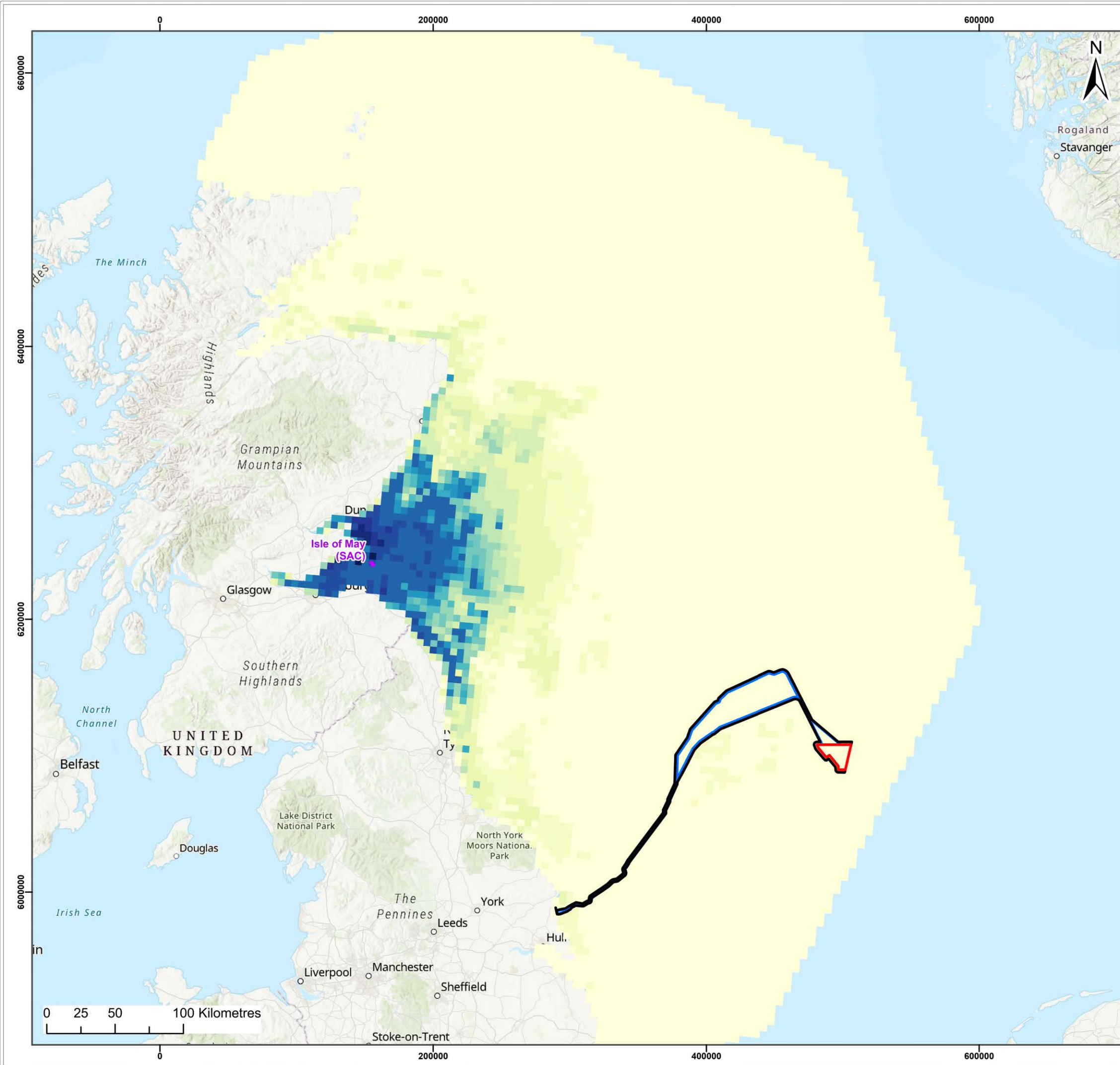
9.8.1.2 Conservation Objectives

2479. The Conservation Objectives are (Scottish Natural Heritage, 2006) “*To avoid deterioration of the habitats of qualifying species (Grey seal Halichoerus grypus) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interests.*”
2480. *To ensure for the qualifying species that the following are maintained in the long term:*
- *Population of the species as a viable component of the site;*
 - *Distribution of the species within site;*
 - *Distribution and extent of habitats supporting the species;*
 - *Structure, function and supporting processes of habitats supporting the species; and*
 - *No significant disturbance of the species.”*

9.8.2 Assessment of Potential Effects of the Project Alone

9.8.2.1 Potential Effects During Construction

2481. Potential effects during construction may arise through disturbance from activities during the installation of offshore infrastructure. Underwater noise during piling, as well as disturbance associated with underwater noise from other construction activities and the presence of vessels offshore, are considered. Potential displacement from important habitat areas and impacts on prey species are also considered.
2482. The potential effects during construction assessed for grey seals are the same as those described in **Section 9.7.2.1**.



Legend:

- Dogger Bank D Array Area
- Offshore Export Cable Corridor
- Offshore Development Area
- Isle of May Special Area of Conservation (SAC)

Mean Grey Seal At-Sea Usage (% per 25km²)

0 - 0.005	0.031 - 0.04
0.0051 - 0.01	0.041 - 0.05
0.011 - 0.02	0.051 - 0.06
0.021 - 0.03	0.061 - 0.07
	0.071 - 0.08
	0.081 - 0.09
	0.091 - 0.1
	0.11 - 0.25
	0.251 - 0.5
	0.51 - 0.75
	0.751 - 1.0
	1.01 - 2.0

Source: © Haskoning DHV UK Ltd, 2025; © JNCC, 2025; © Carter *et al.*, 2022
© OpenStreetMap (and) contributors, CC-BY-SA

Project:

Dogger Bank D Offshore Wind Farm

Title:

Grey Seal At-Sea Mean Densities for Those Individuals Associated With The Isle of May (SAC)

Figure:	9-8	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0528			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:	
01	04/02/2025	FC	KF	A3	1:2,750,000	

Co-ordinate system: WGS 1984 UTM Zone 31N

9.8.2.1.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Impact Piling During Construction

2483. Underwater noise modelling was carried out by SubAcoustech to estimate the noise levels likely to arise during piling and determine the maximum potential areas of effect (see **PEIR Volume 2, Appendix 12-3 Underwaters Noise Modelling Report** and **Section 9.4.2.1.1** for further details).

9.8.2.1.1.1 PTS from A Single Strike

2484. The underwater noise modelling results for the predicted effect ranges and areas for PTS from a single strike of the maximum hammer energy for the worst-case location have been assessed (**Table 9.105**).

Table 9.105 The Predicted Effect Ranges For PTS, At The Worst Case Modelling Location For Seals, For The Maximum Hammer Energies Of Both Monopiles And Pin Piles

Marine mammal species	Potential effect ranges (and areas) for PTS at the maximum hammer energy	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Grey seal	0.06km (0.01km ²)	0.05km (0.01km ²)

2485. An assessment of the maximum number of individuals that could be at risk of instantaneous PTS, due to a single strike at the maximum hammer energy, for both monopiles and jacket pin piles, is presented in **Table 9.106**.

Table 9.106 Assessment of the Potential for Instantaneous PTS Due to a Single Strike of the Maximum Hammer Energy for a Monopile and Jacket Pin Pile

Marine mammal species	Assessment of effect
PTS due to a single strike of a monopile at maximum hammer energy (Sound pressure level (SPL _{peak}))	
Grey seal	0.000003 (0.0000008%)
PTS due to a single strike of a jacket pin pile at maximum hammer energy (SPL _{peak})	
Grey seal	0.000003 (0.0000008%)

2486. The maximum potential number of grey seal that could be at possible risk of PTS due to a single strike at the maximum hammer energy, for monopiles and jacket pin piles, without any mitigation is 0.000003 individuals (0.0000008% of the IoM SAC reference population, based on the array density estimate).

9.8.2.1.1.2 PTS From Cumulative Exposure

2487. The SEL_{cum} is a measure of the total received noise over the whole piling operation. The SEL_{cum} range indicates the distance from the piling location that if the receptor were to start fleeing in a straight line from the noise source starting at a range closer than the modelled range it would receive a noise exposure in excess of the criteria threshold, and if the receptor were to start fleeing from a range further than the modelled range it would receive a noise exposure below the criteria threshold.

2488. **Table 9.107** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of monopiles and jacket pin piles at the worst-case location.

Table 9.107 Predicted Effect Ranges (and Areas) for PTS for Seals, At the Worst Case Modelling Location, for the Cumulative Exposure of Both Monopiles and Pin Piles

Scenario	Potential effect ranges (and areas) for PTS due to cumulative exposure	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Multiple sequential pile installations in a 24 hour period	0.73km (1.6km ²)	0.43km (0.53km ²)

2489. It is important to note that the assessment for PTS from cumulative exposure is highly precautionary. There is some variation in the potential impact ranges for SEL_{cum} at each location and between locations, therefore in many cases less individuals would be at risk of exposure than presented here (as the assessments are based on the worst-case location). It is also unlikely that the maximum hammer energy would be required at all piling locations for the entire duration of the piling activity.

2490. An assessment of the maximum number of grey seal that could be at risk of cumulative PTS, for both sequential monopiles and jacket pin piles, is presented in **Table 9.108**, based on the effect areas as presented in **Table 9.107**.

Table 9.108 Assessment of the Potential for PTS Due to the Cumulative Exposure of Sequential Monopiles or Jacket Pin Piles in a 24 Hour Period for Seals

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of two sequential monopiles in a 24-hour period (SEL _{cum})	0.0004 (0.0001% of IoM SAC)
PTS due to the cumulative exposure of four sequential jacket pin piles in a 24-hour period (SEL _{cum})	0.0001 (0.00004% IoM SAC)

2491. In the worst case 0.0004 individuals (0.0001% of the IoM SAC reference population, based on the array density estimate) could be at risk of cumulative PTS due to the cumulative exposure of two sequential monopiles in a 24-hour period.

9.8.2.1.1.3 PTS From Cumulative Exposure from Multiple Piling Locations

2492. The simultaneous piling scenario assumes that animals are within potential effect ranges for a much longer period (i.e. they would be travelling from one pile location to another which piling is ongoing), and therefore cumulative effect ranges are much larger than for the cumulative exposure ranges of one pile at a time.

2493. The potential effect ranges are not possible to model under this scenario, as there are two starting points for receptors, and it is not possible to determine the potential range at which they need to be in order to not be at risk of effect. Therefore, the following assessment is based on the potential areas of effect only.

2494. Where the potential effect areas are not large enough to interact with each other (i.e. they do not meet), the results for the respective locations and scenarios are used (the results of the modelling for the Southeast and Northwest locations are used to inform the assessment, to align with the modelling locations used for the simultaneous modelling).

2495. **Table 9.109** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of simultaneous monopiles at the NW and SE modelling locations. These locations were chosen as they have the potential for the largest 'spread' in terms of underwater noise propagation. The modelling includes two monopiles being installed sequentially at each location at the same time.

Table 9.109 The Predicted Effect Area For PTS For Seals at the NW and SE Modelling Locations, for the Cumulative Exposure of Multiple Monopiles Installations at the Same Time

Scenario	Potential effect areas for PTS due to cumulative exposure of simultaneous pile installations
	Monopile (8,000kJ)
Multiple sequential pile installations in a 24-hour period (for the NW and SE modelling locations together)	110km ²

2496. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for simultaneous monopiles is presented in **Table 9.110**, based on the effect areas as presented in **Table 9.109**.

Table 9.110 Assessment of the Potential for PTS Due to the Cumulative Exposure of Simultaneous Monopiles at the Same Time

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of simultaneous monopile installations (SEL _{cum})	0.03 (0.008% of IoM SAC)

2497. There would be **no adverse effect** of PTS in grey seal from pile installation on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.1.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Impact Piling During Construction

2498. The range of possible behavioural reactions that may occur as a result of exposure to noise include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases, panic, or stranding, sometimes resulting in injury or death (Southall *et al.*, 2008).

2499. There are currently no agreed thresholds or criteria for the behavioural response and disturbance of grey seal, therefore it is not possible to conduct underwater noise modelling to predict impact ranges.

2500. Disturbance from construction activities (including piling) may have behavioural consequences on grey seal in the study area, including reduced time spent foraging at sea as animals move away from sources of noise, displacement from vessels, etc. Repeated disruptions can have cumulative negative effects on the bioenergetic budget of marine species, with the potential for long-term effects on survival and reproductive rates (Christiansen *et al.*, 2013).

2501. Hastie *et al* (2021) studied the change in foraging behaviour of grey seal when exposed to underwater noise. A high density and low density area of prey was present within an experimental pool, and speakers were located at each prey patch. During the control periods, seals would forage mainly at the high-density patch, but also at the low-density patch for a smaller proportion of time. When the seals were exposed to noise at the low density patch, there was a reduction in foraging of 16-28%, however, when seals were exposed to noise at the high density prey patch, there was no change in foraging in comparison to control periods. This indicates that seals would choose to remain at a noisy environment, if there were good prey resources at the same location.

2502. Russell (2016), have shown that grey seal are present in significantly reduced number up to a distance of 25km during piling (or a disturbance area of 1,963.5km²). This range has therefore been used to determine the number of grey seal that may be disturbed during piling at Array Area (**Table 9.111**).
2503. A distance of 25km during piling Russell (2016) (or a disturbance area of 1,963.5km²) has been used to determine the number of grey seals that may be disturbed during monopiling for the Project. To assess for disturbance of a single jacket pin pile foundation, the recommended EDR of 15km (706.86km²) for harbour porpoise (Graham *et al.*, 2019) has been used as a precautionary impact range for grey seals.

Table 9.111 Assessment of the Potential for Disturbance to Grey Seal Based on a Disturbance Range of 25km for Both Monopiles and Jacket Pin Piles

Potential disturbance range and area	Assessment of effect	Potential adverse effect on site integrity
One Monopile		
25km, with a disturbance area of 1,963.5km ²	0.5 (0.1% of IoM SAC)	No Less than 5% of the population affected.
One Jacket pin pile foundation		
15km, with a disturbance area of 706.86km ²	0.2 (0.05% of IoM SAC)	No Less than 5% of the population affected.

2504. For disturbance based on the known effect ranges, there would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.1.2.1 Dose-Response Assessment

2505. The dose-response methodology is outlined in **Section 13.5 in PEIR Volume 2, Appendix 12.6 Information and Modelling Methods for Disturbance**. The dose-response approach has been undertaken for all piling locations, with the highest resultant number of individuals disturbed presented in this assessment.
2506. The estimated numbers of grey seal and the corresponding percentage of the IoM SAC population that could be disturbed as a result of underwater noise during piling, based on the worst-case foundation and location, is presented in **Table 9.112**.

Table 9.112 Number of Individuals (and % of Reference Population) That Could Be Disturbed During Piling of Monopiles Based on the Dose-Response Approach

Number of individuals disturbed (monopiles) (% of reference population)	Number of individuals disturbed (pin-piles) (% of reference population)
0.6 (0.2% of IoM SAC)	0.6 (0.2% of IoM SAC)

9.8.2.1.2.2 Potential disturbance from ADD activation

2507. During 9 minutes of ADD activation, grey seal would move at least 0.81km from the ADD location (based on a precautionary marine mammal swimming speed of 1.5m/s; Otani *et al.*, 2000), resulting in a potential disturbance area of 8km². This is further than the maximum instantaneous PTS range for monopiles predicted for grey seal. For pin piles the ADD activation required would be 5 minutes to cover the maximum PTS range of 0.43km, resulting in a potential disturbance area of 4.4km².
2508. The estimated numbers (and percentage of the relevant reference populations) of grey seal disturbed as a result of underwater noise during piling after ADD is presented in **Table 9.113**.

Table 9.113 Assessment of the Potential for Disturbance due to ADD Activation Based for Monopiles or Jacket Pin Piles for the Project

Piling Scenario	Assessment of effect	Potential adverse effect on site integrity
Monopiles	0.002 (0.0006% of the IoM SAC)	No. Less than 5% of the population affected
Pin piles	0.001 (0.0003% of IoM SAC)	

2509. The population affected by disturbance from underwater noise at the Project is less than 5%. Therefore, there would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to disturbance or behaviour effects from increased underwater noise during construction (piling) for the Project.

9.8.2.1.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.8.2.1.3.1 Impact 3a: Permanent auditory injury (PTS) Due to Other Construction Activities

2510. Potential sources of underwater noise during construction activities, other than piling, include seabed preparation, dredging, rock placement, trenching and cable installation.

2511. Dredging / cable installation activities have the potential to generate underwater noise at sound levels and frequencies for sufficient durations to disturb marine mammals. Reviews of published sources of underwater noise during dredging activity (Theobald *et al.*, 2011; Thomsen *et al.*, 2006; Todd *et al.*, 2015), indicate that the sound levels that grey seals may be exposed to during dredging activities are typically below permanent auditory injury thresholds (PTS) exposure criteria (as defined in Southall *et al* (2019)). Therefore, the potential risk of any auditory injury in marine mammals as a result of dredging activity is highly unlikely.
2512. The noise levels produced by dredging activity / cable installation, could overlap with the hearing sensitives and communication frequencies used by marine mammals (Todd *et al.*, 2015), and therefore have the potential to impact grey seals present in the area.
2513. The potential for PTS effects that could result from underwater noise during other construction activities, including cable laying and protection would be temporary in nature, not consistent throughout the offshore construction period for the Project and would be limited to only part of the overall construction period and area at any one time.
2514. The assessment for impacts from underwater noise resulting from other construction activities is shown in **Table 9.114**.

Table 9.114 Predicted Impact Ranges (and Areas) for Auditory Injury from 24 Hour Cumulative Exposure During Other Construction Activities

Criteria and threshold (Southall <i>et al.</i> , 2019)	Cable laying	Dredging (backhoe and suction (individually))	Trenching	Rock placement	All activities
SEL _{cum} Weighted (153 dB re 1 µPa²s) Non-impulsive	0.1km (0.03km²)	<0.1km (<0.03km²)	<0.1km (<0.03km²)	<0.1km (<0.03km²)	0.12km²

2515. The number of grey seal that could be impacted as a result of underwater noise during construction activities other than piling is presented in **Table 9.115** has been assessed based on the number of animals that could be present in each of the modelled impact ranges.

Table 9.115 Maximum Number of Individuals (and % of Reference Population) That Could be Impacted as a Result of Underwater Noise Associated with Non-Piling Construction Activities

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
PTS for each individual activity			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.000008 (0.000002% of IoM SAC based on array density estimate) 0.000009 (0.000002% of IoM SAC based on ECC density estimate)	No. Less than 1% of the population affected
PTS for all activities at the same time (4 activities)			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.000003 (0.000009% of IoM SAC based on array density estimate) 0.000004 (0.000009% of IoM SAC based on ECC density estimate)	No. Less than 1% of the population affected

2516. The population affected by auditory injury during other construction activities from underwater noise at the Project is less than 1%. Therefore, there would be no adverse effects on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to auditory injury from increased underwater noise during other construction for the Project.

9.8.2.1.3.2 Impact 3b: Permanent auditory injury (PTS) Due to Construction Vessels

2517. **Table 9.116** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS from the cumulative exposure of vessels within the site. For SEL_{cum} calculations, the duration of the noise is also considered, with noise present for a worst case of 24-hours in a day.

Table 9.116 The Predicted Effect Ranges for Cumulative PTS for Vessels in All Marine Mammal Species

Marine mammal species	Potential effect ranges (and areas) for PTS Medium of large vessels
Grey seal	<100m (0.031km ²)

2518. The results of the underwater noise modelling do not define effect ranges of <100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably lower).

2519. The results of the underwater noise modelling (**Table 9.116**) indicate that any grey seal would have to be <100m (precautionary maximum range) from the continuous noise source for 24 hours, to be exposed to noise levels that could induce PTS. It is therefore highly unlikely that any individual would be at risk of PTS due to vessel noise. It should be noted that the predicted impact ranges are the distances which represent the ‘onset’ stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.

2520. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in **Table 9.117**, based on the effect areas as presented in **Table 9.116**.

Table 9.117 Assessment of the Potential for PTS Due to Medium and Large Vessels

Marine mammal species	Assessment of effect
Grey seal	0.000008 (0.000002% of IoM SAC based on array density estimate) 0.000009 (0.000002% of IoM SAC based on ECC density estimate)

2521. Given the small number of individuals affected, there would be **no adverse effect** of PTS in grey seal from vessels on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

2522. There is the potential that up to 90 vessels may be present in the Offshore Development Area at any one-time during construction. As a worst case and unlikely scenario, an assessment for all 90 vessels has also been undertaken with the assessment split between the Array Area and offshore ECC using the relevant density estimates.

2523. The assessment considers the following assessments:

- Up to 35 vessels within the Array Area;
- Up to 55 vessels in the offshore ECC; and
- The combined number of affected animals for 90 vessels.

2524. **Table 9.118** presents the potential areas of PTS for the maximum construction vessels at any one time, of 90 vessels.

Table 9.118 The Predicted Effect Areas For Cumulative PTS, For Multiple Construction Vessels For All Marine Mammal Species

Area	Potential effect areas for PTS
Array Area	1.1km ²
Offshore ECC	1.7km ²
Combined total	2.79km ²

2525. An assessment of the maximum number of individuals that could be at risk of PTS, due to the maximum number of construction vessels at any one time is presented in **Table 9.119**, based on the effect areas as presented in **Table 9.118**.

Table 9.119 Assessment of the Potential for PTS Due to Multiple Construction Vessels

Area	Assessment of effect
Array Area	0.0003 (0.00008% of IoM SAC)
Offshore ECC	0.0005 (0.0001% of IoM SAC)
Combined total	0.0008 (0.0002% of IoM SAC)

2526. Given the small number of individuals affected, there would be **no adverse effect** of PTS in grey seal from vessels on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.1.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.8.2.1.4.1 Impact 4a: Disturbance effects due to other construction activities

2527. Underwater noise as a result of dredging activity / cable installation has the potential to disturb marine mammals (Pirodda *et al.*, 2014). Therefore, there is the potential for short, perhaps medium-term behavioural reactions and disturbance to grey seal in the area during dredging / cable installation activity. Grey seals may exhibit varying behavioural reactions intensities as a result of exposure to noise (Southall *et al.*, 2008).
2528. Grey seals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.
2529. If the response is displacement from the area, it is predicted that grey seals will return once the activity has been completed and therefore any impacts from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on grey seal.
2530. There is limited data on the potential for a behavioural response or disturbance from other construction activities (or other continuous noise sources). A review of various studies was used to determine the maximum potential disturbance range for other construction activities and vessels. As discussed earlier, Benhemma-Le Gall *et al* (2021), reported a 4km (50.3km²) reduction in harbour porpoise presence for other construction activities, including vessels. As harbour porpoise are the most sensitive marine mammal species, this 4km potential disturbance range has been used for grey seal as a worst case, in the absence of any other data to inform an assessment.
2531. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities based on the 4km potential disturbance range is presented in **Table 9.120** for one activity occurring or four activities happening at the same time.
2532. The population disturbed during other construction activities from underwater noise at the Project is less than 5%. Therefore, there would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to disturbance from increased underwater noise during other construction for the Project.

Table 9.120 Assessment of the Potential for Disturbance Due to Other Construction Activities, Including Cable Laying, Suction Dredging, Cable Trenching, and Rock Placement, for One Activity Taking Place at Any One Time for the Project

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
Disturbance for each individual activity			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.01 (0.004% of IoM SAC for both array and ECC density estimates)	No. Less than 5% of the population affected
Disturbance for four activities at the same time for the Project			
Grey seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.05 (0.01% of IoM SAC based on ECC density estimate) 0.06 (0.02% of IoM SAC based on ECC density estimate)	No. Less than 5% of the population affected

9.8.2.1.4.2 Impact 4b: Disturbance effects due to construction vessels

2533. The assessment on disturbance effects due to construction vessels has been based on the same methods as described in **Section 9.4.2.1.4 Impact 4b**.
2534. The assessments are undertaken based on the maximum number of vessels being present at any one time, which is only likely to occur occasionally.

2535. The disturbance assessment based on one vessel is equivalent to that for one construction activity. This scenario has already been assessed in **Table 9.120** and has therefore not been repeated here.
2536. The disturbance caused by 55 individual vessels within the offshore ECC, would cover a total area of 2,764km², not taking into consideration any potential overlap of the 4km disturbance ranges with other nearby vessels. To account for that, 55 vessels were randomly distributed in the offshore ECC, using QGIS v.3.38. If an overlap in the disturbance areas of multiple adjacent vessels was identified, this area removed from the total area of effect to account for that. Therefore, a potential area of disturbance of 2,500km² has been identified for the worst-case of 55 construction vessels, as shown in the **PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise, Section 12.7.1.4.2.2**.
2537. Assuming the disturbance caused by 35 vessels within the Array Area would not overlap with that of other vessels, the total disturbed area would be 1,759km². This is significantly larger than the Array Area itself, which has a total area of 262km². Therefore, the actual maximum area of effect would be the Array Area with a 4km buffer a 4km buffer (equating to an area of 613km²), as all vessels would be within the Array Area. Therefore, the assessment in **Table 9.121** represents the maximum possible disturbance area of the Array Area, including a 4km buffer.

Table 9.121 Maximum Number of Individuals (and % of Reference Population) That Could Be Disturbed as a Result of Underwater Noise Associated with Construction Vessels at the Project

Component specific density	Maximum number of individuals (% of reference population) for 55 vessels in the offshore ECC (2,500km ²)	Maximum number of individuals (% of reference population) for Array Area, including a 4km buffer (613km ²)	Maximum number of individuals (% of reference population) for all construction vessels in the offshore ECC and Array Area
Array Area	-	0.2 (0.04% of IoM SAC)	1 (0.3% of IoM SAC)
Offshore ECC	0.7 (0.2% of IoM SAC)	-	

2538. Whilst short to medium term behavioural responses have been recorded from vessel disturbance, there are no long-term or population level effects recorded to date. Less than 5% of the reference population is affected, therefore, it is considered that there would be **no adverse effect** from disturbance from underwater noise associated with vessels on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.1.5 Impact 5: Barrier Effects from Underwater Noise During Construction

2539. Underwater noise during construction could have the potential to create a barrier effect, preventing movement or migration of grey seals between important feeding and / or breeding areas, or potentially increasing swimming distances if marine mammals avoid the site and go around it. The potential barrier effects on grey seal has been assessed in **Section 9.7.2.1.5**, the conclusions of the effect on the integrity of the BNNC would be the same as those on the IoM SAC.
2540. Therefore, it has been assessed that any disturbance and any barrier effects would be temporary and for a relatively short duration (i.e. during active piling). As it is predicted that grey seals will return once the activity has been completed, and therefore any effects from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of grey seal.
2541. There would be no significant disturbance of grey seal and **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to potential barrier effects from increased underwater noise during construction of the Project.

9.8.2.1.6 Impact 6: Increased Risk of Collision with Vessels during construction

2542. During offshore construction, there will be an increase in vessel traffic within the Array Area and offshore ECC. Vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. Vessel operators will use best practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever possible and avoiding close proximity to seal haul-out sites. The potential increased risk of collision with vessel effects on grey seal has been assessed in **Section 9.7.2.1.6**, the conclusions of the effect on the integrity of the BNNC SAC would be the same as those on the IoM SAC.
2543. Therefore, there would be minimal increase to collision risk of grey seal and **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to potential vessel collision risk during construction for the Project.

9.8.2.1.7 Impact 7: Disturbance at Seal Haul-Out Sites

2544. The IoM SAC is located, at closest point, 350km from Array Area. The main grey seal haul out site is Donna Nook which is 63km from landfall, 61km from the offshore ECC, 240km from Array Area at closest distance. The closest seal haul-out site is Filey Brigg which is 34km from landfall, 20km from the offshore ECC, 215km from Array Area. Therefore, there would be no effects from construction activities within the Offshore Development Area, only effects from vessels transiting to and from the Offshore Development Area.

2545. The potential disturbance at seal haul-out sites effects on grey seal has been assessed in **Section 9.7.2.1.7**, the conclusions of the effect on the integrity of the BNNC would be the same as those on the IoM SAC.

2546. Therefore, if the vessels committed to keep at least a distance of 500m from the shore, there would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to disturbance at seal haul-out sites during construction for the Project.

9.8.2.1.8 Impact 8: Potential Effects of Changes to Prey Resource

2547. The potential effects on prey species during construction can result from:

- Physical seabed disturbance;
- Increased SSC and sediment re-deposition;
- Remobilisation of contaminated sediments;
- Underwater noise and vibration; and
- Changes in fishing activity.

2548. As discussed in the SNS SAC section (**Section 9.4.2.1.7**), **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any reductions in prey availability would be small scale, localised and temporary. It is considered highly unlikely that potential reductions in prey availability as a result of construction activities at the Project would result in detectable changes to grey seal populations.

2549. Grey seal feed on a variety of prey species and are considered to be opportunistic feeders, feeding on a wide range of prey species and they have relatively large foraging ranges (see **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report**).

2550. The potential impacts of physical disturbance, temporary habitat loss, increased SSC, re-mobilisation of contaminated sediment, underwater noise and vibration and changes in fishing activity on changes in prey availability are localised and short in duration. Therefore, there will be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to potential changes in prey availability during construction for the Project.

9.8.2.1.9 Impact 9: Potential effects of changes to water quality

2551. Potential changes in water quality during construction could occur through:

- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations, and array, cables;
- Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and Offshore Platforms;
- Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
- Deterioration in water quality associated with release of sediment bound contaminants.

2552. Marine mammals often inhabit turbid environments and cetaceans utilise sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly (Todd *et al.*, 2014).

2553. Increased turbidity is unlikely to have a direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely.

2554. Potential changes in water quality during construction would have **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal for the Project.

9.8.2.2 Potential effects during O&M

2555. The potential effects during O&M that have been assessed for are outlined in **Section 4.5.3**.

9.8.2.2.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Operational Wind Turbine Noise

2556. Underwater noise modelling was undertaken by Subacoustech to estimate the noise levels likely to arise during the operational phase (**PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report**) and determine the potential effects on marine mammals.

2557. The risk of injury (defined as onset of PTS) is given as occurring in a range of <100m (**Table 9.122**), a highly precautionary range, and within which the animal would need to stay for a 24 hour period for sufficient noise exposure to result in an effect. Such an occurrence is extremely unlikely and would be atypical behaviour for such a highly mobile species.

Table 9.122 Predicted Effect Ranges (and Areas) for PTS from 24 hour Cumulative Exposure of Underwater Noise from Operational Turbines

Species	Impact	Operational wind turbine	Area of impact for up to 113 Wind turbines
Grey seal	PTS	<0.1km (0.031km ²)	3.55km ²

2558. The maximum number of individuals that could be at risk of PTS, due to a single operational WTG, is 0.000008 grey seal (0.000002% of the IoM SAC reference population), based on the array density estimate.

2559. More than one WTG will be operating at the same time, and therefore an assessment of the potential for auditory injury, due to all operational WTGs, is required. There is the potential for 113 WTGs to be installed for the Project.

2560. The potential areas of PTS for all operational WTGs for grey seal is 3.55km².

2561. An assessment of the maximum number of individuals that could be at risk of PTS from all operational WTGs is 0.001 grey seal (0.0002% of the IoM SAC reference population), based on the array density estimate.

2562. There would be **no adverse effect** of PTS in grey seal from operational WTG noise on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.2.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Operational Wind Turbine Noise

2563. The potential disturbance from operational wind turbine noise with vessel effects on grey seal has been assessed in **Section 9.7.2.2.2**, the conclusions of the effect on the integrity of the BNNC SAC would be the same as those on the IoM SAC.

2564. Based on the available literature for examining disturbance of grey seals and operational wind farms, because the noise levels associated with operational wind turbines are low and continuous, a precautionary low significance of effect has been given to all marine mammal species, including grey seals, for the Project.

2565. Therefore, there would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to disturbance from operational wind turbine noise for the Project.

9.8.2.2.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.8.2.2.3.1 Impact 3a: Permanent Auditory Injury (PTS) Due to Other O&M Activity

2566. The requirements for any potential O&M activities, such as additional rock placement or cable re-burial, are currently unknown, however the work required, and associated effects to grey seal, would be less than those during construction. **Section 9.7.2.1.3** provides an assessment for the same activities during construction, concluding that there is no potential for a significant effect as a result of the Project.

2567. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities, and if the marine mammal remains within close proximity for 24 hours. Therefore, it is highly unlikely for there to be any PTS due to these activities.

2568. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase.

2569. Therefore, there would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to physical and auditory injury from underwater noise associated with O&M activities as a result of the Project.

9.8.2.2.3.2 Impact 3b: Permanent Auditory Injury (PTS) Due to O&M Vessels

2570. During the O&M of the Project, there may be up to 19 vessels in the Offshore Development Area at any one time, compared to the 35 vessels that would be on site during construction. Therefore, the potential effects associated with underwater noise and disturbance from vessels during O&M would be less than of those during construction (as assessed in **Section 9.7.2.1.3**). As a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst-case scenario.

2571. There would therefore be **no adverse effect** of PTS in grey seal from vessels on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.2.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.8.2.2.4.1 Impact 4a: Disturbance Effects Due to Other O&M Activities

2572. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. The requirements for any potential maintenance work are currently unknown, however, the work required, and impacts associated with underwater noise and disturbance from activities during O&M would be less than those during construction. As there is expected to be less noisy activities during the operation phase than is required during construction, it is therefore likely to cause less disturbance to foraging behaviours in grey seal.

2573. Therefore, the potential for adverse effect due to underwater noise from O&M activities is considered to be the same or less than that assessed for underwater noise from other construction activities (including rock placement, trenching and cable laying) (as assessed in **Section 9.7.2.1.4**).

2574. The effect significance for disturbance effects due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.2.4.2 Impact 4b: Disturbance Effects Due to O&M Vessels

2575. The requirements for any potential maintenance work are currently unknown, however the work required, and impacts associated with underwater noise and disturbance from vessels during O&M would be less than those during construction.

2576. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be 16, which is less than the 35 vessels that could be on site during construction. However, as a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst case scenario.

2577. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.

There would therefore be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.2.5 Impact 5: Underwater Noise: Barrier Effects During O&M

2578. The indicative minimum separation distance between turbines would be a minimum of 0.826km to 1.416km, depending on WTG size, therefore there would be no overlap in the potential impact range (PTS; **Table 9.105**) of <100m around each turbine, and there would be adequate room for marine mammals to move through the Array Area.

2579. Therefore, no barrier effects as a result of underwater noise during O&M are anticipated, and no further assessment is required.

9.8.2.2.6 Impact 6: Increased Risk of Collision with Vessels During O&M

2580. The increased risk of marine mammal collision with operational and maintenance vessels would be the same or less than what was assessed for the construction period (**Section 9.7.2.1.6**), given the number of vessels required would be lower.

2581. During the O&M phase, the maximum number of vessels that could be present in the Project offshore components at any one time has been estimated as 16 vessels (**Table 9.2**). The number, type and size of vessels would vary, depending on the activities taking place at any one time and are typically slow moving or stationary.

2582. The potential increased risk of collision with vessels during operation effects on grey seal has been assessed in **Section 9.7.2.2.6**, the conclusions of the effect on the integrity of the BNNC would be the same as those on the IoM SAC.

2583. There would therefore be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.2.7 Impact 7: Disturbance at Seal Haul-Out Sites

2584. The closest seal haul-out sites are listed in **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report Table 12.2-13 and Table 12.2-15**. As the closest haul out (Filey Brigg) is 34km from landfall, 20km from the export cable corridor, 215km from Array Area, there would be no effects from O&M activities within the Offshore Development Area, only effects from vessels transiting to and from the Project.

2585. The annual vessel traffic that could potentially be passing seal haul-out sites during the O&M phase is projected to be lower than that during the construction period, with a maximum total number of 96 round trips per year during O&M. Vessels would use established vessel routes to the port and, where possible, transiting vessels would maintain distances of 500m or more off the coast, particularly in areas near known seal haul-out sites during sensitive periods.

2586. Therefore, there would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal due to disturbance at seal haul-out sites during the O&M phase.

9.8.2.2.8 Impact 8: Potential Effects of Changes to Prey Resource

2587. The potential impacts on fish species during O&M can result from temporary habitat loss / disturbance; permanent habitat loss; introduction of wind turbine foundations; scour protection and hard substrate; increased suspended sediments and sediment re-deposition; re-mobilisation of contaminated sediments; underwater noise; and EMF. The potential changes to prey resource effects on grey seal has been assessed in **Section 9.7.2.2.8**, the conclusions of the effect on the integrity of the BNNC would be the same as those on the IoM SAC.

2588. The effects of changes to prey during operation would have **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal for the Project.

9.8.2.2.9 Impact 9: Barrier Effects from the Physical Presence of the Wind Farm During O&M

2589. There is unlikely to be the potential for any barrier effects upon the completion of construction, as it is predicted that marine mammals will return once the activity has been completed. The potential barrier effects on grey seal have been assessed in **Section 9.7.2.2.5**, the conclusions of the effect on the integrity of the BNNC would be the same as those on the IoM SAC.

2590. The effect significance for barrier effects due to the physical presence of the wind farm has therefore been assessed as having **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.2.3 Potential effects during decommissioning

2591. 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.

2592. Commitment ID CO21 (see **PEIR 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 impacts on grey seal 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.

2593. 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.

2594. 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.

2595. Therefore, the potential effects on grey seal during decommissioning are assumed to be the same or less than those assessed for construction due to the processes of decommissioning potentially being the reverse of the installation, without the need for piling.

9.8.3 Assessment of Potential Effects of the Project In-Combination

2596. The following in-combination assessment has been undertaken based on **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**, and **Section 12.8 of PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise**.

2597. The in-combination assessment considers other schemes and activities where the predicted effects have the potential to combine with the potential effects during construction of the Project. The construction phase has been assessed as the worst case for potential in-combination effects.

2598. The schemes screened into the in-combination assessment for grey seal are those that are located in the relevant MUs. Full information on the screening of effects considered for the in-combination assessment is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**. The in-combination screening for grey seal considers the same schemes as considered in the cumulative screening. For grey seal at the IoM SAC, other OWFs were included in the assessment against the SAC population where the Carter *et al* (2022) densities for the individuals associated with the IoM SAC show presence within the 5km x 5km grid cells that overlap with the other OWF (or where there is a presence of seals within the potential disturbance area of the other OWF, e.g. within 25km for other OWFs that may be piling).

2599. The in-combination effects assessed are outlined in **Section 4.5.3**.

2600. The in-combination screening identified that there is the potential for cumulative effects on grey seal as a result of disturbance from underwater noise during piling and other construction activities. Due to the low noise levels associated with operational OWFs, as the BEIS (2020) RoC HRA for the SNS SAC stated that there would no potential for significant effect from the operation of OWFs, alongside the construction of OWFs (BEIS, 2020), therefore all operational impacts have been screened out.

2601. Further information is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**.

9.8.3.1 In-Combination Impact 1: Disturbance from Underwater Noise

2602. The commitment to the mitigation measures agreed through the final MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) in grey seal. In light of this, and taking account of the type, scale and extent of potential effects arising from the Project assessment, it concluded **no adverse effect** on integrity for grey seal due to physical injury or PTS from construction (see **Section 9.8.2.1.1**).

9.8.3.1.1 In-Combination Impact 1a: Assessment of Underwater Noise from Piling at Other OWFs

2603. One of the greatest potential noise sources during OWF construction is from pile driving. The in-combination assessment considers the potential disturbance of marine mammals during piling for the Project, with the piling at other OWF schemes screened into the in-combination assessment.

2604. The CEA screening (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**) identified twelve projects with the potential for construction to take place at the same time as the construction of the Project. Of these twelve, five of them are shown to have grey seal associated with the IoM SAC present within the project areas. The worst-case scenario would be if the following OWFs were piling at the same time as the Project:

- Dogger Bank South (East);
- Dogger Bank South (West);
- Sheringham Shoal Extension;
- Dudgeon Extension; and
- Outer Dowsing.

2605. The potential piling period for the Project has been based on the widest likely range of offshore construction and piling dates, dependent on the construction scenario, as a precautionary approach. It should be noted that while the schemes included within the in-combination have the potential for piling to overlap with the Project, there is a great deal of uncertainty on when OWFs could be piling. This assessment is therefore considered the worst-case.

2606. Where possible, the CEA screening (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**) included consideration of the realistic potential for cumulative impacts during construction of the Project. For example, it is assumed that where OWF developers have more than one OWF, they are unlikely to develop more than one site at a time.

2607. All of the other OWFs included in the in-combination assessment listed above have not screened in the IoM SAC into their HRA assessments for grey seal, therefore no in-combination assessment with these projects' will be undertaken. The results of the in-combination are therefore the same as the Project alone assessments for piling disturbance.

9.8.3.1.2 In-Combination Impact 1b: Assessment of Disturbance from Other Industries and Activities

2608. During the construction period for the Project, there is the potential for disturbance to marine mammals associated with other potential noise sources, including:

- Geophysical surveys;
- Aggregate extraction and dredging;
- Seismic surveys;
- UXO clearance; and
- Interlink cable.

2609. For the installation of oil and gas infrastructure, marine renewable schemes, and disposal sites, all potential schemes have been screened out. Further information on the CEA screening (and these results) are provided in **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**.

2610. To represent the presence of grey seal in the quantitative assessments, where the location of activities is unknown, this section are based on the average density estimate across all the OWF projects screened in for piling effects using the Carter *et al* (2022) relative density dataset for the IoM SAC of 0.00026/km². The density for the IoM SAC area has not been applied as it represents a particularly small area, located 350km away from the Array Area. Whereas using an average of projects screened in gives an average of the wider area at distances much closer to the Offshore Development Area.

9.8.3.1.2.1 Disturbance from Geophysical Surveys

2611. Based on BEIS (2020) as a precautionary worst-case, due to a lack of data on seal disturbance distances, the potential 3.77km disturbance range has been used. This results in a disturbance area of 434.9km² for one survey and 869.7km² for two geophysical surveys. It is currently not possible to estimate the location or number of potential OWF geophysical surveys that could be undertaken at the same time as construction and potential piling activity for the Project. It is therefore assumed, as a worst-case scenario, that there could potentially be up to two geophysical surveys in the North Sea at any one time, during construction of the Project.
2612. For up to two geophysical surveys undertaken at the same time as construction of the Project, with no other in-combination activities, up to 0.52% of the IoM SAC population may be disturbed (Table 9.123).

Table 9.123 Quantitative Assessment for In-Combination Disturbance of Marine Mammals Due to Two Geophysical Surveys at OWFs

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.00027	1963.495 (25km EDR)	1
Two geophysical surveys	0.00026	869.7 (434.9 per survey)	0.23
Total number of grey seal with DBD			2 (0.52% of IoM SAC)
Total number of grey seal without DBD			0.23 (0.06% of IoM SAC)

2613. There would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal as a result of disturbance due to underwater noise (other than piling) from the Project with geophysical surveys.

9.8.3.1.2.2 Disturbance From Aggregate Extraction and Dredging

2614. Seven aggregate/dredging projects have been screened in that could have potential cumulative disturbance impacts with piling taking place at the Project (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**):
- Greenwich Light East 473/1 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);
 - Greenwich Light East 473/2 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);

- Inner Dowsing 481/1-2;
- Inner Owers North 488;
- Thames D 524;
- West Bassurelle 458; and
- West Bassurelle 464.

2615. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600m of the activities (Diederichs *et al.*, 2010). As a worst-case assessment, a disturbance range of 600m will be applied for the aggregate schemes at the same time as the Projects' construction. A disturbance range of 600m would result in a potential disturbance area of 1.13km² for each project.
2616. Inner Dowsing 481/1-2 of the screened in aggregate schemes is the only scheme where the Carter *et al* (2022) densities for the individuals associated with the IoM SAC show presence within the 5km x 5km grid cells that overlap with the scheme.
2617. For the potential for in-combination disturbance from aggregate and dredging schemes undertaken at the same time as construction of DBD, with no other in-combination activities, up to 0.52% of the IoM SAC population may be disturbed (Table 9.124).

Table 9.124 Quantitative Assessment for In-Combination Disturbance of Grey Seal Due to Aggregate and Dredging Schemes

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.00027	1963.495 (25km EDR)	1
Inner Dowsing 481/1-2	0.00026	1.13	0.00029
Total number of grey seal porpoise with DBD			2 (0.52%)
Total number of grey seal without DBD			0.00029 (0.0001%)

9.8.3.1.2.3 Disturbance from Seismic Surveys

2618. It is currently not possible to estimate the number of potential seismic surveys that could be undertaken at the same time as construction and potential piling activity for the Project. As a precautionary approach, the potential for cumulative impacts from oil and gas seismic surveys has been screened into the CEA for further consideration. It was assumed, as a worst-case scenario, that there could potentially be two seismic surveys in the North Sea at any one time during construction (piling) of the Project.
2619. There is little available information on the potential for disturbance from seismic surveys for grey seal, however, observations of behavioural changes in other seal species have shown avoidance reactions up to 3.6km from the source for a seismic survey (Harris *et al.*, 2001). A more recent assessment of potential for disturbance to seal species, as a result of seismic surveys, shows potential disturbance ranges from 13.3km to 17.0km from source (BEIS, 2020). These ranges are based on modelled impact ranges, using the National Marine Fisheries Service Level B harassment threshold of 160dB, for a noise source of 3,070 cubic inches, 4,240 cubic inches, or 8,000 cubic inches.
2620. A potential disturbance range of 17.0km (or disturbance area of 4,426.9km² for one survey, and 8,853.8km² for up to two seismic surveys) will therefore be applied to grey seal due to a lack of species-specific information.
2621. For two seismic surveys, undertaken at the same time as construction of the Project, up to 1.04% of the IoM SAC population may be disturbed (**Table 9.125**).

Table 9.125 Quantitative Assessment for In-Combination Disturbance of Grey Seal Due to up to Two Seismic Surveys

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.00027	1963.495 (25km EDR)	1
Two seismic surveys	0.00026	8,853.8	3
Total number of grey seal with DBD			4 (1.04%)
Total number of grey seal without DBD			3 (0.86%)

9.8.3.1.2.4 Disturbance From Subsea Cables and Pipelines

2622. Only one subsea pipeline has been screened into the in-combination assessment, Sea Link. This project is currently at scoping stage and therefore there is limited information available on potential effects and disturbance ranges for which to inform the in-combination assessment of the Project.
2623. However, this scheme is not located in the area identified to have connectivity with the IoM SAC (based on the Carter *et al* (2022) IoM SAC density mapping). Therefore, subsea cable and pipeline schemes are not considered further for the IoM SAC.

9.8.3.1.2.5 Disturbance from UXO Clearance

2624. As for piling, the potential risk of PTS in marine mammals from in-combination effects has been screened out from further consideration in the CEA (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening** if there is the potential for any PTS, suitable mitigation would be put in place to reduce any risk to marine mammals. Therefore, the in-combination effects only consider potential disturbance effects.
2625. This assessment has been based on the potential for disturbance due to UXO clearance activities for other schemes, cumulatively with the construction of the Project.
2626. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity for the Project. In 2021 there were six cases of UXO detonations reported to the MNR in the North Sea, these occurred over a total of 16 days. This amount gives an average of less than one UXO detonation to occur within a year at any one time in the North Sea. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO detonation, even if they had overlapping UXO clearance operation durations. The in-combination assessment is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst-case), and one low-order detonation.
2627. The potential effect area during a single UXO clearance event, based on the modelled worst case effect range for the Project for TTS / fleeing response (weighted SEL) of 24km (1,809.5km²) for high-order clearance and 0.57km (1.02km²) for low-order clearance.
2628. However, as outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO, i.e. each blast lasting for a very short duration, marine mammals, including harbour porpoise, are not predicted to be significantly displaced from an area, any changes in behaviour, if they occur, would be an instantaneous response and short-term. Existing guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010a).

2629. **Table 9.126** presents the potential in combination area and the potential maximum number of grey seal disturbed.

Table 9.126 Quantitative Assessment for In-Combination Disturbance of Grey Seal For up to One Low Order and One High Order UXO Clearance

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.00027	1963.495 (25km EDR)	1
One high order UXO clearance	0.00026	1,809.5	0.47
One low order UXO clearance	0.00026	1.02	0.00027
Total number of grey seal with DBD			2 (0.52%)
Total number of grey seal without DBD			0.5 (0.13%)

9.8.3.1.2.6 Summary of In-combination Impact 1: Assessment of Underwater Noise

2630. Each of the above described noise sources with the potential for disturbance on grey seal are quantitatively assessed together in **Table 9.127**.

Table 9.127 Quantitative Assessment for All Noisy Activities with the Potential for In-Combination Disturbance Effects For Grey Seal

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)
DBD piling	1 (0.29%)
Piling at other OWFs	-
Geophysical surveys	0.13 (0.03%)
Aggregates and dredging	0.00029 (0.0001%)
Seismic surveys	0.5 (0.13%)
Subsea cables	Screened out
UXO clearance	0.5 (0.13%)

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)
Total number of grey seal with DBD (percentage of IoM SAC)	4 (1%)
Total number of grey seal without DBD (percentage of IoM SAC)	3 (0.8%)

2631. For grey seal, for noisy activities with the potential for in-combination disturbance effects together with piling for the Project, 1% of the IoM SAC population is at risk of disturbance. Therefore, there would be **no adverse effect** on integrity of the IoM SAC in relation to grey seal, either alone or when in-combination with other schemes.

2632. Behavioural effects from UXO clearance, if they occur, would be an instantaneous response and short-term. Guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010) and therefore could be excluded from the total.

2633. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations. The in-combination is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst case), as well as one low-order clearance event.

2634. It should be noted that while the schemes included within the in-combination assessment for disturbance from other activities and industries were included based on the current knowledge of their possible construction or activity windows, it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the grey seal that could be at risk of disturbance during the offshore construction period of DBD.

9.8.3.2 In-Combination Impact 2: Barrier Effects

2635. For the assessment of the potential for barrier effects due to underwater noise from schemes undergoing construction, the effect to marine mammal species would be as per the assessments provided in **Section 9.8.3.1.2**, for in-combination disturbance effects due to all noisy activities.

2636. It is important to note that the OWFs and other noise sources included in the in-combination assessment are spread over the wider area of the North Sea. Taking into account the locations of the OWFs and other noise sources from the Project, the maximum underwater effect ranges for disturbance at other schemes would not overlap with the maximum underwater effect ranges for disturbance as a result of the Project during piling and construction. Therefore, there is no potential for underwater noise from the Project, other OWFs and noise sources to result in a barrier of movement to marine mammals.
2637. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect, and therefore has not been considered within this in-combination assessment.
2638. Therefore, there would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal.

9.8.3.3 In-Combination Impact 3: Increased Collision Risk with Vessels

2639. The in-combination effects from an increase in the number of vessels and vessel movements can pose a potential collision risk for grey seal.
2640. As outlined in **Section 9.7.2.1.6** (construction) and **Section 9.7.2.2.6** (operation), vessels would be intermittently present throughout the lifetime of the Project. As vessel movements to and from any port would be incorporated within existing vessel routes as far as possible, there would be no increased collision risk, as the increase in the number of OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas. Once on-site, OWF vessels and other construction-related vessels would be stationary or slow-moving as they undertake their associated activities.
2641. Vessel operators for the Project, North Falls (SSE & RWE, 2024), Sheringham Shoal and Dudgeon Extension (Equinor, 2022) will also follow best practices outlined in the **PEIR Outline PEMP (document reference 8.6)** to further reduce collision risks. Hornsea Four (Orsted, 2021) and Outer Dowsing (Outer Dowsing Offshore Wind, 2024) adopt a Vessel Management Plan (VMP) to minimise the potential for any impact. West of Orkney (Offshore Wind Power Limited, 2023), Five Estuaries (Five Estuaries OWF Limited, 2024) and Rampion 2 (Rampion 2 Wind Farm, 2023) adopt a best practice vessel handling protocols such as the WiSe Scheme or Guide to Best Practice for Watching Marine Wildlife. It is expected that other offshore projects and industries will adopt similar measures to mitigate the potential for marine mammal collisions, with Hornsea THREE (Orsted, 2018), Dogger Bank A and B (Forewind, 2014) and South (East and West) (RWE, 2024) also committed to these practices.

2642. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low. Increased collision risk from aggregate extraction and dredging has therefore been screened out from further consideration in the CEA.
2643. In addition, based on the assumption that grey seal would be disturbed as a result of underwater noise from piling, other construction activities, operational and maintenance activities and vessels, there should be no potential for increased collision risk with vessels.
2644. Therefore, there would be **no adverse effect** on integrity of the IoM SAC in relation to the conservation objectives for grey seal due to an increase in collision risk with construction vessels.

9.8.3.4 In-Combination Impact 4: Changes in Prey Resource

2645. Potential effects on prey species for the Project were assessed in **Section 9.7.2.1.8** (construction) and **Section 9.7.2.2.8** (operation). **No adverse effect** on integrity of the IoM SAC in relation to the conservation objectives for grey seal was concluded. Any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat in the surrounding area. This will be the case for all schemes and therefore although the in-combination effects are additive, the effect would be proportionate to the wider range over which effects would occur.
2646. Therefore, there would be **no adverse effect** on the integrity of the IoM SAC in relation to the conservation objectives for grey seal arising due to changes in prey availability.

9.8.4 Summary of Potential Effects on Site Integrity

2647. The assessment of the potential effects for the Project has been summarised in relation to the IoM SAC conservation objectives for grey seal.
2648. The MMMP will provide mitigation or management measures to reduce the potential for any significant disturbance of grey seal as a result of in-combination effects from underwater noise.
2649. There would be **no adverse effect** on integrity of the IoM SAC in relation to the conservation objectives for grey seal, either alone or when in-combination with other schemes.

9.9 The Wash and North Norfolk Coast SAC

9.9.1 Site Description

2650. The Wash, located on the east coast of England, is the largest embayment in the UK, and the extensive intertidal flats both within The Wash, and extending along the north Norfolk coast, provide ideal conditions for harbour seal breeding and haul-out sites. Harbour seal are a primary reason for the designation of The Wash and North Norfolk Coast SAC.
2651. The Wash and North Norfolk Coast (WNNC) SAC is located, at closest point, 244km from the closest point at Array Area. Therefore, there is no potential for direct effects on the SAC as a result of the construction, operation, maintenance or decommissioning of Array Area. However, due to the foraging range of harbour seals, there is the potential for effects on foraging harbour seal from The Wash and North Norfolk Coast SAC in the vicinity of the Project.

9.9.1.1 Qualifying Feature

9.9.1.1.1 Harbour Seal

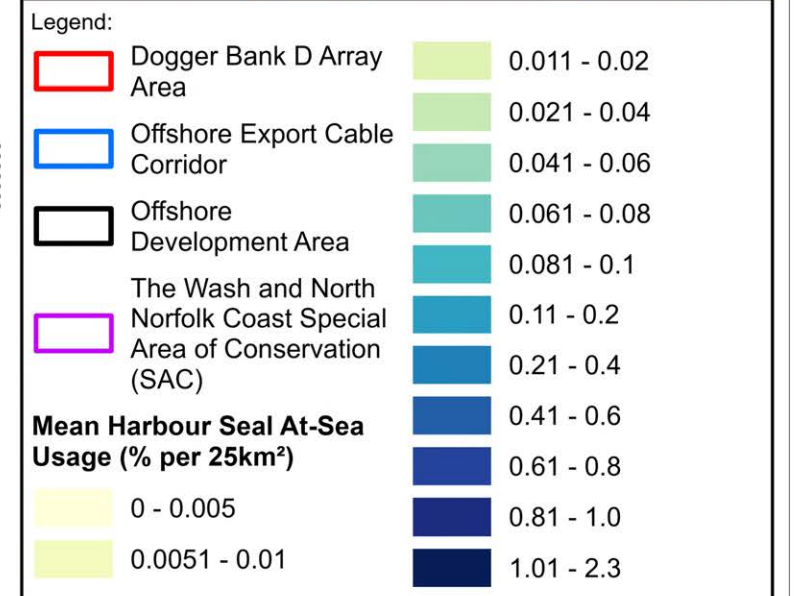
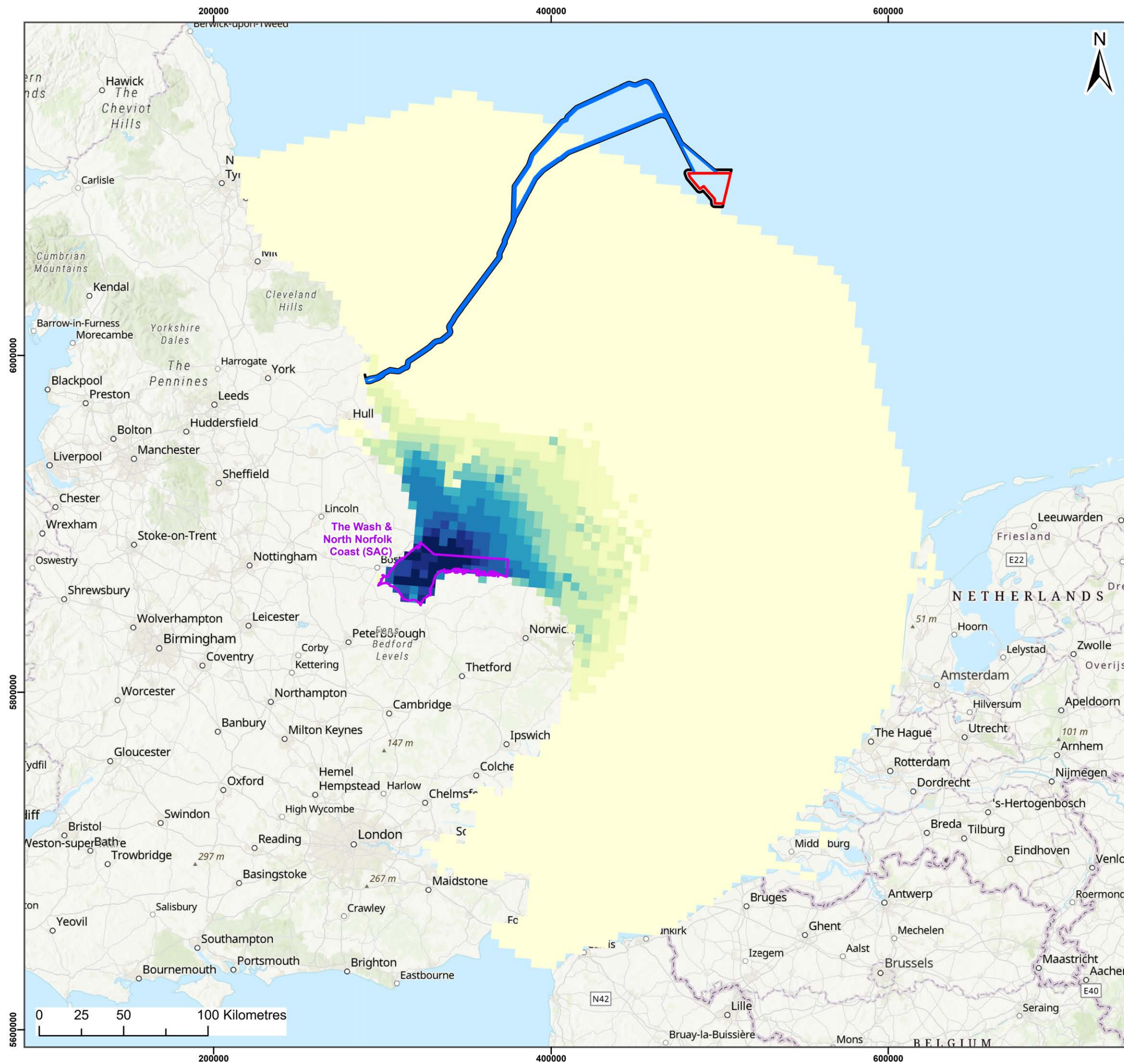
2652. Principal harbour seal haul-out sites in WNNC SAC include Blakeney Point and The Wash (SCOS, 2022).
2653. In the 2021 August seal haul-out count for The Wash sites and Blakeney Point, an average of 2,667 harbour seal were counted within The Wash, and an average of 181 harbour seals at the Blakeney Points site, with a total average count of 2,848 for the haul-out sites associated with The Wash and North Norfolk Coast SAC (SCOS, 2022).
2654. No harbour seal sightings were confirmed during the site-specific aerial surveys. However, there was a total of 15 unidentified seal species recorded in DBD through the 24 survey dates, a proportion of which could be harbour seal (although the majority are expected to be grey seal).
2655. Due to the absence of harbour seal sightings, absolute density and abundance estimates were not possible to derive from the site-specific surveys.
2656. The harbour seal density estimates for the development area have been calculated from the latest seal at sea maps produced by SMRU (Carter *et al.*, 2022). This is based on the 5km x 5km grids that overlap each area and using the density data for the WNNC SAC. This effectively apportions the potential for effect to only those seals that are associated with the SAC itself.

2657. The total harbour seal at sea population in the British Isles is approximately 42,900 individuals, based on the corrected values and most recent haul-out counts for the UK (SCOS, 2022). The total at-sea harbour seal population for The Wash has been estimated as 3,956, based on the total population of harbour seal of this SAC (provided in **Figure 9-9** and **Table 9.128**), and calculating against a correction factor of 0.72 (Lonergan *et al.*, 2013) to take account of those individuals at sea only. This is the population estimate used with the Carter *et al* (2022) data to calculate density estimates. The worst-case density estimates have been applied to these assessments, therefore the density estimate 0.00049 per km² for the offshore ECC has been used.

Table 9.128 Harbour Seal Counts and Population Estimates

Population area	Harbour seal haul-out count	Source of haul-out count data	Correction factor for seals not available to count	Harbour seal SAC population
Total SAC population	2,848	SCOS, 2022	0.72	3,956

2658. The mean at sea density estimates for the areas are:
- 0.000001 individuals per km² for the Array Area; and
 - 0.00049 individuals per km² for the offshore ECC.
2659. There are indications of a current decline in the numbers of harbour seal in the Wash. The assessments are based on the current harbour seal counts at the time of writing. However, any assessments will be based on the latest harbour seal counts at that time to take account of any changes.



Source: © Haskoning DHV UK Ltd, 2025; © JNCC, 2025; © Carter *et al.*, 2022
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Project:
Dogger Bank D Offshore Wind Farm

DOGGER BANK
WIND FARM

Title:
Harbour Seal At-Sea Mean Densities for Those Individuals Associated With The Wash and North Norfolk Coast (SAC)

Figure: 9-9 Drawing No: PC6250-RHD-XX-OF-DR-GS-0529

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	04/02/2025	FC	KF	A3	1:2,250,000

Co-ordinate system: WGS 1984 UTM Zone 31N

9.9.1.2 Conservation Objectives

2660. The Conservation Objectives (Natural England, 2023b) are:

2661. *“To ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring:*

- *The extent and distribution of qualifying natural habitats and habitats of qualifying species;*
- *The structure and function (including typical species) of qualifying natural habitats;*
- *The structure and function of the habitats of qualifying species;*
- *The supporting processes on which qualifying natural habitats and habitats of qualifying species rely;*
- *The populations of qualifying species; and*
- *The distribution of qualifying species within the site.”*

2662. For harbour seal within The Wash and North Norfolk Coast SAC, the specific targets are to:

- Maintain the population size within the site;
- Maintain the reproductive and recruitment capability of the species;
- Maintain the presence and spatial distribution of the species and their ability to undertake key life stage and behaviours;
- Maintain connectivity of the habitat within sites and the wider environment to allow movement of migratory species;
- Restrict the introduction and spread of non-native species and pathogens, and their impacts;
- Maintain the extent and spatial distribution of the following supporting habitats; foraging and haul-out sites;
- Maintain the abundance of preferred food items required by the species;
- Maintain the natural physio-chemical properties of the water;
- Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement is not significantly altered or constrained;
- Restrict aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels;

- Maintain water quality to mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features avoiding deterioration from existing levels; and
- Maintain natural levels of turbidity (e.g. suspended concentrations of sediment, plankton and other material) in areas where this species is, or could be present.

2663. Due to the decline in the harbour seal population within the WNNC SAC, Natural England are in the process of updating the Conservation Objectives of the SAC.

9.9.2 Assessment of Potential Effects of the Project Alone

9.9.2.1 Potential Effects During Construction

2664. Potential effects during construction may arise through disturbance from activities during the installation of offshore infrastructure. Underwater noise during piling, as well as disturbance associated with underwater noise from other construction activities and the presence of vessels offshore, are considered. Potential displacement from important habitat areas and impacts on prey species are also considered.

2665. The potential effects during construction assessed for harbour seals are outlined in **Section 4.5.3**.

9.9.2.1.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Impact Piling During Construction

2666. Underwater noise modelling was carried out by SubAcoustech to estimate the noise levels likely to arise during piling and determine the maximum potential areas of effect (see **PEIR Volume 2, Appendix 12-3 Underwaters Noise Modelling Report** and **Section 9.4.2.1.1** for further details).

9.9.2.1.1.1 PTS from a single strike

2667. The underwater noise modelling results for the predicted effect ranges and areas for PTS from a single strike of the maximum hammer energy for the worst-case location have been assessed (**Table 9.129**).

Table 9.129 The Predicted Effect Ranges For PTS, At The Worst-Case Modelling Location For Seals, For The Maximum Hammer Energies Of Both Monopiles And Pin Piles

Marine mammal species	Potential effect ranges (and areas) for PTS at the maximum hammer energy	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Harbour seal	0.06km (0.01km ²)	0.05km (0.01km ²)

2668. An assessment of the maximum number of individuals that could be at risk of instantaneous PTS, due to a single strike at the maximum hammer energy, for both monopiles and jacket pin piles, is presented in **Table 9.130**.

Table 9.130 Assessment of the Potential for Instantaneous PTS Due to a Single Strike of the Maximum Hammer Energy for a Monopile and Jacket Pin Pile

Marine mammal species	Assessment of effect
PTS due to a single strike of a monopile at maximum hammer energy (Sound pressure level (SPL _{peak}))	
Harbour seal	0.00000001 (0.000000001% of WNNC SAC)
PTS due to a single strike of a jacket pin pile at maximum hammer energy (SPL _{peak})	
Harbour seal	0.00000001 (0.000000001% of WNNC SAC)

2669. The maximum potential number of harbour seal that could be at possible risk of PTS due to a single strike at the maximum hammer energy, for monopiles and jacket pin piles, without any mitigation is 0.00000001 harbour seal 0.000000001% of WNNC SAC reference population, based on the array density estimate).

9.9.2.1.1.2 PTS from cumulative exposure

2670. The SEL_{cum} is a measure of the total received noise over the whole piling operation. The SEL_{cum} range indicates the distance from the piling location that if the receptor were to start fleeing in a straight line from the noise source starting at a range closer than the modelled range it would receive a noise exposure in excess of the criteria threshold, and if the receptor were to start fleeing from a range further than the modelled range it would receive a noise exposure below the criteria threshold.

2671. **Table 9.131** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of monopiles and jacket pin piles at the worst-case location.

Table 9.131 Predicted Effect Ranges (and Areas) for PTS for Seals, At the Worst Case Modelling Location, for the Cumulative Exposure of Both Monopiles and Pin Piles

Scenario	Potential effect ranges (and areas) for PTS due to cumulative exposure	
	Monopile (8,000kJ)	Jacket pin pile (5,000kJ)
Multiple sequential pile installations in a 24 hour period	0.73km (1.6km ²)	0.43km (0.53km ²)

2672. It is important to note that the assessment for PTS from cumulative exposure is highly precautionary. There is some variation in the potential impact ranges for SEL_{cum} at each location and between locations, therefore in many cases less individuals would be at risk of exposure than presented here (as the assessments are based on the worst-case location). It is also unlikely that the maximum hammer energy would be required at all piling locations for the entire duration of the piling activity.

2673. An assessment of the maximum number of harbour seal that could be at risk of cumulative PTS, for both sequential monopiles and jacket pin piles, is presented in **Table 9.132**, based on the effect areas as presented in **Table 9.131**.

Table 9.132 Assessment of the Potential for PTS Due to the Cumulative Exposure of Sequential Monopiles or Jacket Pin Piles in a 24 Hour Period for Seals

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of two sequential monopiles in a 24 hour period (SEL _{cum})	0.000002 (0.00000004% of WNNC SAC)
PTS due to the cumulative exposure of four sequential jacket pin piles in a 24 hour period (SEL _{cum})	0.000001 (0.00000001% of WNNC SAC)

2674. In the worst case 0.000002 individuals (0.00000004% of the WNNC SAC reference population, based on the array density estimate) could be at risk of cumulative PTS due to the cumulative exposure of two sequential monopiles in a 24-hour period.

9.9.2.1.1.3 PTS from cumulative exposure from multiple piling locations

2675. The simultaneous piling scenario assumes that animals are within potential effect ranges for a much longer period (i.e. they would be travelling from one pile location to another which piling is ongoing), and therefore cumulative effect ranges are much larger than for the cumulative exposure ranges of one pile at a time.

2676. The potential effect ranges are not possible to model under this scenario, as there are two starting points for receptors, and it is not possible to determine the potential range at which they need to be in order to not be at risk of effect. Therefore, the following assessment is based on the potential areas of effect only.
2677. Where the potential effect areas are not large enough to interact with each other (i.e. they do not meet), the results for the respective locations and scenarios are used (the results of the modelling for the Southeast and Northwest locations are used to inform the assessment, to align with the modelling locations used for the simultaneous modelling).
2678. **Table 9.133** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS due to the cumulative exposure of simultaneous monopiles at the NW and SE modelling locations. These locations were chosen as they have the potential for the largest 'spread' in terms of underwater noise propagation. The modelling includes two monopiles being installed sequentially at each location at the same time.

Table 9.133 The Predicted Effect Area For PTS For Seals at the NW and SE Modelling Locations, for the Cumulative Exposure of Multiple Monopiles Installations at the Same Time

Scenario	Potential effect areas for PTS due to cumulative exposure of simultaneous pile installations
	Monopile (8,000kJ)
Multiple sequential pile installations in a 24 hour period (for the NW and SE modelling locations together)	110km ²

2679. An assessment of the maximum number of individuals that could be at risk of cumulative PTS, for simultaneous monopiles is presented in **Table 9.134**, based on the effect areas as presented in **Table 9.133**.

Table 9.134 Assessment of the Potential for PTS Due to the Cumulative Exposure of Simultaneous Monopiles at the Same Time

Piling scenario	Assessment of effect
PTS due to the cumulative exposure of simultaneous monopile installations (SEL _{cum})	0.0001 (0.000003% of WNNC SAC)

2680. There would be **no adverse effect** of PTS in harbour seal from pile installation on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

9.9.2.1.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Impact Piling During Construction

2681. The range of possible behavioural reactions that may occur as a result of exposure to noise include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement / diving behaviour, temporary or permanent habitat abandonment and, in severe cases, panic, or stranding, sometimes resulting in injury or death (Southall *et al.*, 2008).
2682. There are currently no agreed thresholds or criteria for the behavioural response and disturbance of harbour seal, therefore it is not possible to conduct underwater noise modelling to predict impact ranges.
2683. Disturbance from construction activities (including piling) may have behavioural consequences on harbour seal in the study area, including reduced time spent foraging at sea as animals move away from sources of noise, displacement from vessels, etc. Repeated disruptions can have cumulative negative effects on the bioenergetic budget of marine species, with the potential for long-term effects on survival and reproductive rates (Christiansen *et al.*, 2013).
2684. Hastie *et al* (2021) studied the change in foraging behaviour of grey seal when exposed to underwater noise. A high density and low density area of prey was present within an experimental pool, and speakers were located at each prey patch. During the control periods, seals would forage mainly at the high-density patch, but also at the low-density patch for a smaller proportion of time. When the seals were exposed to noise at the low density patch, there was a reduction in foraging of 16-28%, however, when seals were exposed to noise at the high density prey patch, there was no change in foraging in comparison to control periods. This indicates that seals would choose to remain at a noisy environment, if there were good prey resources at the same location.
2685. Russell (2016) has shown that grey seal are present in significantly reduced number up to a distance of 25km during piling (or a disturbance area of 1,963.5km²). This range has therefore been used to determine the number of harbour seal that may be disturbed during piling at Array Area (**Table 9.135**).
2686. A distance of 25km during piling Russell (2016) (or a disturbance area of 1,963.5km²) has been used to determine the number of harbour seals that may be disturbed during monopiling for the Project. To assess for disturbance of a single jacket pin pile foundation, the recommended EDR of 15km (706.86km²) for harbour porpoise (Graham *et al.*, 2019) has been used as a precautionary impact range for harbour seals.
2687. For disturbance based on the known effect ranges, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

Table 9.135 Assessment of the Potential for Disturbance to Harbour Seal Based on a Disturbance Range of 25km for Both Monopiles and Jacket Pin Piles for the Project

Potential disturbance range and area	Assessment of effect	Potential adverse effect on site integrity
One Monopile		
25km, with a disturbance area of 1,963.5km ²	0.002 (0.00005% of WNNC SAC)	No. Less than 5% of the population affected.
One Jacket pin pile foundation		
15km, with a disturbance area of 706.86km ²	0.001 (0.00004% of WNNC SAC)	No. Less than 5% of the population affected.

9.9.2.1.2.1 Dose-Response Assessment

2688. The dose-response methodology is outlined in **Section 13.5** in **PEIR Volume 2, Appendix 12.6 Information and Modelling Methods for Disturbance**. The dose-response approach has been undertaken for all piling locations, with the highest resultant number of individuals disturbed presented in this assessment.

2689. The estimated numbers of grey seal and the corresponding percentage of the WNNC SAC population that could be disturbed as a result of underwater noise during piling, based on the worst-case foundation and location, is presented in **Table 9.136**.

Table 9.136 Number of Individuals (and % of Reference Population) That Could Be Disturbed During Piling of Monopiles Based on the Dose-Response Approach

Number of individuals disturbed (monopiles) (% of reference population)	Number of individuals disturbed (pin-piles) (% of reference population)
0.0005 (0.00001% of WNNC SAC)	0.0004 (0.00001% of WNNC SAC)

9.9.2.1.2.2 Potential disturbance from ADD activation

2690. During 9 minutes of ADD activation, grey seal would move at least 0.81km from the ADD location (based on a precautionary marine mammal swimming speed of 1.5m/s; Otani *et al.*, 2000), resulting in a potential disturbance area of 8km². This is further than the maximum instantaneous PTS range for monopiles predicted for grey seal. For pin piles the ADD activation required would be 5 minutes to cover the maximum PTS range of 0.43km, resulting in a potential disturbance area of 4.4km².

2691. The estimated numbers (and percentage of the relevant reference populations) of harbour seal disturbed as a result of underwater noise during piling after ADD minutes is presented in **Table 9.137**.

Table 9.137 Assessment of the Potential for Disturbance due to ADD Activation Based for Monopiles or Jacket Pin Piles for the Project

Piling Scenario	Assessment of effect	Potential adverse effect on site integrity
Monopiles	0.000008 (0.0000002% of the WNNC SAC)	No.
Pin piles	0.000004 (0.0000001% of the WNNC SAC)	Less than 5% of the population affected

2692. The population affected by disturbance from underwater noise at the Project is less than 5%. Therefore, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to disturbance or behaviour effects from increased underwater noise during construction (piling) for the Project.

9.9.2.1.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.9.2.1.3.1 Impact 3a: Permanent auditory injury (PTS) Due to Other Construction Activities

2693. Potential sources of underwater noise during construction activities, other than piling, include seabed preparation, dredging, rock placement, trenching and cable installation.

2694. Dredging / cable installation activities have the potential to generate underwater noise at sound levels and frequencies for sufficient durations to disturb marine mammals. Reviews of published sources of underwater noise during dredging activity (Theobald *et al.*, 2011; Thomsen *et al.*, 2006; Todd *et al.*, 2015), indicate that the sound levels that harbour seals may be exposed to during dredging activities are typically below permanent auditory injury thresholds (PTS) exposure criteria (as defined in Southall *et al.* (2019)). Therefore, the potential risk of any auditory injury in marine mammals as a result of dredging activity is highly unlikely.

2695. The noise levels produced by dredging activity / cable installation, could overlap with the hearing sensitives and communication frequencies used by marine mammals (Todd *et al.*, 2015), and therefore have the potential to impact harbour seals present in the area.

2696. The potential for PTS effects that could result from underwater noise during other construction activities, including cable laying and protection would be temporary in nature, not consistent throughout the offshore construction period for the Project and would be limited to only part of the overall construction period and area at any one time.

2697. The assessment for impacts from underwater noise resulting from other construction activities is shown in **Table 9.138**.

Table 9.138 Predicted Impact Ranges (and Areas) for Auditory Injury from 24 Hour Cumulative Exposure During Other Construction Activities

Criteria and threshold (Southall <i>et al.</i> , 2019)	Cable laying	Dredging (backhoe and suction (individually))	Trenching	Rock placement	All activities
SEL _{cum} Weighted (153 dB re 1 µPa ² s) Non-impulsive	0.1km (0.03km ²)	<0.1km (<0.03km ²)	<0.1km (<0.03km ²)	<0.1km (<0.03km ²)	0.12km ²

2698. The number of harbour seal that could be impacted as a result of underwater noise during construction activities other than piling is presented in **Table 9.139** has been assessed based on the number of animals that could be present in each of the modelled impact ranges.

Table 9.139 Maximum Number of Individuals (and % of Reference Population) That Could be Impacted as a Result of Underwater Noise Associated with Non-Piling Construction Activities

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
PTS for each individual activity			
Harbour seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.00000003 (0.000000001% of WNNC SAC based on array density estimate) 0.00002 (0.0000004% of WNNC SAC based on ECC density estimate)	No. Less than 1% of the population affected

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
PTS for all activities at the same time (4 activities)			
Harbour seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.0000001 (0.000000003% of WNNC SAC based on array density estimate) 0.00006 (0.000002% of WNNC SAC based on ECC density estimate)	No. Less than 1% of the population affected

2699. The population affected by auditory injury during other construction activities from underwater noise at the Project is less than 1%. Therefore, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to auditory injury from increased underwater noise during other construction for the Project.

9.9.2.1.3.2 Impact 3b: Permanent auditory injury (PTS) Due to Construction Vessels

2700. **Table 9.140** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS from the cumulative exposure of vessels within the site. For SEL_{cum} calculations, the duration of the noise is also considered, with noise present for a worst case of 24-hours in a day.

Table 9.140 The Predicted Effect Ranges for Cumulative PTS for Vessels in All Marine Mammal Species

Marine mammal species	Potential effect ranges (and areas) for PTS Medium of large vessels
Harbour seal	<100m (0.031km ²)

2701. The results of the underwater noise modelling does not define effect ranges of <100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably lower).

2702. The results of the underwater noise modelling (**Table 9.140**) indicate that any grey seal would have to be <100m (precautionary maximum range) from the continuous noise source for 24 hours, to be exposed to noise levels that could induce PTS. It is therefore highly unlikely that any individual would be at risk of PTS due to vessel noise. It should be noted that the predicted impact ranges are the distances which represent the ‘onset’ stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.

2703. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in **Table 9.141**, based on the effect areas as presented in **Table 9.140**.

Table 9.141 Assessment of the Potential for PTS Due to Medium and Large Vessels

Marine mammal species	Assessment of effect
Harbour seal	0.00000003 (0.000000001% of WNNC SAC based on array density estimate) 0.00002 (0.0000004% of WNNC SAC based on ECC density estimate)

2704. Given the small number of individuals affected, there would be **no adverse effect** of PTS in harbour seal from vessels on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

2705. There is the potential that up to 90 vessels may be present in the Offshore Development Area at any one-time during construction. As a worst case and unlikely scenario, an assessment for all 90 vessels has also been undertaken with the assessment split between the Array Area and Offshore ECC using the relevant density estimates.

2706. The assessment considers the following assessments:

- Up to 35 vessels within the Array Area;
- Up to 55 vessels in the offshore ECC; and
- The combined number of affected animals for 90 vessels.

2707. **Table 9.142** presents the potential areas of PTS for the maximum construction vessels at any one time.

Table 9.142 The Predicted Effect Areas For Cumulative PTS, For Multiple Construction Vessels For All Marine Mammal Species

Area	Potential effect areas for PTS
Array Area	1.1km ²
Offshore ECC	1.7km ²
Combined total	2.79km ²

2708. An assessment of the maximum number of individuals that could be at risk of PTS, due to the maximum number of construction vessels at any one time is presented in **Table 9.143**, based on the effect areas as presented in **Table 9.142**.

Table 9.143 Assessment of the Potential for PTS Due to Multiple Construction Vessels

Area	Assessment of effect
Array Area	0.000001 (0.00000003% of WNNC SAC)
Offshore ECC	0.0009 (0.00002% of WNNC SAC)
Combined total	0.000901 (0.00002% of WNNC SAC)

2709. Given the small number of individuals affected, there would be **no adverse effect** of PTS in grey seal from vessels on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

9.9.2.1.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.9.2.1.4.1 Impact 4a: Disturbance effects due to other construction activities

2710. Underwater noise as a result of dredging activity / cable installation has the potential to disturb marine mammals (Pirota *et al.*, 2014). Therefore, there is the potential for short, perhaps medium-term behavioural reactions and disturbance to harbour seal in the area during dredging / cable installation activity. Harbour seals may exhibit varying behavioural reactions intensities as a result of exposure to noise (Southall *et al.*, 2008).

2711. Harbour seals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

2712. If the response is displacement from the area, it is predicted that harbour seals will return once the activity has been completed and therefore any impacts from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on harbour seal.
2713. There is limited data on the potential for a behavioural response or disturbance from other construction activities (or other continuous noise sources). A review of various studies was used to determine the maximum potential disturbance range for other construction activities and vessels. As discussed Benhemma-Le Gall *et al* (2021), reported a 4km (50.3km²) reduction in harbour porpoise presence for other construction activities, including vessels. As harbour porpoise are the most sensitive marine mammal species, this 4km potential disturbance range has been used for harbour seal as a worst case, in the absence of any other data to inform an assessment.
2714. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities based on the 4km potential disturbance range is presented in **Table 9.144** for one activity occurring or four activities happening at the same time.

Table 9.144 Assessment of the Potential for Disturbance Due to Other Construction Activities, Including Cable Laying, Suction Dredging, Cable Trenching, and Rock Placement, for One Activity Taking Place at Any One Time for the Project

Species	Potential Impact	Maximum number of individuals (% of reference population)	Potential adverse effect on site integrity
Disturbance for each individual activity			
Harbour seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.0001 (0.000001% of WNNC SAC based on array density estimate) 0.02 (0.0006% of WNNC SAC based on ECC density estimate)	No. Less than 5% of the population affected

Disturbance for four activities at the same time for the Project			
Harbour seal	Cumulative SEL for: <ul style="list-style-type: none"> Cable laying; Trenching; Rock placement; Dredging; Drilling; Vibropiling; and Suction bucket installation. 	0.0002 (0.000005% of WNNC SAC based on array density estimate) 0.1 (0.002% of WNNC SAC based on ECC density estimate)	No. Less than 5% of the population affected

2715. The population disturbed during other construction activities from underwater noise at the Project is less than 5%. Therefore, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to disturbance from increased underwater noise during other construction for the Project.

9.9.2.1.4.2 Impact 4b: Disturbance effects due to construction vessels

2716. The assessment on disturbance effects due to construction vessels has been based on the same methods as described in **Section 9.4.2.1.4**.
2717. The assessments are undertaken based on the maximum number of vessels being present at any one time, which is only likely to occur occasionally.
2718. The disturbance assessment based on one vessel is equivalent to that for one construction activity. This scenario has already been assessed in **Table 9.144** and has therefore not been repeated here.
2719. The disturbance caused by 55 individual vessels within the offshore ECC, would cover a total area of 2,764km², not taking into consideration any potential overlap of the 4km disturbance ranges with other nearby vessels. To account for that, 55 vessels were randomly distributed in the offshore ECC, using QGIS v.3.38. If an overlap in the disturbance areas of multiple adjacent vessels was identified, this area removed from the total area of effect to account for that. Therefore, a potential area of disturbance of 2,500km² has been identified for the worst-case of 55 construction vessels, as shown in the **PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise, Section 12.7.1.4.2.2**.

2720. Assuming the disturbance caused by 35 vessels within the Array Area would not overlap with that of other vessels, the total disturbed area would be 1,759km². This is significantly larger than the Array Area itself, which has a total area of 262km². Therefore, the actual maximum area of effect would be the Array Area with a 4km buffer a 4km buffer (equating to an area of 613km²), as all vessels would be within the Array Area. Therefore, the assessment in **Table 9.145** represents the maximum possible disturbance area of the Array Area, including a 4km buffer.

Table 9.145 Maximum Number of Individuals (and % of Reference Population) That Could Be Disturbed as a Result of Underwater Noise Associated with Construction Vessels for the Project

Component specific density	Maximum number of individuals (% of reference population) for 55 vessels in the offshore ECC (2,500km ²)	Maximum number of individuals (% of reference population) for Array Area, including a 4km buffer (613km ²)	Maximum number of individuals (% of reference population) for all construction vessels in the offshore ECC and Array Area
Array Area	-	0.001 (0.00002% of WNNC SAC)	3 (0.07% of WNNC SAC)
Offshore ECC	2 (0.03% of WNNC SAC)	-	

2721. Whilst short to medium term behavioural responses have been recorded from vessel disturbance, there are no long-term or population level effects recorded to date. Less than 5% of the reference population is affected, therefore, it is considered that there would be **no adverse effect** from disturbance from underwater noise associated with vessels on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

9.9.2.1.5 Impact 5: Barrier Effects from Underwater Noise During Construction

2722. Underwater noise during construction could have the potential to create a barrier effect, preventing movement or migration of harbour seals between important feeding and / or breeding areas, or potentially increasing swimming distances if marine mammals avoid the site and go around it.

2723. The Array Area is located 210km from the coast at closest point. The nearest seal haul-out site is at Filey Brigg, the haul-out site is 20km from the offshore ECC at the closest point.

2724. The greatest potential barrier effect for harbour seal could be from underwater noise during piling. Piling would not be constant during the piling phases and construction periods. Taking into account the distance of the Array Area from the coast and from harbour seal haul-out sites, there is no potential for underwater noise at the windfarm site to result in barrier effects to seals moving to and from haul-out sites.

2725. However, harbour seals have foraging ranges of up to 437km (Carter *et al.*, 2022), with foraging trips lasting up to 30 days (SCOS, 2021). Harbour seal could be affected when travelling to foraging areas, and underwater noise could potentially cause a barrier effect to foraging. However, prey consumption on a daily basis is not vital for energy demands, as mature seals undergo a period of starvation during the breeding season, where the loose up to 40% of their body weight (Sparling, 2003). Therefore, if there are any potential barrier effects from underwater noise, harbour seals would be able to compensate by travelling to other foraging areas within their range.

2726. However, barrier effects from underwater noise could impact foraging females as this is considered the more energetically expensive period for females (Mellish *et al.*, 2000), if they can't meet the energy demands, it can cause devastating effects to the female and her pup. Due to the fact that piling will occur over 100km away, it is unlikely lactating females will travel that far, so there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of harbour seal.

2727. Any disturbance and any barrier effects would be temporary and for a relatively short duration (i.e. during active piling).

2728. As it is predicted that harbour seals will return once the activity has been completed, and therefore any effects from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of harbour seal.

2729. Therefore, there would be no significant disturbance of harbour seal and **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to potential barrier effects from increased underwater noise during construction of the Project.

9.9.2.1.6 Impact 6: Increased Risk of Collision with Vessels during construction

2730. During offshore construction, there will be an increase in vessel traffic within the Array Area and offshore ECC. However, it is anticipated that vessels would follow an established shipping route to the relevant ports in order to minimise vessel traffic in the wider area.

2731. Seals in and around the Offshore Development Area and in the wider southern North Sea would typically be habituated to the presence of vessels. Seals are able to detect and avoid vessels. However, vessel strikes are known to occur, possibly due to distraction whilst foraging and socially interacting, or due to the marine mammals' inquisitive nature (Wilson *et al.*, 2007). Therefore, increased vessel movements, especially those outside recognised vessel routes, can pose an increased risk of vessel collision to marine mammals. Studies have shown that larger vessels are more likely to cause the most severe or lethal injuries, with vessels over 80m in length causing the most damage to marine mammals (Laist *et al.*, 2001; Keen *et al.*, 2023). High speeds are a key factor in collisions with cetaceans; for instance, the likelihood of a lethal injury to large whales, specifically the North Atlantic right whale in this study, increased from around 20% to 80% when vessel speeds increased from 8 to 15 knots (Vanderlaan & Taggart, 2007). Serious injuries have also been documented at lower speeds of 2 and 5.5 knots (Conn & Silber, 2013). Conversely, vessels traveling at speeds below 10 knots rarely cause serious injuries, making reduced speed one of the most effective mitigation strategies (Laist *et al.*, 2001; Conn & Silber, 2013; Laist *et al.*, 2014; Keen *et al.*, 2023).
2732. The predictability of vessel movements by marine mammals is crucial in minimising the risks posed by vessel traffic (Nowacek *et al.*, 2001, Lusseau, 2003; 2006). Reducing vessel speed not only allows more time for marine mammals to move away, but also significantly reduces emitted vessel noise. This reduction in noise enables marine mammals to hear approaching ships and prevents interference with intra-species communication (Leaper, 2019).
2733. For harbour seals a recent UK telemetry study showed there was no evidence of reduced seal presence as a result of vessel traffic. This was despite distributional overlaps (overlaps were most frequently found within 50km of the coast) between seal and vessel presence and high cumulative sound levels (Jones *et al.*, 2017). Another study of grey seal pup tracks in the Celtic Sea and adult grey seals in the English Channel found that no animals were exposed to cumulative shipping noise that exceeded thresholds for temporary threshold shifts (TTS) (using the Southall *et al.* (2019) thresholds) (Trigg *et al.*, 2020). A study of grey seal pupping beaches around Ramsey Island in Pembrokeshire found that disturbance occurred when vessels were closer than 150m to seal locations (Strong and Morris, 2010).
2734. In addition, vessel movements, where practicable, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. Vessel operators will use best practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever possible and avoiding close proximity to seal haul-out sites.
2735. Therefore, there would be minimal increase to collision risk of harbour seal and **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to potential vessel collision risk during construction for the Project.
- 9.9.2.1.7 Impact 7: Disturbance at Seal Haul-Out Sites
2736. The WNNC SAC is located, at closest point, 24km from Array Area and 99km from the offshore ECC. The closest harbour seal haul out site is the Wash which is 280km from the Array Area, 139km from landfall, and 124km from the offshore ECC at closest distance. Blakeney Point is closer to the Array Area, which is 250km from the Project at the closest distance. Therefore, there would be no effects from construction activities within the Offshore Development Area, only effects from vessels transiting to and from the Offshore Development Area.
2737. A study on harbour seals, using remote video monitoring showed hauled out 10km from the Nysted OWF, at Rødsand seal sanctuary showed that there was no disturbance to the hauled out seals during the construction period (thought to be due to boat regulations), but that during periods of piling the number of seals on land decreased significantly (between 31 and 61%) (Edrén *et al.*, 2004). However, the seal haul-out sites are greater than 100km away from piling activity so any piling activity at the Project should not cause any disturbance to seals hauled out.
2738. As studies on the distance of disturbance, on land or in the water, for hauled-out harbour seals have found that the closer the disturbance, the more likely seals are to move into the water. The estimated distance at which most seal movements into the water occurred, varies between study site and type of disturbance but has been estimated at typically less than 100m (Wilson, 2014).
2739. A study was carried out by SMRU (Paterson *et al.*, 2015) using a series of controlled disturbance tests at harbour seal haul-out sites, consisting of regular (every three days) disturbance through direct approaches by vessels and effectively 'chasing' the seals into the water. The seal behaviour was recorded via GPS tags and found that even intense levels of disturbance did not cause seals to abandon their haul-out sites more than would be considered normal (for example seals travelling between sites) and the seals were found to haul-out at nearby sites or to undertake a foraging trip in response to the disturbance (but would later return).
2740. Further studies on the effects of vessel disturbance on harbour seals when they are hauled out, suggest that even with repeated disturbance events that are severe enough to cause individuals to flee into the water, the likelihood of harbour seals moving to a different haul-out site would not increase. Furthermore, this appeared to have little effect on their movements and foraging behaviour (Paterson *et al.*, 2019).

2741. A study by Jansen *et al* (2010) of the reactions of harbour seal from cruise ships found that, if a cruise ship was less than 100m from a harbour seal haul-out site, individuals were 25 times more likely to flee into the water than if the cruise ship was at a distance of 500m from the haul-out site. At distances of less than 100m, 89% of individuals would flee into the water, at 300m this would fall to 44% of individuals, and at 500m, only 6% of individuals would flee into the water. Beyond 600m, there was no discernible effect on the behaviour of harbour seal.
2742. Vessel activity, between the Project to port have the potential to cause disturbance to seal haul-haul out sites. Although, movements to and from any port will be incorporated within existing vessel routes. Taking into account the proximity of shipping channels to and from existing ports, it is likely that seals hauled-out along these routes and in the area of the ports would be habituated to the noise, movements and presence of vessels.
2743. It is expected that if there is any disturbance to seals at haul-out sites from construction activities it is a short-term effect. For example, a 2019 study on harbour seals in Scotland found that 30 minutes after a disturbance event, seals return to 52% pre-disturbance levels at haul-out sites and 94% pre-disturbance levels four hours after a disturbance event (Paterson *et al.*, 2019).
2744. As described above, there would only be disturbance if the vessels came within a few hundred metres of a haul out and any effect would be temporary. Taking into account the proximity of shipping channels to and from ports, it is likely that seals hauled-out along these routes and in the area of the ports would be habituated to the noise, movements and presence of vessels. Therefore, the effect on harbour seals at haul-out sites to disturbance from vessels moving to and from the port(s) during construction is likely to be limited.
2745. Therefore, if the vessels committed to keep at least a distance of 500m from the shore, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to disturbance at seal haul-out sites during construction for the Project.

9.9.2.1.8 Impact 8: Potential Effects of Changes to Prey Resource

2746. The potential effects on prey species during construction can result from:
- Physical seabed disturbance;
 - Increased SSC and sediment re-deposition;
 - Remobilisation of contaminated sediments;
 - Underwater noise and vibration; and
 - Changes in fishing activity.

2747. As discussed in the SNS SAC section (**Section 9.4.2.1.7**), **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any reductions in prey availability would be small scale, localised and temporary. It is considered highly unlikely that potential reductions in prey availability as a result of construction activities at the Project would result in detectable changes to harbour seal populations.
2748. Harbour seal feed on a variety of prey species and are considered to be opportunistic feeders, feeding on a wide range of prey species and they have relatively large foraging ranges (see **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report**).
2749. The potential impacts of physical disturbance, temporary habitat loss, increased SSC, re-mobilisation of contaminated sediment, underwater noise and vibration and changes in fishing activity on changes in prey availability are localised and short in duration. Therefore, there will be **no adverse effect** on the integrity of The WNNC SAC in relation to the conservation objectives for harbour seal due to potential changes in prey availability during construction for the Project.

9.9.2.1.9 Impact 9: Potential effects of changes to water quality

2750. Potential changes in water quality during construction could occur through:
- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations, and array, cables;
 - Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and Offshore Platforms;
 - Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
 - Deterioration in water quality associated with release of sediment bound contaminants.
2751. Marine mammals often inhabit turbid environments and cetaceans utilise sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly (Todd *et al.*, 2014).
2752. Increased turbidity is unlikely to have a direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely.

2753. Potential changes in water quality during construction would have **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal for the Project.

9.9.2.2 Potential effects during O&M

2754. The potential effects during O&M that have been assessed for are outlined in **Section 4.5.3**.

9.9.2.2.1 Impact 1: Underwater Noise: Physical and Auditory Injury Resulting from Operational Wind Turbine Noise

2755. Underwater noise modelling was undertaken by Subacoustech to estimate the noise levels likely to arise during the operational phase (**PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report**) and determine the potential effects on marine mammals.

2756. The risk of injury (defined as onset of PTS) is given as occurring in a range of <100m (**Table 9.146**), a highly precautionary range, and within which the animal would need to stay for a 24 hour period for sufficient noise exposure to result in an effect. Such an occurrence is extremely unlikely and would be atypical behaviour for such a highly mobile species.

Table 9.146 Predicted effect ranges (areas) for PTS from 24-hour Cumulative Exposure of Underwater Noise From Operational Turbines

Species	Impact	Operational wind turbine	Area of impact for up to 113 Wind turbines
Harbour seal	PTS	<0.1km (0.031km ²)	3.55km ²

2757. The maximum number of individuals that could be at risk of PTS, due to a single operational WTG, is 0.00000003 harbour seal (0.000000001% of the WNNC SAC reference population), based on the array density estimate.

2758. More than one WTG will be operating at the same time, and therefore an assessment of the potential for auditory injury, due to all operational WTGs, is required. There is the potential for 113 WTGs to be installed for the Project.

2759. The potential areas of PTS for all operational WTGs for harbour seal is 3.55km².

2760. An assessment of the maximum number of individuals that could be at risk of PTS from all operational WTGs is 0.000004 harbour seal (0.0000001% of the WNNC SAC reference population), based on the array density estimate.

2761. There would be **no adverse effect** of PTS in harbour seal from operational WTG noise on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

9.9.2.2.2 Impact 2: Underwater Noise: Behavioural Impacts Resulting from Operational Wind Turbine Noise

2762. Currently available data indicates that there is no lasting disturbance or exclusion of seals around OWF sites during operation (Diederichs *et al.*, 2008; Lindeboom *et al.*, 2011; Marine Scotland, 2012; McConnell *et al.*, 2012; Russell and McConnell, 2014; Scheidat *et al.*, 2011; Teilmann *et al.*, 2006; Tougaard *et al.*, 2009a, 2009b, 2006). Data collected suggests that any behavioural responses for seals may only occur up to a few hundred metres away (McConnell *et al.*, 2012; Tougaard *et al.*, 2009a).

2763. Monitoring studies at Nysted and Rødsand have also indicated that operational activities have had no impact on regional seal populations (McConnell *et al.*, 2012; Teilmann *et al.*, 2006). Seals have been shown to forage within operational OWFs (Lindeboom *et al.*, 2011; Russell and McConnell, 2014), indicating no restriction to movements in operational OWF sites.

2764. Modelling of noise effects of operational offshore wind turbines suggest that marine mammals are not considered to be at risk of displacement by operational wind farms (Marmo *et al.*, 2013). Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

2765. Aerial surveys of the adjacent seal haul-out sites conducted in the first few months of operation of the Nysted Wind Farm revealed that seals moved between the haul-out sites with the operating wind turbines having no effect on seal movements (Teilman *et al.*, 2004). Seals have been recorded to forage within operating windfarms (Russel *et al.*, 2014) indicating there is no or minimal disturbance from operating turbines to harbour seal.

2766. Based on the available literature for examining disturbance of harbour seals and operational wind farms, because the noise levels associated with operational wind turbines are low and continuous, a precautionary low significance of effect has been given to all marine mammal species, including harbour seals, for the Project.

2767. Therefore, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to disturbance from operational wind turbine noise at the Project.

9.9.2.2.3 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

Impact 3a: Permanent Auditory Injury (PTS) Due to Other O&M Activity

- 2768. The requirements for any potential O&M activities, such as additional rock placement or cable re-burial, are currently unknown, however the work required, and associated effects to harbour seal, would be less than those during construction. **Section 9.9.2.1.1** provides an assessment for the same activities during construction, concluding that there is no potential for a significant effect from the Project.
- 2769. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities, and if the marine mammal remains within close proximity for 24 hours. Therefore, it is highly unlikely for there to be any PTS due to these activities.
- 2770. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase.
- 2771. Therefore, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to physical and auditory injury from underwater noise associated with O&M activities at the Project.

Impact 3b: Permanent Auditory Injury (PTS) Due to O&M Vessels

- 2772. During the O&M of the Project, there may be up to 19 vessels in the Offshore Development Area at any one time, compared to the 35 vessels that would be on site during construction. Therefore, the potential effects associated with underwater noise and disturbance from vessels during O&M would be less than of those during construction (as assessed in **Section 9.9.2.1.3**). As a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst-case scenario.
- 2773. There would therefore be **no adverse effect** of PTS in harbour seal from vessels on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

9.9.2.2.4 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

Impact 4a: Disturbance Effects Due to Other O&M Activities

- 2774. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. The requirements for any potential maintenance work are currently unknown, however, the work required, and impacts associated with underwater noise and disturbance from activities during O&M would be less than those during construction. As there is expected to be less noisy activities during the operation phase than is required during construction, it is therefore likely to cause less disturbance to foraging behaviours in harbour seal.
- 2775. Therefore, the potential for adverse effect due to underwater noise from O&M activities is considered to be the same or less than that assessed for underwater noise from other construction activities (including rock placement, trenching and cable laying) (as assessed in **Section 9.9.2.1.4**).
- 2776. The effect significance for disturbance effects due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

Impact 4b: Disturbance Effects Due to O&M Vessels

- 2777. The requirements for any potential maintenance work are currently unknown, however the work required, and impacts associated with underwater noise and disturbance from vessels during O&M would be less than those during construction.
- 2778. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be 19, which is less than the 35 vessels that could be on site during construction. However, as a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst case scenario.
- 2779. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.
- 2780. There would therefore be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

9.9.2.2.5 Impact 5: Underwater Noise: Barrier Effects During O&M

2781. The indicative minimum separation distance between turbines would be a minimum of 0.826km to 1.416km, depending on WTG size, therefore there would be no overlap in the potential impact range (PTS; **Table 9.129**) of <100m around each turbine, and there would be adequate room for marine mammals to move through the Array Area.
2782. Therefore, no barrier effects as a result of underwater noise during O&M are anticipated, and no further assessment is required.

9.9.2.2.6 Impact 6: Increased Risk of Collision with Vessels During O&M

2783. The increased risk of marine mammal collision with operational and maintenance vessels would be the same or less than what was assessed for the construction period (**Section 9.9.2.1.6**), given the number of vessels required would be lower.
2784. During the O&M phase, the maximum number of vessels that could be present in the Project offshore components at any one time has been estimated as 16 vessels (**Table 9.2**). The number, type and size of vessels would vary, depending on the activities taking place at any one time and are typically slow moving or stationary.
2785. Given the existing levels of marine traffic, as outlined in **PEIR Volume 1, Chapter 15 Shipping and Navigation**, marine mammals in and around the windfarm site would typically be habituated to the presence of vessels and would be able to detect and avoid vessels.
2786. There would therefore be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

9.9.2.2.7 Impact 7: Disturbance at Seal Haul-Out Sites

2787. The closest seal haul-out sites are listed in **PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report Table 12.2-13 and 12.2-15**. As the closest haul out (The Wash) is 139km from landfall, 124km from the export cable corridor, 280km from Array Area, there would be no effects from O&M activities within the Offshore Development Area, only effects from vessels transiting to and from the Project.
2788. The annual vessel traffic that could potentially be passing seal haul-out sites during the O&M phase is projected to be lower than that during the construction period, with a maximum total number of 96 round trips per year during O&M. Vessels would use established vessel routes to the port and, where possible, transiting vessels would maintain distances of 500m or more off the coast, particularly in areas near known seal haul-out sites during sensitive periods.

2789. Therefore, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to disturbance at seal haul-out sites during the O&M phase.

9.9.2.2.8 Impact 8: Potential Effects of Changes to Prey Resource

2790. The potential impacts on fish species during O&M can result from temporary habitat loss / disturbance; permanent habitat loss; introduction of wind turbine foundations; scour protection and hard substrate; increased suspended sediments and sediment re-deposition; re-mobilisation of contaminated sediments; underwater noise; and EMF.
2791. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any impacts on prey species have the potential to affect marine mammals. A summary of the key effects to prey species (and their relevance for harbour seal) is provided below.
2792. Habitat loss will occur during the lifetime of the Project as a result of structures, scour and external cable protection installed on the seabed. The introduction of hard substrate, such as wind turbine towers, foundations and associated scour protection and cable protection would increase habitat heterogeneity through the introduction of hard structures in an area predominantly characterised by sediment habitats. During operation of the Project, the estimated total permanent habitat loss would be up to 4.06km² in total. In **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** this is considered minor to negligible, depending on the species in the context of the amount of similar available habitat in the wider area.
2793. Increases in SSC within the water column and subsequent deposition onto the seabed may occur as a result of O&M activities. Disturbance caused by jack up vessel legs or anchors, as well as cable reburial and/or repair may result in small volumes of sediment being re-suspended. However, the volumes of sediment disturbed from such activities, as well as the overall duration of the disturbance, would be significantly less compared to construction.
2794. The electromagnetic attributes of EMFs have the potential to disrupt organs used for navigation and foraging within a number of fish species. EMFs can have attractive and repulsive effects, that can cause barrier effects dependent on the species and the spatial scale of EMF, for further information, see **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**. The cables will be buried, either within the seabed or under rock protection, resulting in a negligible impact zone for fish and shellfish.

2795. The introduction of various man-made structures such as foundations and scour protection in soft sediment areas increases and changes habitat availability and type, resulting in locally altered biodiversity as species are able to establish and thrive in previously hostile environments (Wilhelmsson *et al.*, 2006; Birchenough and Degraer, 2020). Physical structures provide a foundation for settling invertebrates, which increase the organic matter surrounding the structure, and underpin artificial reef ecosystems through ‘bottom-up’ control of productivity. Increasing nutrient availability and biomass presents opportunities for all fish and shellfish species, from top predators to detritivores (Raoux *et al.*, 2017).

2796. The benefit of this potential increase in prey availability to marine mammals has not yet been studied widely. However, the presence of an artificial reef does increase the abundance and biomass of species, and the increase in prey species availability increases the attractiveness of the area to predators (Devault *et al.*, 2017; Paxton *et al.*, 2022). Increasing habitat heterogeneity may benefit harbour porpoise, that have shown to prefer variations in seabed topography (Isojunno *et al.*, 2012, Brookes *et al.*, 2013, Stalder *et al.*, 2020).

2797. The introduction of new hard substrate in areas that are predominantly sandy or soft sediments may cause positive effects through potential habitat enhancement (Roach and Cohen, 2020).

2798. The effects arising during the operational phase of the Project are likely to be the same or less than those assessed for construction. The effects of changes to prey during operation would have **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal for the Project.

9.9.2.2.9 Impact 9: Barrier Effects from the Physical Presence of the Wind Farm During O&M

2799. There is unlikely to be the potential for any barrier effects upon the completion of construction, as it is predicted that marine mammals will return once the activity has been completed. Monitoring was conducted at the Horns Rev and Nysted OWFs in Denmark in 1999 and 2006 during operation (Diederichs *et al.*, 2008). The data showed that numbers of harbour porpoise within Horns Rev were slightly reduced compared to the wider area during the first two years of operation and found no effect on numbers after two years of operation. Though, it was not possible to conclude that the OWF was solely responsible for this change in abundance without analysing other dynamic environmental variables (Tougaard *et al.*, 2009).

2800. Lindeboom *et al* (2011) documented that harbour porpoise have been observed to foraging within operational wind farm sites indicating that the physical presence of the wind farm does not cause a barrier. Therefore, there is unlikely to be the potential for any barrier effects that could significantly restrict the movements of marine mammals including seals in operational OWF sites.

2801. The effect significance for barrier effects due to the physical presence of the wind farm has therefore been assessed as having **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

9.9.2.3 Potential effects during decommissioning

2802. 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.

2803. Commitment ID CO21 (see **PEIR 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 impacts on harbour seal 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.

2804. 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.

2805. 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.

2806. Therefore, the potential effects on harbour seal during decommissioning are assumed to be the same or less than those assessed for construction due to the processes of decommissioning potentially being the reverse of the installation, without the need for piling.

9.9.3 Assessment of Potential Effects of the Project In-Combination

2807. The following in-combination assessment has been undertaken based on **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**, and **Section 12.8 of PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise**.
2808. The in-combination assessment considers other schemes and activities where the predicted effects have the potential to combine with the potential effects during construction of the Project. The construction phase has been assessed as the worst case for potential in-combination effects.
2809. The schemes screened into the in-combination assessment for harbour seal are those that are located in the relevant MUs. Full information on the screening of effects considered for the in-combination assessment is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**. The in-combination screening for harbour seal considers the same schemes as considered in the cumulative screening. For harbour seal at the WNNC SAC, other OWFs were included in the assessment against the SAC population where the Carter *et al* (2022) densities for the individuals associated with the WNNC SAC show presence within the 5km x 5km grid cells that overlap with the other OWF (or where there is a presence of seals within the potential disturbance area of the other OWF, e.g. within 25km for other OWFs that may be piling).
2810. The in-combination effects assessed are outlined in **Section 4.5.3**.
2811. The in-combination screening identified that there is the potential for cumulative effects on harbour seal as a result of disturbance from underwater noise during piling and other construction activities. Due to the low noise levels associated with operational OWFs, as the BEIS (2020) RoC HRA for the SNS SAC stated that there would no potential for significant effect from the operation of OWFs, alongside the construction of OWFs (BEIS, 2020), therefore all operational impacts have been screened out.
2812. Further information is provided in the **Volume 2, Appendix 12.5 Cumulative Effect Screening**.

9.9.3.1 In-Combination Impact 1: Disturbance from Underwater Noise

2813. The commitment to the mitigation measures agreed through the final MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) in harbour seal. In light of this, and taking account of the type, scale and extent of potential effects arising from the Project assessment, it concluded **no adverse effect** on integrity for harbour seal due to physical injury or PTS from construction (see **Section 9.6.2.1.1**).

9.9.3.1.1 In-Combination Impact 1a: Assessment of Underwater Noise From Piling at Other OWFs

2814. One of the greatest potential noise sources during OWF construction is from pile driving. The in-combination assessment considers the potential disturbance of marine mammals during piling for the Project, with the piling at other OWF schemes screened into the in-combination assessment.
2815. The CEA screening (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**) identified twelve projects with the potential for construction to take place at the same time as the construction of the Project. Of these twelve, seven of them are shown to have harbour seal associated with the WNNC SAC present within the relevant project areas. The worst-case scenario would be if the following OWFs were piling at the same time as the Project:
- Dogger Bank South (East);
 - Dogger Bank South (West);
 - Sheringham Shoal Extension;
 - Dudgeon Extension;
 - Five Estuaries;
 - North Falls; and
 - Outer Dowsing.
2816. The potential piling period for the Project has been based on the widest likely range of offshore construction and piling dates, dependent on the construction scenario, as a precautionary approach. It should be noted that while the schemes included within the in-combination have the potential for piling to overlap with the Project, there is a great deal of uncertainty on when OWFs could be piling. This assessment is therefore considered the worst-case.
2817. Where possible, the CEA screening (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**) included consideration of the realistic potential for cumulative impacts during construction at the Project. For example, it is assumed that where OWF developers have more than one OWF, they are unlikely to develop more than one site at a time.
2818. The commitment to the mitigation agreed through the final MMMP for piling would reduce the risk of physical injury or permanent auditory injury (PTS) for all marine mammals.
2819. For harbour seal, the in-combination assessment is based on the reported disturbance range of 25km for seal species, with a potential disturbance area of 1,963.5km².

2820. It should be noted that the potential areas of disturbance assume that there is no overlap in the areas of disturbance between different schemes and are therefore highly conservative.
2821. The approach to the in-combination for piling at OWFs is based on the potential for single piling at each OWF at the same time as single piling at the Project. This approach allows for some of the OWFs not to be piling at the same time, while others could be simultaneously piling. This is considered to be the most realistic worst-case scenario, as it is highly unlikely that all other OWFs would be simultaneously piling at exactly the same time as piling at the Project.
2822. It is important to note the actual duration for active piling time which could disturb marine mammals is only a very small proportion of the potential construction period, of up to approximately 25.1 days for the Project (based on 5.33hrs per pile for the Project), based on the estimated maximum duration to install individual piles.
2823. For harbour seal, the potential worst-case scenario of other OWFs piling at the same time as the Project is assessed in **Table 9.147**. Less than 5% of the reference population could potentially be disturbed, this is a very precautionary, as it is unlikely that all other OWF schemes could be piling at exactly the same time as piling at the Project.

Table 9.147 Quantitative Assessment for the Potential Disturbance of Harbour Seal From Single Piling (25km) At Other OWFs At The Same Time As Piling At The Project

Project	Harbour seal density (/km ²)	Maximum number of individuals potentially disturbed
Single piling at other OWFs that could be piling at the same time as DBD		
DBD	0.000001	0.002
DBS (East)	0.0018	4
DBS (West)	0.0015	3
Dudgeon Extension Project	0.08	31
Five Estuaries	-	2
North Falls	0.00001	0.02
Outer Dowsing	-	21
Sheringham Shoal Extension ³	0.274	62
Total number of harbour seal with DBD		124

Project	Harbour seal density (/km ²)	Maximum number of individuals potentially disturbed
Total number of harbour seal without DBD		124
Percentage of WNNC SAC population (with DBD)		3.11%
Percentage of WNNC SAC population (without DBD)		3.11%

2824. In practice, the potential temporary effects would be less than those predicted in this assessment as there is likely to be a great deal of variation in timing, duration, and hammer energies used throughout the various OWF project construction periods. In addition, not all individuals would be displaced over the entire potential disturbance range (25km) used within the assessments.

9.9.3.1.2 In-Combination Impact 1b: Assessment of Disturbance from Other Industries and Activities

2825. During the construction period for the Project, there is the potential for disturbance to marine mammals associated with other potential noise sources, including:

- Geophysical surveys;
- Aggregate extraction and dredging;
- Seismic surveys;
- UXO clearance; and
- Interlink cable.

2826. For the installation of oil and gas infrastructure, marine renewable schemes, and disposal sites, all potential schemes have been screened out. Further information on the CEA screening (and these results) are provided in **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**.

2827. To represent the presence of harbour seal in the wider WNNC SAC the quantitative assessments in this section are based on the average density estimate across the Carter *et al* (2022) relative density dataset for the WNNC SAC of 0.027/km².

9.9.3.1.2.1 Disturbance from Geophysical Surveys

2828. Based on BEIS (2020) as a precautionary worst-case, due to a lack of data on seal disturbance distances, the potential 3.77km disturbance range has been used. This results in a disturbance area of 434.9km² for one survey and 869.7km² for two geophysical surveys. It is currently not possible to estimate the location or number of potential OWF geophysical surveys that could be undertaken at the same time as construction and potential piling activity for the Project. It is therefore assumed, as a worst-case scenario, that there could potentially be up to two geophysical surveys in the North Sea at any one time, during construction of the Project.
2829. For up to two geophysical surveys undertaken at the same time as construction of the Project, with no other in-combination activities, up to 0.63% of the WNNC SAC population may be disturbed (Table 9.148).

Table 9.148 Quantitative Assessment for In-Combination Disturbance of Marine Mammals Due to Two Geophysical Surveys at OWFs

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.000001	1963.495 (25km EDR)	0.002
Two geophysical surveys	0.027	869.7 (434.9 per survey)	24
Total number of harbour seal with DBD			25 (0.63%)
Total number of harbour seal without DBD			24 (0.61%)

2830. There would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal as a result of disturbance due to underwater noise (other than piling) from the Project with geophysical surveys.

9.9.3.1.2.2 Disturbance from aggregate extraction and dredging

2831. Seven aggregate/dredging projects have been screened in that could have potential cumulative disturbance impacts with piling taking place at the Project (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**):
- Greenwich Light East 473/1 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);
 - Greenwich Light East 473/2 (one project area owned by CEMEX UK Marine and one by Hanson Aggregates Marine Ltd.);

- Inner Dowsing 481/1-2;
- Inner Owers North 488;
- Thames D 524;
- West Bassurelle 458; and
- West Bassurelle 464.

2832. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600m of the activities (Diederichs *et al.*, 2010). As a worst-case assessment, a disturbance range of 600m will be applied for the aggregate schemes at the same time as the Projects' construction. A disturbance range of 600m would result in a potential disturbance area of 1.13km² for each project.
2833. Inner Dowsing 481/1-2 of the screened in aggregate schemes is the only scheme where the Carter *et al* (2022) densities for the individuals associated with the WNNC SAC show presence within the 5km x 5km grid cells that overlap with the scheme.
2834. For the potential for in-combination disturbance from aggregate and dredging schemes undertaken at the same time as construction of the Project, with no other in-combination activities, up to 0.032% of the WNNC SAC population may be disturbed (Table 9.149).

Table 9.149 Quantitative Assessment for In-Combination Disturbance of Harbour Seal Due to Aggregate and Dredging Schemes

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.000001	1963.495 (25km EDR)	0.002
Inner Dowsing 481/1-2	0.027	1.13	0.03
Total number of harbour seal with DBD			0.032 (0.001% of WNNC SAC)
Total number of harbour seal without DBD			0.03 (0.0008% of WNNC SAC)

9.9.3.1.2.3 Disturbance from seismic surveys

2835. It is currently not possible to estimate the number of potential seismic surveys that could be undertaken at the same time as construction and potential piling activity at the Project. As a precautionary approach, the potential for cumulative impacts from oil and gas seismic surveys has been screened into the CEA for further consideration. It was assumed, as a worst-case scenario, that there could potentially be two seismic surveys in the North Sea at any one time during construction (piling) of the Project.
2836. There is little available information on the potential for disturbance from seismic surveys for harbour seal, however, observations of behavioural changes in other seal species have shown avoidance reactions up to 3.6km from the source for a seismic survey (Harris *et al.*, 2001). A more recent assessment of potential for disturbance to seal species, as a result of seismic surveys, shows potential disturbance ranges from 13.3km to 17.0km from source (BEIS, 2020). These ranges are based on modelled impact ranges, using the National Marine Fisheries Service Level B harassment threshold of 160dB, for a noise source of 3,070 cubic inches, 4,240 cubic inches, or 8,000 cubic inches.
2837. A potential disturbance range of 17.0km (or disturbance area of 4,426.9km² for one survey, and 8,853.8km² for up to two seismic surveys) will therefore be applied to grey seal due to a lack of species-specific information.
2838. For two seismic surveys, undertaken at the same time as construction of the Project, up to 6.07% of the WNNC SAC population may be disturbed (**Table 9.150**).

Table 9.150 Quantitative Assessment for In-Combination Disturbance of Harbour Seal Due to up to Two Seismic Surveys

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.000001	1963.495 (25km EDR)	0.002
Two seismic surveys	0.027	8,853.8	239
Total number of harbour seal with DBD			240 (6.07% of WNNC SAC)
Total number of harbour seal without DBD			239 (6.04% of WNNC SAC)

9.9.3.1.2.4 Disturbance from subsea cables and pipelines

2839. Only one subsea pipeline has been screened into the in-combination assessment, Sea Link. This project is currently at scoping stage and therefore there is limited information available on potential effects and disturbance ranges for which to inform the in-combination assessment with the Project.
2840. The disturbance ranges that could be generated during the cabling works and vessels would be up to 4km (with a disturbance area of 50.3km²), for all marine mammal species.
2841. The density for the Sea Link project has been estimated based on the Carter et al (2022) relative density data for the WNNC SAC, with an estimated density (for only those harbour seals that are associated with the WNNC SAC) of 0.00053/km².
2842. For disturbance from Sea Link and the Project piling, up to 0.001% of the WNNC SAC population may be disturbed (**Table 9.151**).

Table 9.151 Quantitative Assessment for In-Combination Disturbance of Harbour Seal Due To Subsea Cable And Pipeline Schemes

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.000001	1963.495 (25km EDR)	0.002
Sea Link	0.00053	50.3	0.02
Total number of harbour seal with DBD			1 (0.001% of WNNC SAC)
Total number of harbour seal without DBD			0.02 (0.0007% of WNNC SAC)

9.9.3.1.2.5 Disturbance from UXO Clearance

2843. As for piling, the potential risk of PTS in marine mammals from in-combination effects has been screened out from further consideration in the CEA (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening** if there is the potential for any PTS, suitable mitigation would be put in place to reduce any risk to marine mammals. Therefore, the in-combination effects only consider potential disturbance effects.
2844. This assessment has been based on the potential for disturbance due to UXO clearance activities for other schemes, cumulatively with the construction of the Project.

2845. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity at the Project. In 2021 there were six cases of UXO detonations reported to the MNR in the North Sea, these occurred over a total of 16 days. This amount gives an average of less than one UXO detonation to occur within a year at any one time in the North Sea. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO detonation, even if they had overlapping UXO clearance operation durations. The in-combination assessment is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst-case), and one low-order detonation.
2846. The potential effect area during a single UXO clearance event, based on the modelled worst case effect range at the Project for TTS / fleeing response (weighted SEL) of 24km (1,809.5km²) for high-order clearance and 0.57km (1.02km²) for low-order clearance.
2847. However, as outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO, i.e. each blast lasting for a very short duration, marine mammals, including harbour porpoise, are not predicted to be significantly displaced from an area, any changes in behaviour, if they occur, would be an instantaneous response and short-term. Existing guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010a).
2848. **Table 9.152** presents the potential in combination area and the potential maximum number of harbour seal disturbed.

Table 9.152 Quantitative Assessment for In-Combination Disturbance of Harbour Seal For up to One Low Order and One High Order UXO Clearance

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.000001	1963.495 (25km EDR)	0.002
One high order UXO clearance	0.027	1,809.5	49
One low order UXO clearance	0.027	1.02	0.03
Total number of harbour seal with DBD			50 (1.26% of WNNC SAC)
Total number of harbour seal without DBD			50 (1.26% of WNNC SAC)

9.9.3.1.2.6 Summary of In-combination Impact 1: Assessment of Underwater Noise

2849. Each of the above described noise sources with the potential for disturbance on harbour seal are quantitatively assessed together in **Table 9.153**.

Table 9.153 Quantitative Assessment for All Noisy Activities with the Potential for In-Combination Disturbance Effects For Harbour Seal

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)
DBD piling	0.002 (0.0001%)
Piling at other OWFs	124 (3.11%)
Geophysical surveys	24 (0.61%)
Aggregates and dredging	0.03 (0.0008%)
Seismic surveys	239 (6.04%)
Subsea cables	0.02 (0.0007%)
UXO clearance	49 (1.23%)
Total number of harbour seal (percentage of WNNC SAC)	436 (11%)

2850. For harbour seal, for noisy activities with the potential for in-combination disturbance effects together with piling at the Project 11% of the WNNC SAC population is at risk of disturbance. Therefore, there is a **potential for a temporary adverse effect** on integrity of the WNNC SAC in relation to harbour seal, when in-combination with other schemes.
2851. Behavioural effects from UXO clearance, if they occur, would be an instantaneous response and short-term. Guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010) and therefore could be excluded from the total.
2852. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations. The in-combination is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst case), as well as one low-order clearance event.

2853. It should be noted that while the schemes included within the in-combination assessment for disturbance from other activities and industries were included based on the current knowledge of their possible construction or activity windows, it is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the harbour seal that could be at risk of disturbance during the offshore construction period of the Project.

9.9.3.2 In-Combination Impact 2: Barrier Effects

2854. For the assessment of the potential for barrier effects due to underwater noise from schemes undergoing construction, the effect to marine mammal species would be as per the assessments provided in **Section 9.9.3.1.2**, for in-combination disturbance effects due to all noisy activities.

2855. It is important to note that the OWFs and other noise sources included in the in-combination assessment are spread over the wider area of the North Sea. Taking into account the locations of the OWFs and other noise sources from the Project, the maximum underwater effect ranges for disturbance at other schemes would not overlap with the maximum underwater effect ranges for disturbance at the Project during piling and construction. Therefore, there is no potential for underwater noise from the Project, other OWFs and noise sources to result in a barrier of movement to marine mammals.

2856. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect, and therefore has not been considered within this in-combination assessment.

2857. Therefore, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal.

9.9.3.3 In-Combination Impact 3: Increased Collision Risk with Vessels

2858. The in-combination effects from an increase in the number of vessels and vessel movements can pose a potential collision risk for harbour seal.

2859. As outlined in **Section 9.9.2.1.6** (construction) and **Section 9.9.2.2.6** (operation), vessels would be intermittently present throughout the lifetime of the Project. As vessel movements to and from any port would be incorporated within existing vessel routes as far as possible, there would be no increased collision risk, as the increase in the number of OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas. Once on-site, OWF vessels and other construction-related vessels would be stationary or slow-moving as they undertake their associated activities.

2860. Vessel operators for the Project, North Falls (SSE & RWE, 2024), Sheringham Shoal and Dudgeon Extension (Equinor, 2022) will also follow best practices outlined in the **Outline PEMP** (document reference 8.6) to further reduce collision risks. Hornsea Four (Orsted, 2021) and Outer Dowsing (Outer Dowsing Offshore Wind, 2024) adopt a Vessel Management Plan (VMP) to minimise the potential for any impact. West of Orkney (Offshore Wind Power Limited, 2023), Five Estuaries (Five Estuaries OWF Limited, 2024) and Rampion 2 (Rampion 2 Wind Farm, 2023) adopt a best practice vessel handling protocols such as the WiSe Scheme or Guide to Best Practice for Watching Marine Wildlife. It is expected that other offshore projects and industries will adopt similar measures to mitigate the potential for marine mammal collisions, with Hornsea THREE (Orsted, 2018), Dogger Bank A and B (Forewind, 2014) and South (East and West) (RWE, 2024) also committed to these practices.

2861. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low. Increased collision risk from aggregate extraction and dredging has therefore been screened out from further consideration in the CEA.

2862. In addition, based on the assumption that harbour seal would be disturbed as a result of underwater noise from piling, other construction activities, operational and maintenance activities and vessels, there should be no potential for increased collision risk with vessels.

2863. Therefore, there would be **no adverse effect** on integrity of the WNNC SAC in relation to the conservation objectives for harbour seal due to an increase in collision risk with construction vessels.

9.9.3.4 In-Combination Impact 4: Changes in Prey Resource

2864. Potential effects on prey species for the Project were assessed in **Section 9.9.2.1.8** (construction) and **Section 9.9.2.2.8** (operation). **No adverse effect** on integrity of the WNNC SAC in relation to the conservation objectives for harbour seal was concluded. Any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat in the surrounding area. This will be the case for all schemes and therefore although the in-combination effects are additive, the effect would be proportionate to the wider range over which effects would occur.

2865. Therefore, there would be **no adverse effect** on the integrity of the WNNC SAC in relation to the conservation objectives for harbour seal arising due to changes in prey availability.

9.9.4 Summary of Potential Effects on Site Integrity

2866. The assessment of the potential effects for the Project has been summarised in relation to the WNNC SAC conservation objectives for harbour seal.
2867. The MMMP will provide mitigation or management measures to reduce the potential for any significant disturbance of harbour seal as a result of in-combination effects from underwater noise.
2868. There would be **no adverse effect** on integrity of the WNNC SAC in relation to the conservation objectives for harbour seal, either alone or when in-combination with other schemes.

9.10 Moray Firth SAC

9.10.1 Site Description

2869. The Moray Firth SAC in north-east Scotland supports the only known resident population of bottlenose dolphin in the North Sea (NatureScot, 2021). The Moray Firth is approximately 469km from Array Area and 392km from the offshore ECC at closest point. Individuals are present all year round within the Moray Firth SAC with over 50% of the east coast population utilising the area (Arso Civil *et al.*, 2019). The population generally maintain a coastal distribution which extends south to the Firth of Forth (Hague *et al.*, 2020).

9.10.1.1 Qualifying Feature

9.10.1.1.1 Bottlenose Dolphin

2870. Bottlenose dolphin within the Moray Firth SAC are in favourable (maintained) condition (NatureScot, 2021). The latest conservation status assessment for bottlenose dolphin in UK waters was classed as 'unknown' (JNCC, 2019).
2871. The population estimate for the Moray Firth SAC is 226 individuals (Coefficient of Variation (CV) = 0.02; 95% Confidence Interval (CI) = 214-234) (Arso Civil *et al.*, 2019; IAMMWG, 2023).
2872. Historically, very few sightings of bottlenose dolphin were recorded further south on the east coast of the UK. In recent years an increase in bottlenose dolphins along the coastline of north-east England have been reported. A total of 48 individuals sighted along the north-east coast were attributed to being part of the Moray Firth population using photo-identification (Hackett, 2022).

2873. During the site specific digital aerial surveys of Array Area, undertaken from October 2021 to September 2023, no bottlenose dolphin were recorded. However, there were 18 sightings recorded as unidentified dolphin or porpoise species, which could have been attributed to bottlenose dolphin and has not been included in the assessments.
2874. There is currently no density estimate for bottlenose dolphin in and around the Moray Firth SAC from the SCANS survey or at any other sources.
2875. The density estimate from SCANS-IV survey block NS-C is used for the assessment of bottlenose dolphin as the Project is within this area. The Array Area falls within SCANS block NS-H, however the worst-case density estimate has been used which is Block NS-C. This results in a density estimate of 0.0419 bottlenose dolphin per km² (Gilles *et al.*, 2023).

9.10.1.2 Conservation Objectives

2876. To ensure that the qualifying features of Moray Firth SAC are in favourable condition and make an appropriate contribution to achieving FCS.
2877. To ensure that the integrity of Moray Firth SAC is maintained or restored in the context of environmental changes by meeting the following objectives for each qualifying feature:
- To ensure that the qualifying features of Moray Firth SAC are in favourable condition and make an appropriate contribution to achieving FCS; and
 - To ensure that the integrity of Moray Firth SAC is maintained or restored in the context of environmental changes by meeting objectives 2a, 2b and 2c for each qualifying feature.

9.10.2 Assessment of Potential Effects of the Project Alone

9.10.2.1 Potential Effects During Construction

2878. Potential effects during construction may arise through disturbance from activities during the installation of offshore infrastructure. The potential displacement from important habitat areas and impacts on prey species are also considered.
2879. Underwater noise during piling will not be assessed for the Moray Firth SAC, as piling for the Project is offshore, it will not have an impact on the population associated with the Moray Firth SAC due to the coastal nature of their distributions. However, disturbance associated with underwater noise from other construction activities and the presence of vessels offshore will be considered as these activities may occur closer to shore in the offshore ECC.
2880. The potential effects during construction assessed for bottlenose dolphin of the Moray Firth SAC are outlined in **Section 4.5.3**.

9.10.2.1.1 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.10.2.1.1.1 Impact 3a: Permanent Auditory Injury (PTS) Due to Other Construction Activities

2881. **Table 9.154** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS from the cumulative exposure of other construction activities. For SEL_{cum} calculations, the duration of the noise is also considered, with all sources operating for a worst case of 24-hours in a day.

Table 9.154 The Predicted Effect Ranges For Cumulative PTS For Other Construction Activities In All Marine Mammal Species

Marine mammal species	Potential effect ranges (and areas) for PTS Cable laying, suction dredging, cable trenching, and rock placement
Bottlenose dolphin	<100m (0.031km ²)

2882. The results of the underwater noise modelling do not define effect ranges of <100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably lower).

2883. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in **Table 9.155**, based on the effect areas as presented in **Table 9.154**.

Table 9.155 Assessment Of The Potential For PTS Due To Other Construction Activities, Including Cable Laying, Suction Dredging, Cable Trenching, And Rock Placement, For One Activity Taking Place At Any One Time

Marine mammal species	Assessment of effect
Bottlenose dolphin	0.001 (0.0006% of Moray Firth SAC)

2884. There is the potential that more than one of these other construction activities could be underway at the Array Area or within the offshore export at the same time. As a worst case and unlikely scenario, an assessment for all four activities being undertaken simultaneously has also been undertaken.

2885. **Table 9.156** presents the potential areas of PTS for all four other construction activities taking place at the same time.

Table 9.156 The Predicted Effect Areas For Cumulative PTS, For All Other Construction Activities Taking Place At The Same Time For Bottlenose Dolphins

Marine mammal species	Potential effect ranges (and areas) for PTS Cable laying, suction dredging, cable trenching, and rock placement
Bottlenose dolphin	400m (0.126km ²)

2886. An assessment of the maximum number of individuals that could be at risk of PTS, due to all other construction activities undertaken at the same time is presented in **Table 9.157**, based on the effect areas as presented in **Table 9.156**.

Table 9.157 Assessment Of The Potential For PTS Due To All Other Construction Activities Taking Place At The Same Time

Marine mammal species	Assessment of effect
Bottlenose dolphin	0.005 (0.002% of Moray Firth SAC)

2887. Given the small number of individuals affected, there would be **no adverse effect** of PTS in bottlenose dolphin from other construction activities either alone or taking place simultaneously on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

9.10.2.1.1.2 Impact 3b: Permanent auditory injury (PTS) Due to Construction Vessels

2888. **Table 9.158** presents the underwater noise modelling results for the predicted effect ranges and areas for PTS from the cumulative exposure of vessels within the site. For SEL_{cum} calculations, the duration of the noise is also considered, with noise present for a worst case of 24-hours in a day.

2889. The results of the underwater noise modelling does not define effect ranges of <100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably lower).

2890. The results of the underwater noise modelling (**Table 9.158**) indicate that any bottlenose dolphin would have to be <100m (precautionary maximum range) from the continuous noise source for 24 hours, to be exposed to noise levels that could induce PTS. It is therefore highly unlikely that any individual would be at risk of PTS due to vessel noise. It should be noted that the predicted impact ranges are the distances which represent the 'onset' stage, which is the minimum exposure that could potentially lead to the start of an effect and may only be marginal. In most hearing groups, the noise levels are low enough that there is negligible risk.

Table 9.158 The Predicted Effect Ranges for Cumulative PTS for Vessels in All Marine Mammal Species

Marine mammal species	Potential effect ranges (and areas) for PTS
	Medium of large vessels
Bottlenose dolphin	<100m (0.031km ²)

2891. An assessment of the maximum number of individuals that could be at risk of PTS, due to other construction activities, is presented in **Table 9.159**, based on the effect areas as presented in **Table 9.158**.

Table 9.159 Assessment of the Potential for PTS Due to Medium and Large Vessels

Marine mammal species	Assessment of effect
Bottlenose dolphin	0.001 (0.0006% of Moray Firth SAC)

2892. Given the small number of individuals affected, there would be **no adverse effect** of PTS in bottlenose dolphin from vessels on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

2893. There is the potential that up to 90 vessels may be present in the Offshore Development Area at any one-time during construction. As a worst case and unlikely scenario, an assessment for all 90 vessels has also been undertaken.

2894. **Table 9.160** presents the potential areas of PTS for the maximum construction vessels at any one time, of 90 vessels.

Table 9.160 The Predicted Effect Areas For Cumulative PTS, For Multiple Construction Vessels For All Marine Mammal Species

Marine mammal species	Potential effect areas for PTS
Bottlenose dolphin	2.82km ²

2895. An assessment of the maximum number of individuals that could be at risk of PTS, due to the maximum number of construction vessels at any one time is presented in **Table 9.161**, based on the effect areas as presented in **Table 9.160**.

Table 9.161 Assessment of the Potential for PTS Due to Multiple Construction Vessels

Marine mammal species	Assessment of effect
Bottlenose dolphin	0.1 (0.05% of Moray Firth SAC)

2896. Given the small number of individuals affected, there would be **no adverse effect** of PTS in bottlenose dolphin from vessels on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

9.10.2.1.2 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.10.2.1.2.1 Impact 4a: Disturbance effects due to other construction activities

2897. Marine mammals within the potential disturbance area are considered to have limited capacity to avoid such effects, although any disturbance to marine mammals would be temporary and they would be expected to return to the area once the disturbance had ceased or they had become habituated to the sound.

2898. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of construction activities other than piling noise will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance impact on marine mammals.

2899. There is limited data on the potential for a behavioural response or disturbance from other construction activities (or other continuous noise sources).

2900. The following assessments are based on the 4km disturbance as recorded for harbour porpoise due to the construction activities associated with OWFs (Benhemma-Le Gall *et al.*, 2021). This is over precautionary as it is unlikely bottlenose dolphin would respond to underwater noise disturbance at the same level as harbour porpoise.

9.10.2.1.2.1.1 Disturbance Due To Other Construction Activities (For A Single Activity)

2901. An assessment of the maximum number of individuals that could be at risk of disturbance due to other construction activities based on the 4km potential disturbance range (with an effect area of 50.3km²) is presented in **Table 9.162**. As less than 5% of the reference population is affected, there would be **no adverse effect** of disturbance in bottlenose dolphin from vessels on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

Table 9.162 Assessment Of The Potential For Disturbance Due To Other Construction Activities, Including Cable Laying, Suction Dredging, Cable Trenching, And Rock Placement, For One Activity Taking Place At Any One Time

Marine mammal species	Assessment of effect
Bottlenose dolphin	3 (1.3% of Moray Firth SAC)

9.10.2.1.2.1.2Disturbance Due to Other Construction Activities at Multiple Simultaneous Locations

2902. As noted above, there is the potential that more than one of these other construction activities could be underway at the Array Area or within the offshore export cable at the same time. As a worst case and unlikely scenario, an assessment for all four activities being undertaken simultaneously has also been undertaken.
2903. Based on a 4km potential disturbance range, and up to four other construction activities taking place at the same time, there is the potential for a simultaneous disturbance effect area of 201.06km² for all marine mammal species. As noted above, this assumes that the disturbance would only affect the area around the vessel at the time of the activity taking place, and that marine mammals would return to the disturbed area once the activity had either completed or transited to a new location.
2904. An assessment of the maximum number of individuals that could be at risk of disturbance, due to all other construction activities undertaken at the same time is presented in **Table 9.163**.

Table 9.163 Assessment Of The Potential For Disturbance Due To All Other Construction Activities Taking Place At The Same Time

Marine mammal species	Assessment of effect
Bottlenose dolphin	9 (3.8% of Moray Firth SAC)

2905. As less than 5% of the reference population is affected, there would be **no adverse effect** of disturbance in bottlenose dolphin from vessels on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

9.10.2.1.2.2 Impact 4b: Disturbance Effects Due to Construction Vessels

2906. The assessment on disturbance effects due to construction vessels has been based on the same methods as described in **Section 9.4.2.1.4 Impact 4b**. However, for coastal ecotype bottlenose dolphin from the Moray Firth SAC, this scenario is not appropriate to apply as the animals would stay within an approximate distance to the coast of 12nm. Within that area, only approximately six vessels are likely to be present at the same time in the space between the coast and the 12nm limit (any more vessels would not significantly increase the potential disturbance area due to the extensive overlaps this would generate). In **PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise, Figure 12-8** this scenario is illustrated, which equates to a disturbance area of 301.59km².
2907. The assessments are undertaken based on the maximum number of vessels being present at any one time, which is only likely to occur occasionally.

2908. The disturbance assessment based on one vessel is equivalent to that for one construction activity. This scenario has already been assessed in **Table 9.162** and has therefore not been repeated here.
2909. The assessment indicates that more than 5% of the reference population may be disturbed by all six vessels being present in the offshore ECC area (**Table 9.164**). It is highly unlikely that all vessels will be located this close to shore at the same time and the 4km buffer applied as described in **Section 12.7.1.4.2.2 in PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise** is highly over-precautionary so not realistic for bottlenose dolphin. Therefore, there would be **no adverse effect** of disturbance in bottlenose dolphin from vessels on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

Table 9.164 Maximum Number of Individuals (and % of Reference Population) That Could Be Disturbed as a Result of Underwater Noise Associated with Construction Vessels at the Project

Component specific density	Maximum number of individuals (% of reference population) for 55 vessels in the offshore ECC (301.59km ²)
Offshore ECC	13 (5.6% of Moray Firth SAC)

9.10.2.1.3 Impact 5: Barrier Effects from Underwater Noise During Construction

2910. Underwater noise during construction could have the potential to create a barrier effect, preventing movement of bottlenose dolphin, or potentially increasing swimming distances if they avoid the area. As noted above, bottlenose dolphin are known to move along the coast and are therefore unlikely to be affected as a result of underwater noise at the Array Area.
2911. The worst-case scenario in relation to barrier effects as a result of underwater noise is based on the maximum spatial and temporal (i.e. largest area and longest duration) scenarios.
2912. The maximum number of bottlenose dolphin that could be affected during construction is due to vessel presence within the inshore region of the offshore ECC; less than 13 dolphins, in the unlikely case of six vessels all being present within the inshore region of the offshore ECC. Any potential for a barrier to movement would be temporary and localised, within a small area of the inshore region only.
2913. Any potential barrier effects as a result of underwater noise during construction have been assessed as having **no adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

9.10.2.1.4 Impact 6: Increased Risk of Collision With Vessels During Construction

2914. During the construction phase there would be an increase in the number of vessels transiting to and from the Array Area and within the offshore ECC. However, it is anticipated that vessels would follow an established shipping route to the relevant ports to minimise vessel volume in the area. The **Outline MMMP (document reference 8.1)** provides a protocol for minimising collision risk of marine mammals with vessels.
2915. Evidence shows a lower incidence of physical trauma in strandings of smaller species, like dolphins and seals, which often display normal behaviour around vessels or even habituate to their presence.
2916. In the United Kingdom, approximately 4-6% of stranded small cetaceans (harbour porpoise, common dolphin, white-beaked dolphin and Risso's dolphin) showed evidence of physical trauma during postmortem examinations, potentially attributable to ship strikes. This is compared to 15-20% of stranded whales, based on data from the Cetacean Strandings Investigation Programme (CSIP) database (1990-2010) (Evans *et al.*, 2011).
2917. Vessel activity influences dolphin behaviour, with socialising and foraging often occurring in the presence of various vessel sizes, as demonstrated in a study conducted by Mills *et al.* (2023) in a busy shipping channel in the Gulf of Mexico. It has been suggested in this study that vessel movements enhanced nutrient mixing, thereby increasing prey abundance. Locally, bottlenose dolphins in Cardigan Bay exhibit responses to vessels that vary based on the type of vessel and their degree of habituation (Koroza & Evans, 2022). Observations indicated that the resident bottlenose dolphins in Cardigan Bay were more likely to tolerate disturbances compared to more transient dolphins in the region (Hudson, 2014). At the time of writing there was no information or recorded instances on of ship strikes for bottlenose dolphin in Cardigan Bay. For bottlenose dolphin and common dolphin, the estimated collision risk rate with vessel traffic in the North Sea was relatively low compared to that of harbour porpoise (Robbins, 2022). In contrast, however, white-beaked dolphin was modelled to have high levels of spatial co-occurrence with vessels in the North Sea, although data for the NE coast of England shows this to be mainly in the winter months (October to April) (Robbins, 2022).
2918. Being highly mobile, marine mammals have the potential to avoid vessels but if an individual receptor collides with a vessel, there is the potential for a very limited capacity to recover from the worst-case impact.
2919. Marine mammals can, to some extent, detect and avoid vessels (National Oceanic and Atmospheric Administration (NOAA), 2021). Research shows that larger vessels, such as cruise ships and cargo vessels over 80 meters in length, are more likely to cause severe or fatal injuries to marine mammals (Laist *et al.*, 2001; Keen *et al.*, 2023). High speeds are a key factor in collisions with cetaceans; for instance, the likelihood of a lethal injury to large whales, specifically the North Atlantic right whale in this study, increased from around 20% to 80% when vessel speeds increased from 8 to 15 knots (Vanderlaan & Taggart, 2007). Serious injuries have also been documented at lower speeds of 2 and 5.5 knots (Conn & Silber, 2013). Conversely, vessels traveling at speeds below 10 knots rarely cause serious injuries, making reduced speed one of the most effective mitigation strategies (Laist *et al.*, 2001; Conn & Silber, 2013; Laist *et al.*, 2014; Keen *et al.*, 2023).
2920. The predictability of vessel movements by marine mammals is crucial in minimising the risks posed by vessel traffic (Nowacek *et al.*, 2001, Lusseau, 2003; 2006). Reducing vessel speed not only allows more time for marine mammals to move away, but also significantly reduces emitted vessel noise. This reduction in noise enables marine mammals to hear approaching ships and prevents interference with intra-species communication (Leaper, 2019).
2921. An analysis of the International Whaling Commission (IWC) Ship Strike Database reveals that baleen whales, specifically fin and humpback whales, followed closely by right whales, constitute the majority of ship strike victims (Winkler *et al.*, 2020). However, a significant proportion of reported cases (12.1%) lacked species identification. Reports of collisions involving smaller cetacean species are generally scarce due to reporting biases, such as unnoticed collisions, quickly sinking carcasses, or less concern for smaller species (Schoeman *et al.*, 2020). The IWC report underscores that the lack of species identification and the mis- or underreporting of ship strikes remain global issues, leading to uncertainties in the numbers and species affected (Van Waerebeek *et al.*, 2007; Winkler *et al.*, 2020).
2922. A review on vessel disturbance, detailed in **Section 12.6.5 of PEIR Volume 2, Appendix 12-6 Information and Modelling Methods for Disturbance**, indicated that most marine mammals are affected by vessel noise. The discussion above highlighted that these animals typically respond to noise by exhibiting avoidance or fleeing behaviours, particularly observed in harbour porpoise (Dyndo *et al.*, 2015, Benhemma-Le Gall *et al.*, 2021 and 2023; Frankish *et al.*, 2023), or by co-existing with ships and seals.
2923. The maximum number of vessels that could be in the construction corridors at any one time has been estimated to be 90 vessels. The number, type and size of vessels would vary, depending on the activities taking place at any one time.
2924. Marine mammals in the relevant study area(s) are already accustomed to vessels. All vessel movements would be kept to the minimum number that is required to develop the Project. Additionally, vessel operators would use industry best practice to reduce any risk of collisions with marine mammals.

2925. Therefore, any increase in vessel collision risk during construction has been assessed as having **no adverse effect** on the integrity of the Moray Firth SAC.

9.10.2.1.5 Impact 8: Potential Effects of Changes to Prey Resource and habitat quality

2926. The potential effects on prey species during construction can result from physical disturbance and loss of seabed habitat; increased SSC and sediment re-deposition; and underwater noise. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms.

2927. During construction activities, the worst-case footprint for disturbance would be 28.85km². Predominantly fine sand was the sediment type found (see **PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality**). Increased suspended sediment and sediment re-deposition would only occur for a limited duration at specific locations (e.g. piling location), at any given time. Increases in suspended sediment concentrations and minimal disposal would occur within the 35.4km. The highest suspended sediment concentrations would cover a much smaller area (around 20km from release).

2928. The conclusions in **PEIR Volume 1, Chapter 9 Marine Water and Sediment Quality** indicates that levels of contaminants within the Offshore Development Area are low and do not contain elevated levels to cause concern.

2929. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of the potential underwater noise impacts on fish and shellfish species and predicts that impacts would be of a temporary nature (see **PEIR Volume 1, Chapter 11** for a detailed assessment of underwater noise impacts on fish species). Potential sources of underwater noise and vibration during construction include piling, increased vessel traffic, seabed preparation, rock placement and cable installation. Of these, piling is considered to produce the highest levels of underwater noise and therefore has the greatest potential to result in adverse impacts on fish.

2930. During piling of two sequential monopiles at 8,000kJ, stationary fish with swim bladders involved in hearing could potentially die within a 6km radius or sustain recoverable injuries up to 9.4km away from the piling source (see **Table 11-23** in **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**). Fish species that sustain recoverable injuries, TTS or show behavioural responses would still be available as prey to marine mammals. Like fish, marine mammals would also be displaced from the area. Therefore, these impacts on fish species would not affect the prey resources available to marine mammals.

2931. **PEIR Volume 1, Chapter 14 Commercial Fisheries** provides an assessment of the potential changes of fishing activity by the presence of safety zones associated with the project during construction. The predicted impact would be of negligible impact given the short-term and temporary nature of the construction phase.

2932. The footprint of the project is relatively small and at a distance from the coastline. Therefore, there would be **no adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin for the Project.

9.10.2.1.6 Impact 9: Potential Effects of Changes To Water Quality

2933. Potential changes in water quality during construction could occur through:

- Deterioration in water quality due to an increase in suspended sediment associated with seabed preparation for the installation of foundations and array interconnector cables;
- Deterioration in water quality due to an increase in sediment concentrations due to drill arisings for installation of piled foundations for wind turbines and Offshore Platforms;
- Deterioration in water quality due to increases in suspended sediment associated with the installation of the offshore export cable; and
- Deterioration in water quality associated with release of sediment bound contaminants.

2934. Marine mammals often inhabit turbid environments and cetaceans utilise sonar to sense the environment around them and there is little evidence that turbidity affects cetaceans directly (Todd *et al.*, 2014).

2935. Increased turbidity is unlikely to have a direct impact on marine mammals that often inhabit naturally turbid or dark environments. This is likely because other senses are utilised, and vision is not relied upon solely.

2936. Potential changes in water quality during construction would have **no adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin for the Project.

9.10.2.2 Potential Effects During O&M

9.10.2.2.1 Impact 3: Underwater Noise: Physical and Auditory Injury Resulting from Noise Associated with Other Construction and Maintenance Activities (Such as Dredging and Rock Placement) and Vessel Noise

9.10.2.2.1.1 Impact 3a: Permanent Auditory Injury (PTS) Due to Other O&M Activity

2937. The requirements for any potential O&M work, such as additional rock placement or cable re-burial, are currently unknown, however the work required, and associated effects to marine mammals would be less than those during construction.

2938. The potential for PTS is only likely in very close proximity to cable laying or rock placement activities, and if the marine mammal remains within close proximity for 24 hours. Therefore, it is highly unlikely for there to be any PTS due to these activities.

2939. The effects from additional cable laying and protection are temporary in nature and will be limited to relatively short periods during the O&M phase.

2940. The effect significance for permanent changes in hearing sensitivity (PTS) due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

9.10.2.2.1.2 Impact 3b: Permanent auditory injury (PTS) due to O&M vessels

2941. During the O&M of the Project, there may be up to 16 vessels in the Offshore Development Area at any one time, compared to the 35 vessels that would be on site during construction. Therefore, the potential effects associated with underwater noise and disturbance from vessels during O&M would be less than of those during construction (as assessed in **Section 9.10.2.1.1**). As a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst case scenario.

2942. There would therefore be **no adverse effect** of PTS in bottlenose dolphin from vessels on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

9.10.2.2.2 Impact 4: Underwater Noise: Behavioural Impacts Resulting from Other Construction and Maintenance Activities (Such as Dredging and Rock Placement), and Vessel Noise (Including Disturbance to Foraging Areas)

9.10.2.2.2.1 Impact 4a: Disturbance effects due to other O&M activities

2943. Disturbance responses are likely to occur at significantly shorter ranges than construction noise. Any disturbance is likely to be limited to the area in and around where the actual activity is taking place. The requirements for any potential maintenance work are currently unknown, however, the work required, and impacts associated with underwater noise and disturbance from activities during O&M would be less than those during construction. As there is expected to be less noisy activities during the operation phase than is required during construction, it is therefore likely to cause less disturbance to foraging behaviours in bottlenose dolphin.

2944. Therefore, the potential for adverse effect due to underwater noise from O&M activities is considered to be the same or less than that assessed for underwater noise from other construction activities (including rock placement, trenching and cable laying) (as assessed in **Section 9.10.2.1.2**).

2945. The effect significance for disturbance effects due to these operational activities has therefore been assessed as having **no adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

9.10.2.2.2.2 Impact 4b: Disturbance Effects Due to O&M Vessels

2946. The requirements for any potential maintenance work are currently unknown, however the work required, and impacts associated with underwater noise and disturbance from vessels during O&M would be less than those during construction.

2947. It is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be 19, which is less than the 35 vessels that could be on site during construction. However, as a precautionary approach the assessment for construction has been used for the O&M assessment, as a worst case scenario.

2948. If the response is displacement from the area, it is predicted that marine mammals will return once the activity has been completed and therefore any impacts from underwater noise as a result of O&M activities will be both localised and temporary. Therefore, there is unlikely to be the potential for any significant disturbance effect on marine mammals.

2949. There would therefore be **no adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

9.10.2.2.3 Impact 5: Underwater Noise: Barrier Effects During O&M

2950. No barrier effects as a result of underwater noise during O&M are anticipated at the Project for bottlenose dolphin.

2951. The maximum number of bottlenose dolphin that could be affected during operation is due to vessel presence within the inshore region of the offshore ECC. Therefore, any potential for a barrier to movement would be temporary and localised, within a small area of the inshore region only.

2952. Therefore, no barrier effects as a result of underwater noise during O&M are anticipated, and no further assessment is required.

9.10.2.2.4 Impact 6: Increased Risk of Collision with Vessels During O&M

2953. As noted in **Section 9.10.2.1.4**, it is estimated that the maximum number of vessels that could be required on site at any one-time during O&M could be up to 19.

2954. The number of marine mammals at risk of collision, per vessel, in UK waters, has been assessed as described for the construction phase. Vessel movements, where possible, will be incorporated into recognised vessel routes and hence to areas where marine mammals are accustomed to vessels, in order to reduce any increased collision risk. In addition, vessel operators will use best practice to reduce any risk of collisions with marine mammals, such as reducing the speed of vessel transits wherever possible.

2955. Any increase in vessel collision risk during operation has been assessed as having **no adverse effect** on the integrity of the Moray Firth SAC. This is in relation to the conservation objectives for bottlenose dolphin.

9.10.2.2.5 Impact 8: Potential Effects of Changes to Prey Resource

2956. The potential impacts on fish species during O&M can result from temporary habitat loss / disturbance; permanent habitat loss; introduction of wind turbine foundations; scour protection and hard substrate; increased suspended sediments and sediment re-deposition; re-mobilisation of contaminated sediments; underwater noise; and EMF.

2957. **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** provides an assessment of these impact pathways on the relevant fish and shellfish species and concludes impacts of negligible to minor adverse significance in EIA terms. Any impacts on prey species have the potential to affect marine mammals. A summary of the key effects to prey species (and their relevance for bottlenose dolphin) is provided below.

2958. Habitat loss will occur during the lifetime of the Project as a result of structures, scour and external cable protection installed on the seabed. The introduction of hard substrate, such as wind turbine towers, foundations and associated scour protection and cable protection would increase habitat heterogeneity through the introduction of hard structures in an area predominantly characterised by sediment habitats. During operation of the Project, the estimated total permanent habitat loss would be up to 4.06km² in total. In **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology** this is considered minor to negligible, depending on the species in the context of the amount of similar available habitat in the wider area.

2959. Increases in SSC within the water column and subsequent deposition onto the seabed may occur as a result of O&M activities. Disturbance caused by jack up vessel legs or anchors, as well as cable reburial and/or repair may result in small volumes of sediment being re-suspended. However, the volumes of sediment disturbed from such activities, as well as the overall duration of the disturbance, would be significantly less compared to construction.

2960. The electromagnetic attributes of EMFs have the potential to disrupt organs used for navigation and foraging within a number of fish species. EMFs can have attractive and repulsive effects, that can cause barrier effects dependent on the species and the spatial scale of EMF, for further information, see **PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology**. The cables will be buried, either within the seabed or under rock protection, resulting in a negligible impact zone for fish and shellfish.

2961. The introduction of various man-made structures such as foundations and scour protection in soft sediment areas increases and changes habitat availability and type, resulting in locally altered biodiversity as species are able to establish and thrive in previously hostile environments (Wilhelmsson *et al.*, 2006; Birchenough and Degraer, 2020). Physical structures provide a foundation for settling invertebrates, which increase the organic matter surrounding the structure, and underpin artificial reef ecosystems through ‘bottom-up’ control of productivity. Increasing nutrient availability and biomass presents opportunities for all fish and shellfish species, from top predators to detritivores (Raoux *et al.*, 2017).

2962. The benefit of this potential increase in prey availability to marine mammals has not yet been studied widely. However, the presence of an artificial reef does increase the abundance and biomass of species, and the increase in prey species availability increases the attractiveness of the area to predators (Devault *et al.*, 2017; Paxton *et al.*, 2022).

2963. The introduction of new hard substrate in areas that are predominantly sandy or soft sediments may cause positive effects through potential habitat enhancement (Roach and Cohen, 2020).

2964. The effects arising during the operational phase of the Project are likely to be the same or less than those assessed for construction. The effects of changes to prey during operation would have **no adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin for the Project.

9.10.2.3 Potential Effects During Decommissioning

2965. 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.

2966. Commitment ID CO21 (see **PEIR 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 impacts on bottlenose dolphin 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.

2967. 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.
2968. 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.
2969. Therefore, the potential effects on bottlenose dolphin during decommissioning are assumed to be the same or less than those assessed for construction due to the processes of decommissioning potentially being the reverse of the installation, without the need for piling.

9.10.3 Assessment of Potential Effects of the Project In-Combination

2970. The following in-combination assessment has been undertaken based on **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**, and **Section 12.8 of PEIR Volume 1, Chapter 12 Marine Mammals and Underwater Noise**.
2971. The in-combination assessment considers other schemes and activities where the predicted effects have the potential to combine with the potential effects during construction of the Project. The construction phase has been assessed as the worst case for potential in-combination effects.
2972. The schemes screened into the in-combination assessment for bottlenose dolphin are those that are located in the relevant MUs. Full information on the screening of effects considered for the in-combination assessment is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**.
2973. The in-combination effects assessed are disturbance from underwater noise are outlined in **Section 4.5.3**.

2974. Further information is provided in the **PEIR Volume 2, Appendix 12.5 Cumulative Effect Screening**.

9.10.3.1 In-Combination Impact 1: Disturbance from Underwater Noise

2975. It is intended that this approach to assessing the potential effects of disturbance from underwater noise will reduce some of the uncertainties and complications in using the different assessments from HRAs, based on different noise models, thresholds and criteria, as well as different approaches to density estimates.
- 9.10.3.1.1 In-combination impact 1: Assessment of disturbance from other industries and activities
2976. During the construction period for the Project, there is the potential for disturbance to marine mammals associated with other potential noise sources, including:
- Geophysical surveys;
 - Aggregate extraction and dredging;
 - Seismic surveys;
 - UXO clearance; and
 - Interlink cable.
2977. For the installation of oil and gas infrastructure, marine renewable schemes, and disposal sites, all potential schemes have been screened out. Further information on the CEA screening (and these results) are provided in **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**.
- 9.10.3.1.1.1 Disturbance from Geophysical Surveys*
2978. Assessments for the EPS Protected Sites and Species Risk Assessment (Scottish and Southern Energy, 2020) modelled the potential for a possible behavioural response in marine mammals up to 3.12km from the source in water depths at 10m, and 4.22km in water depths at 100m. Given the shallow water depths in the Array Area (21.2 – 34.6m below LAT), the disturbance distance of 3.12km has been taken forward, resulting in an impact area of 707km² for bottlenose dolphins.
2979. For up to two geophysical surveys undertaken at the same time as construction of the Project, with no other in-combination activities, up to 14.6% of the Moray Firth SAC population may be disturbed (**Table 9.165**).

Table 9.165 Quantitative Assessment for In-Combination Disturbance of Marine Mammals Due to Two Geophysical Surveys at OWFs

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.0419	50.3	3
Two geophysical surveys	0.0419	707 (353.5 per survey)	30
Total number of bottlenose dolphin with DBD			33 (14.6% of Moray Firth SAC)
Total number of bottlenose dolphin without DBD			30 (13.3% of Moray Firth SAC)

2980. There would be a **potential for an adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin as a result of disturbance due to underwater noise (other than piling) from the Project with geophysical surveys. However, this assessment is on a highly precautionary basis, and as can be seen the population reference threshold is breached before the Project effects are considered.

9.10.3.1.1.2 Disturbance from aggregate extraction and dredging

2981. Seven aggregate/dredging projects have been screened in that could have potential cumulative disturbance impacts with piling taking place at the Project (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening**).
2982. As outlined in the BEIS (2020) RoC HRA for the SNS SAC, studies have indicated that harbour porpoise may be displaced by dredging operations within 600m of the activities (Diederichs *et al.*, 2010). As a worst-case assessment, a disturbance range of 600m will be applied for the aggregate schemes at the same time as the Projects' construction. Considering the distance between the aggregate projects and the Moray Firth SAC the projects have been screened out of this assessment as the effects of the projects are unlikely to affect the reference population.

9.10.3.1.1.3 Disturbance from seismic surveys

2983. There are no oil and gas blocks or current developments within the 12nm in the southern North Sea that would require seismic surveys to be undertaken within 5km of the coast (expected range of the coastal Moray Firth bottlenose dolphins) at the same time as construction activity at the Project. Therefore, seismic surveys that could be taking place in-combination with the Project are not considered further at this time.

9.10.3.1.1.4 Disturbance from subsea cables and pipelines

2984. Only one subsea pipeline has been screened into the in-combination assessment, Sea Link. This project is currently at scoping stage and therefore there is limited information available on potential effects and disturbance ranges for which to inform the in-combination assessment with the Project.

2985. However, this scheme is not located in an area identified to have connectivity with the Moray Firth SAC. Therefore, subsea cable and pipeline schemes are not considered further for the Moray Firth SAC

9.10.3.1.1.5 Disturbance from UXO Clearance

2986. As for piling, the potential risk of PTS in marine mammals from in-combination effects has been screened out from further consideration in the CEA (see **PEIR Volume 2, Appendix 12-5 Cumulative Assessment Screening** if there is the potential for any PTS, suitable mitigation would be put in place to reduce any risk to marine mammals. Therefore, the in-combination effects only consider potential disturbance effects.

2987. This assessment has been based on the potential for disturbance due to UXO clearance activities for other schemes, cumulatively with the construction of the Project.

2988. It is currently not possible to estimate the number of potential UXO clearance events that could be undertaken at the same time as construction and potential piling activity at the Project. In 2021 there were six cases of UXO detonations reported to the MNR in the North Sea, these occurred over a total of 16 days. This amount gives an average of less than one UXO detonation to occur within a year at any one time in the North Sea. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO detonation, even if they had overlapping UXO clearance operation durations. The in-combination assessment is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst-case), and one low-order detonation.

2989. The potential effect area of 2,123.7km² per project, based on 26km EDR for UXO high order detonation, and 78.5km² for low-order detonation, following the current SNCB guidance for the assessment of effect to harbour porpoise in the SNS SAC, as a precautionary approach.

2990. However, as outlined in the BEIS (2020) RoC HRA, due to the nature of the sound arising from the detonation of UXO, i.e. each blast lasting for a very short duration, marine mammals, including harbour porpoise, are not predicted to be significantly displaced from an area, any changes in behaviour, if they occur, would be an instantaneous response and short-term. Existing guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010a).

2991. **Table 9.166** presents the potential in combination area and the potential maximum number of bottlenose dolphins disturbed.

Table 9.166 Quantitative Assessment for In-Combination Disturbance of Bottlenose Dolphins For up to One Low Order and One High Order UXO Clearance

Potential in-combination effect	Marine mammal density (/km ²)	Potential in-combination effect area (km ²)	Maximum number of individuals potentially disturbed (% of reference population)
DBD	0.0419	50.3	3
One high order UXO clearance	0.0419	2,123.7	89
One low order UXO clearance	0.0419	78.5	4
Total number of bottlenose dolphin with DBD			96 (42.4% of Moray Firth SAC)
Total number of bottlenose dolphin without DBD			93 (41.1% of Moray Firth SAC)

2992. There would be a **potential for an adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin as a result of disturbance due to underwater noise (other than piling) from the Project with UXO clearances. However, this assessment is on a highly precautionary basis, and as can be seen the population reference threshold is breached before the Project effects are considered.

9.10.3.1.1.6 Summary of In-combination Impact 1: Assessment of Underwater Noise

2993. Each of the above-described noise sources with the potential for disturbance on bottlenose dolphin are quantitatively assessed together in **Table 9.167**.
2994. For bottlenose dolphin, for noisy activities with the potential for in-combination disturbance effects together with other construction at the Project 53.9% of the population is at risk of disturbance. Therefore, there is the **potential for an adverse effect** on integrity of the Moray Firth SAC in relation to bottlenose dolphin, when in-combination with other schemes against the Moray Firth SAC population.
2995. Behavioural effects from UXO clearance, if they occur, would be an instantaneous response and short-term. Guidance suggests that disturbance behaviour is not predicted to occur from UXO clearance if undertaken over a short period of time (JNCC, 2010) and therefore could be excluded from the total.

Table 9.167 Quantitative Assessment for All Noisy Activities with the Potential for In-Combination Disturbance Effects For Bottlenose Dolphin

Potential in-combination effect	Maximum number of individuals potentially disturbed (% of reference population)
DBD other construction	3 (1.3%)
Geophysical surveys	30 (13.3%)
Aggregates and dredging	Screened out
Seismic surveys	Screened out
Subsea cables	Screened out
UXO clearance	89 (39.3%)
Total number of bottlenose dolphin (percentage of MU)	122 (53.9%)

2996. Mitigation measures required for UXO clearance include the use of low-order clearance techniques, which could include a small donor charge, rather than full high-order detonation which is only used as a last resort. It is therefore highly unlikely that more than one UXO high-order detonation would occur at exactly the same time or on the same day as another UXO high-order detonation, even if they had overlapping UXO clearance operation durations. The in-combination is therefore based on potential for disturbance from one UXO high-order detonation without mitigation (worst case), as well as one low-order clearance event.
2997. It should be noted that while the schemes included within the in-combination assessment for disturbance from other activities and industries were included based on a precautionary approach, the current knowledge of their possible construction or activity windows is unknown. It is very unlikely that all activities would be taking place on the same day or in the same season, and therefore this likely represents an over-precautionary and worst case estimate of the bottlenose dolphin that could be at risk of disturbance during the offshore construction period of the Project. The reference population would exceed the 5% threshold for temporary effects significantly without the Project activities being considered, therefore it is unlikely these disturbance effects are realistic and can't be linked to the proposed activity by the Project. Therefore, a more appropriate conclusion would be there is no adverse effect on integrity of the Moray Firth SAC in relation to bottlenose dolphin, when in-combination with other schemes against the Moray Firth SAC population.

9.10.3.2 In-Combination Impact 2: Barrier Effects

2998. For the assessment of the potential for barrier effects due to underwater noise from schemes undergoing construction, the effect to marine mammal species would be as per the assessments provided in **Section 9.10.3.1.1**, for in-combination disturbance effects due to all noisy activities.
2999. It is important to note that the noise sources included in the in-combination assessment are spread over the wider area of the North Sea. It is likely the maximum underwater effect ranges for disturbance at other schemes would not overlap with the maximum underwater effect ranges for disturbance at the Project during construction. Therefore, there is no potential for underwater noise from the Project, other OWFs and noise sources to result in a barrier of movement to marine mammals.
3000. The potential for a barrier effect due to underwater noise during operation was assessed as having no effect, and therefore has not been considered within this in-combination assessment.
3001. Therefore, there would be **no adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin.

9.10.3.3 In-Combination Impact 3: Increased Collision Risk with Vessels

3002. The in-combination effects from an increase in the number of vessels and vessel movements can pose a potential collision risk for bottlenose dolphin.
3003. As outlined in **Sections 9.10.2.1.4** and **9.10.2.2.4**, vessels would be intermittently present throughout the lifetime of the Project. As vessel movements to and from any port would be incorporated within existing vessel routes as far as possible, there would be no increased collision risk, as the increase in the number of OWF vessels would be relatively small compared to the baseline levels of vessel movements in these areas. Once on-site, OWF vessels and other construction-related vessels would be stationary or slow-moving as they undertake their associated activities.

3004. Vessel operators for the Project, North Falls (SSE & RWE, 2024), Sheringham Shoal and Dudgeon Extension (Equinor, 2022) will also follow best practices outlined in the **PEIR Outline PEMP (document reference 8.6)** to further reduce collision risks. Hornsea Four (Orsted, 2021) and Outer Dowsing (Outer Dowsing Offshore Wind, 2024) adopt a Vessel Management Plan (VMP) to minimise the potential for any impact. West of Orkney (Offshore Wind Power Limited, 2023), Five Estuaries (Five Estuaries OWF Limited, 2024) and Rampion 2 (Rampion 2 Wind Farm, 2023) adopt a best practice vessel handling protocols such as the WiSe Scheme or Guide to Best Practice for Watching Marine Wildlife. It is expected that other offshore projects and industries will adopt similar measures to mitigate the potential for marine mammal collisions, with Hornsea THREE (Orsted, 2018), Dogger Bank A and B (Forewind, 2014) and South (East and West) (RWE, 2024) also committed to these practices.
3005. Vessels associated with aggregate extraction and dredging are large and typically slow moving, using established transit routes to and from ports. Therefore, the potential increased collision risk with vessels is considered to be extremely low. Increased collision risk from aggregate extraction and dredging has therefore been screened out from further consideration in the CEA.
3006. In addition, based on the assumption that bottlenose dolphin would be disturbed as a result of other construction activities, operational and maintenance activities and vessels, there should be no potential for increased collision risk with vessels.
3007. Therefore, there would be **no adverse effect** on integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin due to an increase in collision risk with construction vessels.

9.10.3.4 In-Combination Impact 4: Changes in Prey Resource

3008. Potential effects on prey species for the Project were assessed in **Section 9.10.2.1.5** (construction) and **Section 9.10.2.2.5** (operation). **No adverse effect** on integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin was concluded. Any effects on prey species are likely to be intermittent, temporary and highly localised, with potential for recovery following cessation of the disturbance activity. Any permanent loss or changes of prey habitat will typically represent a small percentage of the potential habitat in the surrounding area. This will be the case for all schemes and therefore although the in-combination effects are additive, the effect would be proportionate to the wider range over which effects would occur.
3009. Therefore, there would be **no adverse effect** on the integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin arising due to changes in prey availability.

9.10.4 Summary of Potential Effects on Site Integrity

3010. The assessment of the potential effects for the Project has been summarised in relation to the Moray Firth SAC conservation objectives for bottlenose dolphin.
3011. There would be **no adverse effect** on integrity of the Moray Firth SAC in relation to the conservation objectives for bottlenose dolphin, either alone or when in-combination with other schemes.

9.11 European Sites

9.11.1 Conservation Objectives

3012. All the screened in European Designated Sites use the OSPAR Conservation Objectives:
- To protect, conserve and restore species, habitats and ecological processes which have been adversely affected by human activities;
 - To prevent degradation of, and damage to, species, habitats and ecological processes, following the precautionary principle; and
 - To protect and conserve areas that best represent the range of species, habitats and ecological processes in the maritime area.

9.11.2 Klaverbank SAC

9.11.2.1 Site Description

3013. The Klaverbank SAC, designated by the Netherlands has been recognised as an SAC since June 2016. The SAC is a designated site for the marine mammals harbour porpoise, harbour seal and grey seal (EUNIS, 2020).
3014. The Klaverbank SAC covers an area of 1,539km². The SAC's closest point to the Projects is 72km.

9.11.2.2 Qualifying Feature

9.11.2.2.1 Harbour porpoise

3015. Harbour porpoise densities for the Dutch Delta region were estimated at 0.71 per km² in summer 2019, totalling to 14,713 individuals (Geelhoed *et al.*, 2020).

9.11.2.2.2 Harbour seal

3016. A range of 101 and 250 individual harbour seals were counted (Natura 2000). Within the greater area of the Dutch Delta, harbour seal counts ranged from 677- 2581 from (2011-2021) (Central Bureau of Statistics *et al.*, 2023).

9.11.2.2.3 Grey seal

3017. A maximum of 400 individual grey seals were counted (Natura 2000). Within the greater area of the Dutch Delta, harbour seal counts ranged from 677- 2581 from (2011-2021) (Central Bureau of Statistics *et al.*, 2023).

9.11.2.3 Assessment

3018. To assess the site most appropriately, despite the lack of site-specific species population data, a precautionary approach for the assessment has been used.
3019. The SNS SAC (**Section 9.4**), Doggersbank SAC (**Section 9.5**) is deemed as the worst case scenario because the Project lies within the SAC boundaries either via the Array Area or the offshore ECC. Given the slightly longer distance between the Project and Klaverbank SAC, the effects on harbour porpoise would likely to be similar or less than those assessed in the SNS SAC or Doggersbank SAC.
3020. Tracking data of harbour seals (Carter *et al.*, 2022, 2020) showed some trips from the southeast of the UK and the Belgian-French coastline, although there is a higher level of connectivity with The Wash and North Norfolk Coast SAC (**Section 9.9**). This suggests that harbour seals from the Klaverbank SAC could potentially utilise this corridor as well, possibly becoming affected by activities at the Projects, such as vessel collision and underwater noise.
3021. Grey seal tracking data (Carter *et al.*, 2022, 2020; see **Figure 9-10** and **Figure 9-11**; Vincent *et al.*, 2017 see **Figure 9-12**) showed grey seals tagged in Britain are more likely to use the wider offshore North Sea area, with limited examples of tracked grey seals swimming to the north coast of France, Belgium, or Germany. Grey seals tagged in France are more likely to travel along the north coast of France and Belgium, although there is movement of seals to south-east England. This suggests that grey seals in Doggersbank SAC are less likely to be connected to the Project than the HE SAC (**Section 9.6**).

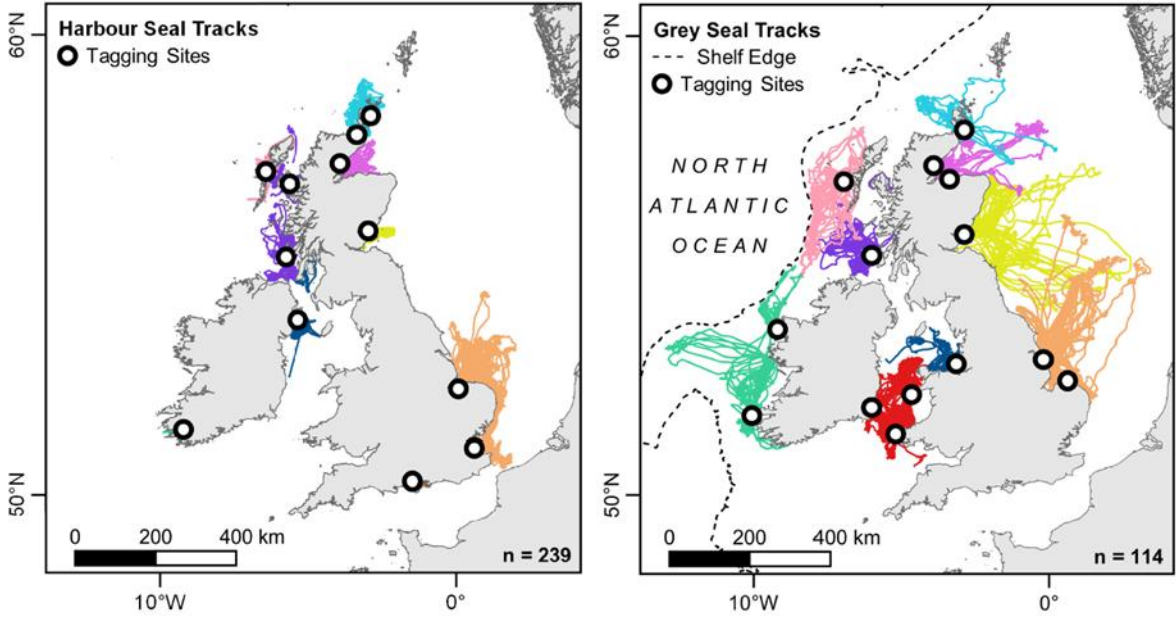


Figure 9-10 Tracking data for harbour seals and grey seals, colour-coded by habitat preference region (data shown have been cleaned to remove erroneous location estimates, trips between regions and locations during the corresponding species' breeding season) (Carter et al., 2022)

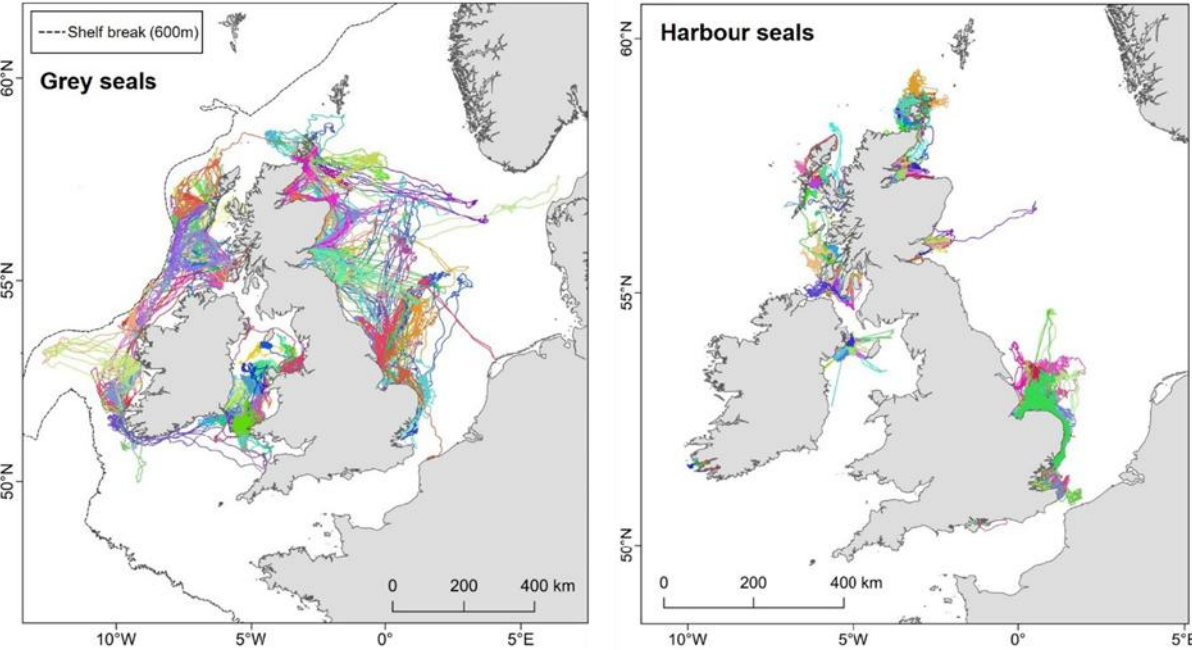


Figure 9-11 Tracking Data for Grey and Harbour Seals (Coloured By Individual (Grey Seals = 114; Harbour Seals = 239)) (Carter et al., 2020)

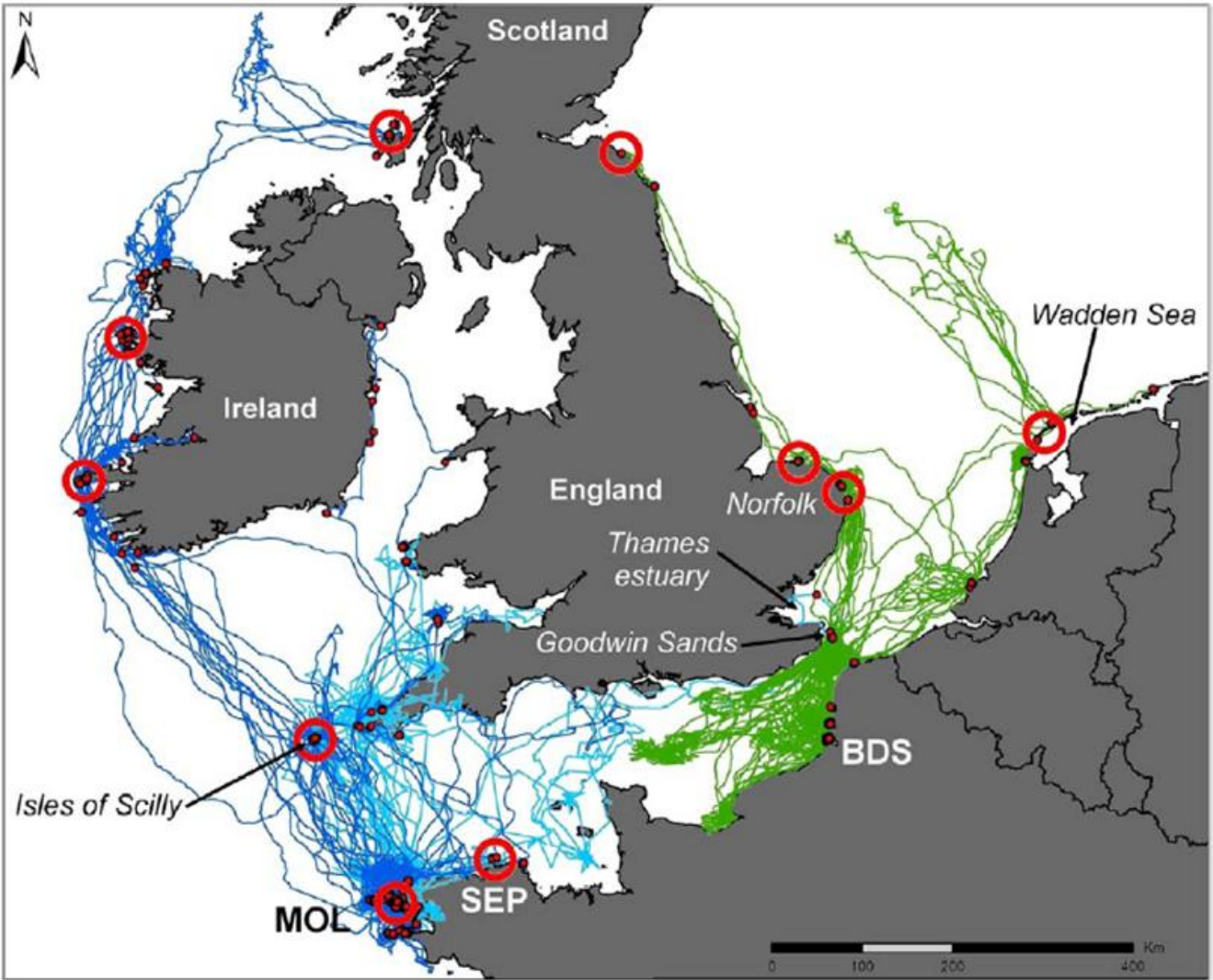


Figure 9-12 Grey Seal Telemetry Tracks from Molene Archipelago (MOL) (15 Individuals from 1999 to 2003, in Light Blue, and 19 Individuals from 2010 to 2013, in Dark Blue) and Baie de Somme (BDS) (11 Individuals Tracked in 2012, in Green) (Vincent et al., 2017)

3022. **Table 9.168** summarises the assessment of potential effects on Klaverbank SAC on the species that were screened in for further assessment as a qualifying feature, based on the assessments undertaken for the SNS SAC (**Section 9.4**) and Doggersbank SAC (**Section 9.5**) for harbour porpoise, HE for grey seal (**Section 9.6**), and The Wash and North Norfolk Coast SAC for harbour seal (**Section 9.9**) under the assumption that greater connectivity is expected for the sites within the UK, and therefore the greater potential for effect would be present (and assessed) for the UK sites as noted above.

Table 9.168 Summary of Potential Construction Effects for Qualifying Features of the Klaverbank SAC (X = No Potential for Adverse Effect on Site Integrity; √= Potential for Adverse Effect on Site Integrity)

Qualifying features	Underwater noise from piling	Underwater noise from other noisy activities	Underwater noise from vessels	Underwater noise from operational WTGs	Barrier effects from underwater noise	Collision risk	Prey availability / habitat quality	Water quality	Disturbance to seal haul-out sites
Construction phase									
Harbour porpoise	X	X	X	N/A	X	X	X	X	X
Grey seal	X	X	X	N/A	X	X	X	X	X
Harbour seal	X	X	X	N/A	X	X	X	X	X
Operational phase									
Harbour porpoise	N/A	X	X	X	X	X	X	X	X
Grey seal	N/A	X	X	X	X	X	X	X	X
Harbour seal	N/A	X	X	X	X	X	X	X	X
Decommissioning phase									
Harbour porpoise	N/A	X	X	N/A	X	X	X	X	X
Grey seal	N/A	X	X	N/A	X	X	X	X	X
Harbour seal	N/A	X	X	N/A	X	X	X	X	X

3023. Disturbance from underwater noise for the Project with other schemes and activities is unlikely to result any significant disturbance or barrier effects for foraging harbour porpoise, harbour seal or grey seal, especially taking into the proposed mitigation approach for harbour porpoise in the SNS SAC. Under these circumstances, there is **no adverse effect** on the integrity of the Klaverbank SAC in relation to the conservation objectives for harbour porpoise, grey seal and harbour seal.

9.11.3 Other Sites

3024. As listed in **Table 4.15** there are other European sites screened due to the Project having the potential effect the designated features of those sites. However, due to distance and connectivity the worst-case impacts have already been assessed for other sites. Potential effects on designated features for the other sites listed below will be less than those assessed for the UK sites, as concluded for the Klaverbank SAC.
3025. A European site where harbour porpoise and harbour seal are the designated feature screened in for assessment is Doggerbank SCI.
3026. Other European sites where grey seal is the designated feature screened in for assessment includes:
- Vlaamse Banken SAC (Site code: BEMNZ0001);
 - Vlake van de Raan SCI (Site code: BEMNZ0005);
 - Sydlige Nordsø SAC (Site code: DK00VA347);
 - Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde SAC (Site code: DK00AY176);
 - Baie de Canche et couloir des trois estuaires SAC (Site code: FR3102005);
 - Bancs des Flandres SAC (Site code: FR3102002);
 - Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardingenhen et Dunes de Wissant SAC (Site code: FR3100478);
 - Recifs Gris-Nez Blanc-Nez SAC (Site code: FR3102003);
 - Ridens et dunes hydrauliques du etroit du Pas-de-Calais SAC (Site code: FR3102004);
 - Dünenlandschaft Süd-Sylt SAC (Site code: DE1115391);
 - Hamburgisches Wattenmeer SAC (Site code: DE2016301);
 - Helgoland mit Helgolander Felssockel SAC (Site code: DE1813391);
 - Küsten- und Dünenlandschaften Amrums SAC (Site code: DE1315391);
 - National park Niedersächsisches Wattenmeer SAC (Site code: DE2306301);
 - NTP S-H Wattenmeer und angrenzende Küstengebiete SAC (Site code: DE0916391);
 - SPA Ostliche Deutsche Bucht SPA (Site code: DE1011401);

- Steingrund SAC (Site code: DE1714391);
- Sylter Außenriff SCI (Site code: DE1209301);
- Duinen Ameland SAC (Site code: NL3009005);
- Duinen en Lage Land Texel SAC (Site code: NL2003060);
- Duinen Goeree & Kwade Hoek SAC (Site code: NL9801079);
- Duinen Terschelling SAC (Site code: NL2003059);
- Duinen Vlieland SAC (Site code: NL2003061);
- Grevelingen SAC (Site code: NL4000021);
- Noordzeekustzone SAC (Site code: NL9802001);
- Oosterschelde SPA and SAC (Site code: NL3009016);
- Vlake van de Raan SAC (Site code: NL2008003);
- Voordelta SAC and SPA (Site code: NL4000017);
- Waddenzee SAC (Site code: NL1000001); and
- Westerschelde & Saeftinghe SAC (Site code: NL9803061).

9.11.4 Summary of Potential Effects on Site Integrity

3027. The assessment of the potential effects for the Project has been summarised in relation to other European SAC site conservation objectives for harbour porpoise, grey seal and harbour seal.
3028. There would be no adverse effect on integrity on any of the European SAC sites in relation to the conservation objectives for harbour porpoise, grey seal and harbour seal, either alone or when in-combination with other schemes.

10 Summary

3029. This RIAA reports on the outcomes of the screening process and how associated stakeholder feedback has been addressed and provides the RIAA to support the PEIR consultation process. This RIAA concludes that the Project, in combination with other plans and projects, would have no AEol on designated sites and their features with the exception of:
- Flamborough and Filey Coast SPA – Kittiwake (collision risk during the O&M phase; and
 - Dogger Bank SAC - Sandbanks (habitat loss).
3030. The Applicant concludes no AEol (alone or in combination) for guillemot and razorbill associated with the Flamborough and Filey Coast SPA. However, the Secretary of State (SoS) has previously concluded AEol for guillemot for a number of recent projects. Although the increase in baseline mortality on guillemot and razorbill feature of the FFC SPA for the Project in-combination is over 1%, the guillemot and razorbill features of the FFC SPA are considered to be in favourable condition, with steady continual long term population increases recorded. The reduction in the guillemot and razorbill population growth rate is highly unlikely to lead to a population decline when considering the consistent increasing growth trend of these features.
3031. The assessment conclusions are presented in **Table 10-1**.

Table 10-1 Conclusions of the European Sites' Assessment

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
Annex I Habitats			
Dogger Bank SAC	Sandbanks which are slightly covered by seawater all the time.	Long term habitat loss during O&M.	During operation and maintenance, given the restore objectives the potential for an AEol of the conservation objectives of the site for the Project alone and in-combination with other plans and projects for long term habitat loss. Subsequently, the Annex I sandbank habitat may not be maintained as favourable in the long term without the implementation of additional compensation measures.
Annex II Terrestrial Ecology and Ornithology			
Humber Estuary Ramsar	<ul style="list-style-type: none">Bar-tailed godwit (overwintering).Black-tailed godwit (passage and overwintering).Dunlin (passage and overwintering).Golden plover (passage and overwintering).Knot (passage and overwintering).Redshank (passage and overwintering).Shelduck (overwintering).Waterbird assemblage (overwintering).	<ul style="list-style-type: none">Disturbance / displacement as a result of onshore and landfall works during construction, O&M, and decommissioning.Long term and temporary loss of functionally linked land as a result of onshore and landfall works and infrastructure during construction, O&M, and decommissioning.Indirect impacts through effects on supporting habitats and prey species as a result of onshore and landfall works and infrastructure during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
	<ul style="list-style-type: none">Estuarine habitats.	<ul style="list-style-type: none">Indirect habitat degradation through changes in air quality as a result of onshore and landfall works during construction.	
Humber Estuary SPA	<ul style="list-style-type: none">Avocet (non-breeding bio-season).Bar-tailed godwit (non-breeding bio-season).Black-tailed godwit (non-breeding bio-season).Dunlin (non-breeding bio-season).Golden plover (non-breeding bio-season).Hen harrier (non-breeding bio-season).Knot (non-breeding bio-season).Marsh harrier (breeding bio-season).Redshank (non-breeding bio-season).Ruff (non-breeding bio-season).Shelduck (non-breeding bio-season).Waterbird assemblage (non-breeding bio-season).	<ul style="list-style-type: none">Disturbance / displacement as a result of onshore and landfall works during construction, O&M, and decommissioning.Long term and temporary loss of functionally linked land as a result of onshore and landfall works and infrastructure during construction, O&M, and decommissioning.Indirect impacts through effects on supporting habitats and prey species as a result of onshore and landfall works and infrastructure during construction, O&M, and decommissioning.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
Humber Estuary SAC	<ul style="list-style-type: none">Estuaries.Mudflats and sand flats not covered by seawater at low tide.Atlantic salt meadows.	<ul style="list-style-type: none">Indirect habitat degradation through changes in air quality as a result of onshore and landfall works during construction.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Greater Wash SPA	<ul style="list-style-type: none">Little tern (breeding bio-season).Common tern (breeding bio-season).Sandwich tern (breeding bio-season).Little gull (breeding and non-breeding bio-season)Common scoter (non-breeding bio-season).Red-throated diver (non-breeding bio-season).	<ul style="list-style-type: none">Disturbance / displacement as a result of onshore and landfall works during construction, O&M, and decommissioning.Long term and temporary loss of functionally linked land as a result of onshore and landfall works and infrastructure during construction, O&M, and decommissioning.Indirect impacts through effects on supporting habitats and prey species as a result of onshore and landfall works and infrastructure during construction, O&M, and decommissioning.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Annex II Marine and Intertidal Ornithology			
Greater Wash SPA	<ul style="list-style-type: none">Little tern (breeding and non-breeding bio-season).Common tern (breeding and non-breeding bio-season).Sandwich tern (breeding and non-breeding bio-season).Common scoter (non-breeding bio-season).Red-throated diver (non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Humber Estuary SPA	<ul style="list-style-type: none">Little tern (breeding and non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Flamborough and Filey Coast SPA	<ul style="list-style-type: none">Kittiwake (breeding and non-breeding bio-season).	<ul style="list-style-type: none">Indirect effects via habitat or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination effects during O&M.	<p>Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone.</p> <p>However, the potential for an AEol therefore as a result of collisions cannot be ruled out for the Project in-combination with other projects.</p>

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
Flamborough and Filey Coast SPA (<i>continued</i>)	<ul style="list-style-type: none">Guillemot (non-breeding bio-season).Razorbill (non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.Barrier effects during O&M.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
	<ul style="list-style-type: none">Gannet (breeding and non-breeding bio-season).	<ul style="list-style-type: none">Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitat or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination effects during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
	<ul style="list-style-type: none">Seabird assemblage (breeding and non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
	<ul style="list-style-type: none">Herring gull (component species) (non-breeding bio-season).	<ul style="list-style-type: none">Indirect effects via habitat or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination effects during O&M.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
Coquet Island SPA	<ul style="list-style-type: none">Seabird assemblage (non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
	<ul style="list-style-type: none">Puffin (non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.Barrier effects during O&M.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Farne Island SPA	<ul style="list-style-type: none">Guillemot (non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.Barrier effects during O&M.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
Farne Island SPA (continued)	<ul style="list-style-type: none">Seabird assemblage (breeding and non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
	<ul style="list-style-type: none">Kittiwake (breeding and non-breeding bio-season).	<ul style="list-style-type: none">Indirect effects via habitat or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination effects during O&M.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
	<ul style="list-style-type: none">Puffin (non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.Barrier effects during O&M.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Forth Islands SPA	<ul style="list-style-type: none">Gannet (breeding and non-breeding bio-season).	<ul style="list-style-type: none">Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitat or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination effects during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
Forth Islands SPA <i>(continued)</i>	<ul style="list-style-type: none">Puffin (non-breeding bio-season).	<ul style="list-style-type: none">Disturbance and displacement due to work activity in the DBD Array Area, offshore ECC or landfall during construction, O&M, and decommissioning.Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitats or prey availability during construction, O&M, and decommissioning.Barrier effects during O&M.In-combination impacts during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Fowlsheugh SPA	<ul style="list-style-type: none">Kittiwake (non-breeding bio-season).	<ul style="list-style-type: none">Indirect effects via habitat or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination effects during O&M.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
East Caithness Cliffs SPA	<ul style="list-style-type: none">Herring gull (non-breeding bio-season).Kittiwake (non-breeding bio-season).	<ul style="list-style-type: none">Indirect effects via habitat or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination effects during O&M.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Noss SPA	<ul style="list-style-type: none">Gannet (non-breeding bio-season).	<ul style="list-style-type: none">Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitat or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination effects during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
Hermaness, Saxa Vord and Valla Field SPA	<ul style="list-style-type: none">Gannet (non-breeding bio-season).	<ul style="list-style-type: none">Direct disturbance and displacement due to presence of wind turbines and other offshore infrastructure during construction, O&M, and decommissioning.Indirect effects via habitat or prey availability during construction, O&M, and decommissioning.Collision risk during O&M.Barrier effects during O&M.In-combination effects during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Annex II Migratory Fish			
River Derwent SAC (Site code: UK0030253)	<ul style="list-style-type: none">River lamprey.Sea lamprey.	Underwater Noise (inshore UXO clearance).	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Humber Estuary SAC (Site code: UK0030170)	<ul style="list-style-type: none">River lamprey.Sea lamprey.	Underwater Noise (inshore UXO clearance).	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.
Humber Estuary Ramsar (Site code: UK11031; RSIS code: 663)	<ul style="list-style-type: none">River lamprey.Sea lamprey.	Underwater Noise (inshore UXO clearance).	Potential for an AEol of the conservation objectives of the site can be confidently ruled out for the Project alone and in-combination with other projects.

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
Annex II Marine Mammals			
Doggersbank SAC	<ul style="list-style-type: none">Grey sealHarbour sealHarbour porpoise	<ul style="list-style-type: none">Underwater noise: physical and auditory injury (permanent threshold shift (PTS)) resulting from impact piling during construction.Underwater noise: behavioural impacts resulting from impact piling during construction.Underwater noise: physical and auditory injury (PTS) resulting from operational wind turbine noise.Underwater noise: behavioral impacts resulting from operational wind turbine noise.Underwater noise: physical and auditory injury (PTS) resulting from noise associated with other construction, O&M, and decommissioning activities (such as dredging and rock placement) and vessel noise.Underwater noise: behavioral impacts resulting from other construction, O&M, and decommissioning activities (such as dredging and rock placement), and vessel noise (including disturbance to foraging areas).Underwater noise: barrier effects during construction, O&M, and decommissioning.Disturbance at seal haul-out sites during construction, O&M, and decommissioning.Vessel interaction (increase in risk of collision) during construction, O&M, and decommissioning.Changes to prey resource during construction, O&M, and decommissioning.Changes to water quality during construction and decommissioning.Barrier effects from the physical presence of the wind farm during operation.In-combination effects during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the sites can be confidently ruled out for the Project alone and in-combination with other projects.
Southern North Sea SAC	Harbour porpoise		
Humber Estuary SAC	Grey seal		
Ridens et dunes hydrauliques du etroit du Pas-de-Calais SAC	Grey seal		
Klaverbank SAC	<ul style="list-style-type: none">Harbour sealGrey sealHarbour porpoise		
The Wash and North Norfolk Coast SAC	Harbour seal		
Berwickshire and North Northumberland Coast SAC	Grey seal		
Sylter Außenriff SCI	Grey seal		
Noordzeekustzone SAC	Grey seal		
Duinen Terschelling SAC	Grey seal		
Waddenzee SAC	Grey seal		
Duinen Vlieland SAC	Grey seal		
Duinen en Lage Land Texel SAC	Grey seal		
Duinen Ameland SAC	Grey seal		
Sydlig Nordsø SAC	Grey seal		
Isle of May SAC	Grey seal		

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
SPA Ostliche Deutsche Bucht SPA	Grey seal	<ul style="list-style-type: none">Underwater noise: physical and auditory injury (permanent threshold shift (PTS)) resulting from impact piling during construction.Underwater noise: behavioural impacts resulting from impact piling during construction.Underwater noise: physical and auditory injury (PTS) resulting from operational wind turbine noise.Underwater noise: behavioral impacts resulting from operational wind turbine noise.Underwater noise: physical and auditory injury (PTS) resulting from noise associated with other construction, O&M, and decommissioning activities (such as dredging and rock placement) and vessel noise.Underwater noise: behavioral impacts resulting from other construction, O&M, and decommissioning activities (such as dredging and rock placement), and vessel noise (including disturbance to foraging areas).Underwater noise: barrier effects during construction, O&M, and decommissioning.Disturbance at seal haul-out sites during construction, O&M, and decommissioning.Vessel interaction (increase in risk of collision) during construction, O&M, and decommissioning.Changes to prey resource during construction, O&M, and decommissioning.Changes to water quality during construction and decommissioning.Barrier effects from the physical presence of the wind farm during operation.In-combination effects during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the sites can be confidently ruled out for the Project alone and in-combination with other projects.
National park Niedersachsisches Wattenmeer SAC	Grey seal		
NTP S-H Wattenmeer und angrenzende Küstengebiete SAC	Grey seal		
Vadehavet med Ribe Å, Tved Å og Varde Å vest for Varde SAC	Grey seal		
Vlaamse Banken SAC	Grey seal		
Helgoland mit Helgolander Felssockel SAC	Grey seal		
Bancs des Flandres SAC	Grey seal		
Steingrund SAC	Grey seal		
Doggerbank SCI	Harbour seal Harbour porpoise		
Voordelta SAC and SPA	Grey seal		
Dünenlandschaft Süd-Sylt SAC	Grey seal		
Küsten- und Dünenlandschaften Amrums SAC	Grey seal		
Vlakte van de Raan SCI	Grey seal		
Vlakte van de Raan SAC	Grey seal		
Duinen Goeree & Kwade Hoek SAC	Grey seal		
Recifs Gris-Nez Blanc-Nez SAC	Grey seal		

European Site	Qualifying Feature	Potential Effects	Potential for adverse effect on site integrity alone/ in combination?
Grevelingen SAC	Grey seal	<ul style="list-style-type: none">Underwater noise: physical and auditory injury (permanent threshold shift (PTS)) resulting from impact piling during construction.Underwater noise: behavioural impacts resulting from impact piling during construction.Underwater noise: physical and auditory injury (PTS) resulting from operational wind turbine noise.Underwater noise: behavioral impacts resulting from operational wind turbine noise.Underwater noise: physical and auditory injury (PTS) resulting from noise associated with other construction, O&M, and decommissioning activities (such as dredging and rock placement) and vessel noise.Underwater noise: behavioral impacts resulting from other construction, O&M, and decommissioning activities (such as dredging and rock placement), and vessel noise (including disturbance to foraging areas).Underwater noise: barrier effects during construction, O&M, and decommissioning.Disturbance at seal haul-out sites during construction, O&M, and decommissioning.Vessel interaction (increase in risk of collision) during construction, O&M, and decommissioning.Changes to prey resource during construction, O&M, and decommissioning.Changes to water quality during construction and decommissioning.Barrier effects from the physical presence of the wind farm during operation. In-combination effects during construction, O&M, and decommissioning.	Potential for an AEol of the conservation objectives of the sites can be confidently ruled out for the Project alone and in-combination with other projects.
Hamburgisches Wattenmeer SAC	Grey seal		
Oosterschelde SPA and SAC	Grey seal		
Westerschelde & Saeftinghe SAC	Grey seal		
Falaises du Cran aux Oeufs et du Cap Gris-Nez, Dunes du Chatelet, Marais de Tardinghen et Dunes de Wissant SAC	Grey seal		
Baie de Canche et couloir des trois estuaires SAC	Grey seal		
Moray Firth SAC	Bottlenose dolphin		
Estuaires et littoral picards (baies de Somme et d'Authie) SAC	Grey seal		

11 Next Steps – DCO Application

3032. Following consultation on this draft RIAA alongside the PEIR, and further to ongoing project design and development, this RIAA will be updated.

3033. On the basis of the conclusions of this Draft RIAA and previous precedent, the Applicant intends to provide a derogation case to support the final DCO application (on a with and/or without prejudice basis, depending on the conclusions of the final RIAA). The derogation case relates to the following features and designated sites:

- Flamborough and Filey Coast SPA – Kittiwake (collision risk during the O&M phase);
- Flamborough and Filey Coast SPA – Guillemot and razorbill (displacement during the O&M phase) (on a without prejudice basis); and
- Dogger Bank SAC - Sandbanks (habitat loss).

3034. To support this derogation case, from the outset of the Project, the Applicant has:

- Ensured the mitigation hierarchy is observed at the EIA and AA stages;
- Continued to ensure that all relevant alternative solutions (that meet the Project’s objectives) have been considered and evaluated as the project has progressed to ensure should any alternative solution that avoids the AEoI outcome be identified it has been pursued wherever feasible; and
- Progressed options for compensatory measures in discussion with stakeholders via the EPP and additional meetings, with the aim of progressing compensation measures to a suitable mature stage prior to submission of the DCO application. It is noted that strategic compensation is being developed by Defra for the habitat types within the Dogger Bank SAC. Work undertaken to date on compensation measures and proposed next steps are set out in the following roadmap documents:
 - Benthic HRA Derogation Compensation - Roadmap & Evidence (document reference 5.4.1);
 - Kittiwake Compensation - Roadmap & Evidence (document reference 5.4.2); and
 - Guillemot and Razorbill Compensation - Roadmap & Evidence (document reference 5.4.3).

3035. With the final DCO application the Applicant will produce a derogation case document that sets out:

- Legislation and policy context for derogation – This will set out the policy and legislative context for derogation along with relevant guidance that has been used to inform the approach to derogation
- Project objectives and need case – Objectives are used to frame the assessment as to whether there are any alternative solutions to the plan or project that would avoid or reduce the impact on a protected site, and whether there are any imperative reasons of overriding public interest that outweigh the harm to the site. An overview of the need case and objectives of the project are provided in **PEIR Volume 1, Chapter 1 Introduction** and **Chapter 2 Need for the Project**, but in summary, DBD seeks to build upon the successful development of the Dogger Bank leasing area by generating from an otherwise allocated but unused portion of that area a significant quantity of low-carbon electricity for export to the UK’s national electricity transmission system. In doing so, and once operational, DBD aims to support the government’s aim to achieve its Clean Power target²⁰, thereby delivering critical decarbonisation and energy security and affordability benefits to the UK electricity system.
- Consideration of alternatives – In line with Defra (2021) guidance the derogation case document will review alternative locations, scale/size, design, methods and timing to demonstrate that there are no feasible alternatives the project that would be less damaging to the protected site/s. This review will consider financial, legal and technical feasibility of the alternatives considered.
- Imperative reasons of overriding public interest – This aspect of the derogation case will set out the imperative reasons for the project in relation to public interest and set out how the public interest outweighs the harm, or risk of harm, to the integrity of the protected site.

3036. In addition, a series of compensation plans will be submitted with the final application detailing proposed compensation measures and associated implementation and monitoring plans.

5. Clean Power 2030 Action Plan Connections Reform Annex, <https://assets.publishing.service.gov.uk/media/6776751e6a79200ddfa21b83/clean-power-2030-action-plan-connections-reform-annex.pdf>.

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List of Acronyms

Acronym	Definition
AA	Appropriate Assessment
ADDs	Acoustic Deterrent Devices
AEol	Adverse Effect on Integrity
AEoSI	Adverse Effect on Site Integrity
AOD	Above Ordnance Datum
AoS	Area of Search
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
BAS	Burial Assessment Study
BATNEEC	Best available technology not entailing excessive costs
BDMPS	Biologically Defined Minimum Population Scales
BEIS	Department for Business, Energy and Industrial Strategy
BGS	British Geological Society
BNG	Biodiversity Net Gain
BSI	British Standards Institution
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effect Assessment
Cefas	Centre for the Environment and Fisheries and Aquaculture Science
CL	Critical Level
CRM	Collision Risk Modelling
DAS	Digital Aerial Survey
DBA	Dogger Bank A
DBB	Dogger Bank B

Acronym	Definition
DBC	Dogger Bank C
DBD	Dogger Bank D
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DEFRA	Department of Environmental, Food and Rural Affairs
DEP	Dudgeon Extension Project
DESNZ	Department for Energy Security and Net Zero
DVI	Disturbance Vulnerability Index
ECC	Export cable corridors
ECC	Offshore Export Cable Corridor
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EOWDC	European Offshore Wind Deployment Centre
EPP	Evidence Plan Process
EPS	European Protect Species
ES	Environmental Statement
ESBI	Energy Storage and Balancing Infrastructure
ESO	Electricity System Operator
ETG	Expert Topic Group
EU	European Union
FFC	Flamborough and Filey Coast
GPS	Global Positioning System

Acronym	Definition
ha	Hectare
HAT	Highest Astronomical Tide
HDD	Horizontal Directional Drilling
HND	Holistic Network Design
HPAI	Highly Pathogenic Avian Influenza
HPF	Hydrogen Production Facility
HRA	Habitats Regulation Assessment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
IDB	Internal Drainage Board
IROPI	Imperative Reasons of Overriding Public Interest
IUCN Red List	The International Union for Conservation of Nature’s Red List of Threatened Species
JNCC	Joint Nature Conservancy Committee
km	Kilometre
km2	Square kilometre
LAT	Lowest Astronomical Tide
LSE	Likely Significant Effect
m	Metre
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMFR	Mean Max Foraging Range

Acronym	Definition
MMMP	Marine Mammal Mitigation Protocol
MMO	Marine Management Organisation
MPA	Marine Protected Area
MPI	Multi-Purpose Interconnector
MU	Management Unit
MW	Megawatts
NE	Natural England
NESO	National Energy System Operator
NGESO	National Grid Electricity System Operator
NGET	National Grid Electricity Transmission
nm	Nautical Mile
NPS	National Policy Statement
NPS	National Policy Statements
NRW	Natural Resource Wales
NSIP	Nationally Significant Infrastructure Project
O&M	Operation and Maintenance
O&M	Operational and Maintenance
OCS	Onshore Converter Station
OHA	Offshore Hybrid Assets
ORJIP	Offshore Renewables Joint Industry Programme
OSP	Offshore Substation Platforms
OTNR	Offshore Transmission Network Review
OWEZ	Wind farm Egmond aan Zee
OWF	Offshore Wind Farm

Acronym	Definition
OWL	Offshore Wind Ltd
PAH	Polyaromatic Hydrocarbon
PCBs	Polychlorinated Biphenols
PDE	Project Design Envelope
PEIR	Preliminary Environmental Information Report
PEMP	Project Environmental Management Plan
PINS	Planning Inspectorate
PRoW	Public Rights of Way
PTS	Permanent Threshold Shift
PVA	Population Viability Analysis
RIAA	Report to Inform Appropriate Assessment
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SACO	Supplementary Advice on Conservation Objectives
SCANS-III	Small Cetaceans in the European Atlantic and North Sea
SCI	Site of Community Importance
SCOS	Special Committee on Seals
sCRM	Stochastic Collision Risk Model
SD	Standard Deviation
SEL _{cum}	Cumulative impact from Sound Exposure Level
SEL _{ss}	Sound Exposure Level for a single strike
SEP	Shoal Extension Project
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Bodies

Acronym	Definition
SNH	Scottish Natural Heritage
SNS	Southern North Sea
SPA	Special Protection Area
SPL _{peak}	Peak Sound Pressure Level
SSC	Suspended Sediment Concentrations
TCDD	Tetrachlorodibenzo(P)Dioxin
tCSNP2	Transitional Centralised Strategic Network Plan
TJB	Transition Joint Bays
TTS	Temporary Threshold Shift
UK	United Kingdom
UK	United Kingdon
UXO	Unexploded Ordnance
WOZEP	Dutch Governmental Offshore Wind Ecological Programme
WTG	Wind Turbine Generator

Appendix A.1 Dogger Bank D HRA Consultation Responses

DOGGER BANK D WIND FARM

Preliminary Environmental Information Report

Volume 2

Appendix A.1 Consultation Responses for Habitats
Regulations Assessment

Document Reference No: 5.1.1

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Revision: V1



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APPENDIX A.1 CONSULTATION REPONSES FOR HABITATS REGULATION
ASSESSMENT

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1.1 Consultation Responses on Habitats Regulations Assessment

Table 1-1 Consultation Responses on HRA

Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Scoping Opinion (02/08/24)	It is unclear if Section 5.7 relates specifically to SACs and SPAs and that therefore the assessment should be to determine the in-combination effects at the scale of the site and for the designated features within the site, with the intention of assessing the in-combination effects against meeting the conservation objectives. Currently the paragraph refers to environmental topics and receptors. We advise that the requirements of in-combination assessments for designated sites should be clearer.	<p>The Applicant issued a HRA Screening Report for comment on 19 December 2023 to Natural England, the Environment Agency, the Marine Management Organisation, Joint Nature Conservation Committee, Centre for Environment, Fisheries and Aquaculture and the Royal Society for the Protection of Birds. Sites screened in for further assessment are detailed in the HRA Screening Report. A 'Screening Opinion' was then received detailing responses on the HRA Screening Report from relevant stakeholders who wished to provide comment.</p> <p>The Applicant issued a subsequent HRA Addendum for comment on 21st August 2024 to Natural England and the MMO. This provided an update on sites / features screened into the HRA, in response to key Project changes, feedback from the HRA Screening Opinion and consultation through the EPP. Subsequent feedback was obtained from Natural England and the MMO, which has been noted in the EPP meetings that have taken place since. The Report to Inform Appropriate Assessment will be submitted in draft form at PEIR and consider in-combination effects.</p>

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Offshore Annex I Habitats			
Marine Management Organisation (MMO)	HRA Screening Report Response (26/01/2024)	The MMO agree with the approach to the HRA within the screening report regarding Benthic Ecology matters.	Noted.
Marine Management Organisation (MMO)	HRA Screening Report Response (26/01/2024)	The MMO agree with the Benthic Ecology impacts which have been screened in within the Likely Significant Effect (LSE) screening.	Noted.
Marine Management Organisation (MMO)	HRA Screening Report Response (26/01/2024)	The MMO agree that the potential impacts from the proposed Electric Connection Opportunities are likely to be limited to within the Zone of Influence (ZOI) buffer around the Dogger Bank D array area and offshore export cable route.	Noted.
Natural England	HRA Screening Response Report (02/02/2024)	<p>We welcome that gravity base foundations have not been included as an option for the wind turbines but note that they have been included as a platform foundation option.</p> <p>We highlight that no project in UK waters to date has required the use of gravity bases, and that their use would result in a greater area of habitat loss within Dogger Bank SAC than with any other foundation option.</p> <p>We advise that gravity base foundations are removed from the project envelope, or that further information is provided to justify their inclusion.</p>	Engineering studies are currently ongoing on the various platform foundations considered for DBD, which will inform any refinement of options at a later date, gravity base foundation is considered for the Offshore Platforms to cover the worst-case scenario, should piled jacket prove un-feasible. This is defined in Section 2 of the RIAA.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	HRA Screening Response Report (02/02/2024)	We welcome that HVDC will be used for the export cable but question why up to six might be needed for a single array. Clarity is needed on whether this is for a single connection option or is the cabling requirements summed across all connection options. If this is for a single option, full justification should be provided in the ES. Clarification required.	Clarification is provided in Section 2 of the RIAA.
Natural England	HRA Screening Response Report (02/02/2024)	NE advise that cables should be bundled to reduce benthic impacts and the volume of cable protection needed. This is particularly the case where cable routes are intersecting designated sites. To note.	Clarification is provided in Section 2 of the RIAA, noting that further design refinement is ongoing and will continue through to the DCO application.
Natural England	HRA Screening Response Report (02/02/2024)	It is stated that the HDD will “exit the seabed in an exit pit at a suitable site with a water depth of approximately 10m below Lowest Astronomical Tide (LAT)”. We understand this to mean that the exit pit will be at or beyond the 10m depth contour, thereby removing the need for cable protection within the 10m depth contour. Please confirm if this is correct.	Trenchless methods (e.g. Horizontal Directional Drilling (HDD), Direct Pipe, etc) have been described and committed to, as detailed in Section 2.3.3 of the RIAA.
Natural England	HRA Screening Response Report (02/02/2024)	NE notes that open cut trenching has been included as a proposed landfall installation method in Table 2-2, however this is not mentioned as an option in Section 2.3. NE would not support the use of open cut trenching along the Holderness Coastline and advise that the Project commit to using trenchless techniques. To note.	Trenchless methods (e.g. HDD, Direct Pipe, etc) have been described and committed to, as detailed in Section 2.3.3 of the RIAA.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	HRA Screening Response Report (02/02/2024)	Natural England disagree with the introduction or spread of INNS being screened out for the construction and decommissioning phases, as this is when vessel traffic and material introduction will be at its highest. We advise that INNS are screened in for all phases of the project.	This has been assessed in Section 5.4.2.8, Section 5.4.2.9, and Section 5.4.3.6 of the RIAA with regard to Invasive Non-Native Species (INNS) on benthic habitat receptors.
Natural England	HRA Screening Response Report (02/02/2024)	We note that the Humber Estuary SAC has been screened in but only for impacts resulting from the onshore works. NE considers that the Humber Estuary SAC should also be screened in for indirect effects from the landfall/nearshore works until project specific modelling is available to rule out impacts to sediment transport and/or the Project commits to no cable protection within the Holderness Inshore MCZ/10m depth contour. We advise that the Humber Estuary SAC is screened in for indirect effects from the landfall/nearshore works. Please also see our comment on HDD (above).	As detailed in Section 4.1.2 of Annex A.2 HRA Screening Addendum Report, the distances of any Project works following the Project update have been identified as confirming the Humber Estuary SAC (and Humber Estuary Ramsar) is outside the Zone of Influence in relation to offshore works and it has been screened out on that basis. However, the potential effects of onshore vehicle emissions have been screened in. These have been assessed in Section 6.6 of the RIAA. Trenchless methods (e.g. HDD, Direct Pipe, etc) have been described and committed to, as detailed in Section 2.3.3 of the RIAA. Consequently, emergence of the offshore export cable occurs offshore and in deep water to the extent that it will not impact on the sediment transport patterns that are supporting factors for the Humber Estuary SAC (and Humber Estuary Ramsar) as noted in Table 5-1 of Annex A.2 HRA Screening Addendum Report.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	HRA Addendum Response (10/10/2024)	The MMO agree with the approach to the Habitats Regulations Assessment (HRA) within the screening report which is based on assessing likely significant effects (LSE) for the worst-case scenario within a design envelope. This includes the full range of potential installation options and required infrastructure for the refined project (i.e., removal of the Hydrogen Production Facility and confirmed grid connection). The MMO note that three potential effects have been screened out following the removal of the Hydrogen Production Facility. The MMO agree with this approach. The MMO also agree with the conclusion to remove assessment of potential pressures to the Humber Estuary SAC and Ramsar Sites due to the distance from the Project (40 kilometres (km)) being greater than the ZOI (20 km) for potential impacts from the Project calculated using tidal ellipse data.	Noted.
MMO	HRA Addendum Response (10/10/2024)	Table 10-1 in Section 10 of the HRA Addendum includes the designated Annex I habitat associated with the Dogger Bank SAC to be considered in the LSE assessment. The MMO consider that the feature screened in for assessment (namely, 'Sandbanks which are slightly covered by seawater all the time') is accurate for benthic habitats. However, the MMO defer to the relevant SNCB for further comments.	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	HRA Addendum Response (10/10/2024)	The MMO consider that a comprehensive list of relevant potential benthic impacts have been screened in for LSE (Table 5-1 of the HRA Addendum) and the MMO do not consider there to be any omissions regarding the benthic ecology receptors.	Noted.
MMO	HRA Addendum Response (10/10/2024)	The MMO agree with the ZOI used to assess Annex I offshore sites and note this is based on the tidal ellipse distance and the maximum worse-case scenario for potential benthic impacts following refinement of the Project.	Noted.
MMO	HRA Addendum Response (10/10/2024)	Statutory advice pertaining to protected habitats and features that may be affected by the Dogger Bank D development is provided by the relevant SNCB and the MMO defer to their expertise regarding HRA assessment.	Noted.
Natural England	HRA Addendum Response (19/09/2024)	As good practice and for ease of assessment, we would expect the Annex I marine habitat relevant to the impact pathway to be specified in this section, rather than just the designation (e.g. 'Sandbanks which are slightly covered by water at all times' rather than just Dogger Bank SAC).	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	Seabed ETG1 Meeting 1 (13/09/23) Agreement Log	<p>The MMO notes that sediment heating from cables is scoped out. While the data obtained from the test sites in Taormina et al. 2020 did not indicate any increase in temperature on the cable surface or the surrounding water, the authors acknowledge that there remains a knowledge gap concerning the heating of sediment around a buried cable, and MMO would therefore recommend that additional information is sought is provided (e.g., depth of burial and maximum current loads) so that it can be assured that the cables proposed for use in the project will not negatively affect the benthic assemblage along the cable route before scoping this impact out entirely. Should the theoretical capacity for heat transfer from the cables to the surrounding benthic assemblage be negligible, the MMO agrees that this impact can be scoped out of further assessment.</p>	<p>Recent evidence indicates that the surface temperature difference of operational power cables in comparison to inert sections of the same cable was negligible at a sensitivity level of 0.06°C (Taormina et al., 2018; 2020). This rationale was presented during the Dogger Bank South Scoping and EPP. All stakeholders were content for this issue to be scoped out using that rationale.</p> <p>In addition, modelling of heating for HVDC cables with similar high-voltage specifications as high capacity OWF export cables (525kV) (Brakelmann and Stammen, 2017) suggests that even for a worst-case scenario of bundled high voltage cables, any increases in temperature will be limited to a very narrow band above the cables with negligible lateral heat transfer. The footprint of any effect will therefore be extremely narrow; less than a 1m strip above the cable (although it is not possible to define the area precisely), noting that cables at DBD have a potential burial depth range of 0.2m to 9m (target 3.5m). Indeed, conservative modelling suggests that a cable-induced temperature increase at 20cm below the surface will be below 2°C at cable burial depths greater 0.35 – 0.55m. At cable burial depths over 1.5m, any temperature change at 20cm below the surface is likely to be negligible (Brakelmann and Stammen, 2017).</p>

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
			<p>It is important to note that demersal spawned eggs will be surface laid, and therefore located even further away from the buried cable. Surface-laid eggs will be subject to constant heat transfer from water flow, similarly to the surface laid cables where no cable surface heating was observed (Taormina et al., 2018; 2020).</p> <p>The Project Area does not lie at a fringe of the North Sea, meaning that fish, shellfish and benthic biological assemblages are relatively typical of a North Sea environment. In other words, the Project does not coincide with the northern or southern limits of the distributional ranges of species under consideration. For this reason, it is very unlikely that temperature changes will be ecologically significant at a local scale, i.e. the footprint of a heating effect. Since this footprint is so small the potential for population level effects is considered to be negligible.</p> <p>The Applicant considers that the above evidence is sufficient to demonstrate that ecological risks of sediment heating from cables is negligible and can be scoped out. The Applicant will communicate the specifications of the subsea cables and refinements to proposed burial depths through the EPP to justify the scoping out of this impact.</p>

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed ETG1 Meeting 1 (13/09/23) Agreement Log	Light attenuation is highly correlated with levels of suspended matter, and the availability of underwater irradiance will influence phytoplankton biomass. Therefore, the potential impact of sediment plumes on light attenuation across the array should be considered (although we acknowledge that this may be addressed elsewhere in other receptor/topic chapters).	<p>The marine physical processes chapter will assess changes in suspended sediment. It is expected that increases in suspended sediment concentrations are expected to be localised and short-term. Fine suspended sediment may be transported further than coarser sediments, however, this is likely to be widely and rapidly dispersed and within the range of natural variability within the region.</p> <p>Wang et al (2023) reviewed a number of OWF projects worldwide regarding trophic level species showed phytoplankton biomass to increase due to increased suspended matter.</p> <p>Therefore, it is proposed to scope out this impact as it would have a low sensitivity and the magnitude of the areas effected would also be minimal.</p>
MMO	Seabed ETG1 Meeting 1 (13/09/23) Agreement Log	It is indicated that potential remobilisation of contaminated sediments will be scoped out if justified by the results of upcoming benthic surveys and that levels of offshore sediment contamination will be determined through ongoing survey campaigns. It is indicated that if contaminant levels fall below guideline thresholds (e.g. Cefas Action Levels) that this impact be scoped out. The MMO considers that remobilisation of contaminated sediments should be scoped in until surveys have been completed. The MMO are unable to comment further until specific data have been provided.	Section 5.4.2.4 of the RIAA describes and references the received results of the sediment quality analysis and confirms that all results were below threshold levels and as such effects relating to remobilisation of contaminants has been scoped out.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed ETG1 Meeting 1 (13/09/23) Agreement Log	<p>Further information on the UXO approach was provided to Natural England in a catch up meeting following the ETG on 19th September 2023. The Project confirmed that ‘DBD are looking to take the same approach as SEP/DEP, i.e. a high-level assessment of impacts for UXO in the Environmental Statement (ES), however the meaningful assessment (noise impacts, modelling etc based on confirmed UXOs following a survey campaign post consent) will come pre-construction.’</p> <p>Natural England acknowledge that UXO clearance will form a separate Marine Licence. However, assessments based on potential worst-case scenarios for UXO clearance need to be provided for information in the ES, the HRA report & MCZ assessment. We advise that and a draft Marine Mammal Mitigation Protocol (MMMP) is also provided in order for a complete list of impacts to be taken into account during Examination. We highlight that in the case of Dogger Bank D, UXO clearance activities will also need to consider benthic impacts to designated sites.</p> <p>For the DEP&SEP Examination, the Applicant produced an appendix on ‘Assessment of Sea Bed Disturbance Impacts from UXO Clearance’ for information purposes only. We suggest there could be benefit in Dogger Bank D preparing something similar.</p>	<p>The Project has assessed UXO clearance and associated effects within Section 5.4.2, Section 8.4.2, Section 8.4.3, Section 8.5.2, Section 8.5.3, Section 8.5.4, Section 8.5.2, Section 8.6.3, Section 8.6.4, and various sub-sections within Section 10 of the RIAA.</p> <p>A draft MMMP has been provided with the application.</p>

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	2.1. The MMO defer to Natural England for comments regarding the approach to the benthic headroom assessment and the quantification of impacts presented at the ETG.	Noted.
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	Derogation and Compensation 3.1. The MMO agree with the measure Removal of Structures and agree with Natural England's comments in the meeting minutes regarding the change of this wording to 'Removal of Pressures' to increase its ecological merit.	Noted.
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	The MMO agree the removal of structures would help restore the subtidal sandbanks in the long term as it would remove barriers to sediment transport systems. It may be that some of the infrastructure is minor, and that sediment transport has not been overly affected, in which case it would need to be considered how beneficial this measure is.	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	3.2. The MMO defer to Natural England for comments regarding the measure ‘Sediment Volume Restoration. The MMO would like to highlight the issues with this measure regarding the sourcing of the sediment material for the restoration. It would be important for the sediment to be of sediment size and composition to work effectively, so the source needs to be considered, including the impacts within that region of dredging etc. to create the sediment volume needed for restoration. There was discussion within the meeting of the size of the craters and whether they are expected to recover within the SAC. I would suggest this would need further investigation for this to be a viable option.	<p>This constructive feedback is appreciated. The Project is currently preparing a Sediment Volume Restoration Technical Note to clarify the proposed approach to this compensation option, to further the discussions from ETG 5 Meeting 1 and in response to Natural England’s written response (ref DAS/426551 sent 31st October 2023).</p> <p>We look forward to discussing further the points therein, in addition to those raised by the MMO in this response at a later date.</p>
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	3.3 The MMO defer to Natural England and JNCC for comments regarding the measure ‘Resolution of Data Gaps.’	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	<p>3.4 The MMO do not recommend the measure 'Beneficial Effects on Other Sites: Enhancement of Harbour Porpoise Food Supply'. This measure is already associated with the protection of the Annex I sandbank and its role in enhancing the presence of sand eels. The MMO agree with JNCCs comment that this measure would therefore not directly apply and cannot be classed as an enhancement. The MMO are supportive of examining measures which will protect sandeel, and crucially areas of suitable sandeel habitat, although these may not strictly be 'compensatory measures'. The Applicant should recognise that sandeel are demersal spawners and their eggs form batches which attach to the seabed, and that all species of sandeel display a high level of site fidelity within areas where suitable habitat occurs (Latto et al., 2013). Additionally, populations of sandeel are unlikely to interact beyond a separation of 200km, meaning that populations of sandeel are somewhat discrete from one another (Wright et al., 2019). Therefore, importance should remain on maintaining suitable habitat, as sandeel spawn in and within the vicinity of the sediments which they inhabit. The MMO ultimately agree with the comments made within the meeting, that enhancing the presence of sandeels is intrinsically linked with preserving the integrity of the sandbanks within the Dogger Bank SAC.</p>	The feedback from the MMO on this point are noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	3.5. The MMO defer to Natural England for comments regarding the measure 'Habitat Creation - Other Features whereby habitat creation for other features at a different location would be preferable to equivalent habitat creation work within the SAC. The MMO agree with NE's comment that were made during the meeting regarding the creation of other Annex I habitats as compensation for loss of Annex I sandbanks. The ecological functions of the various Annex I habitats are not equivalent and cannot be mutually compensated.	The MMO comment suggesting different Annex I habitats are not equivalent and would not qualify as 'like-for-like' compensation is acknowledged. However, it is also noted that these different habitats could provide compensation for some specific Sandbank features. The Applicant highlights report NECR443 that MarineSpace produced for NE; this identifies functional ecosystem service similarities between different habitat types for the specific purpose of identifying compensatory options. It is noted that there is a lack of evidence for seagrass and native oyster/shellfish reef restoration/recreation in subtidal environment, and this measure is less preferred than other measures that have potential for 'like-for-like' benefits. However, the Applicant may wish to further discuss the applicability of this option as the Project progresses.
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	3.6. The MMO defer to Natural England for comments regarding the measure 'Threat Reduction: Debris Removal'. 3.7. The MMO defer to Natural England for comments regarding the measure 'Threat Reduction: Debris Removal Educational Measures (as part of a package of measures).'	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	3.8. The MMO do not recommend the measure 'Threat Reduction: Control of Invasive Non-native Species (as part of a package of measures)' as the MMO are not aware of any feasible control measures that could be employed to effectively control marine invasive non-native species within designated areas.	This point is noted and aligns with the fact that the Dogger Bank SAC SACO makes no reference to INNS pressures. However, given that NE noted this may offer sufficient ecological merit to be included as part of a package of measures, the Project would like to keep this option open for further consideration.
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	3.9. The MMO defer to Natural England for comments regarding the measure 'Threat Reduction: Management of Physical and Chemical Processes. The MMO note that there is limited potential for this to effectively improve the designated areas.	Noted.
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	3.10. The MMO agree with the approach taken on compiling the long list of measures (circulated prior to the ETG).	Noted.
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	3.11. The MMO agree there are strategic measures worth considering in the long list of measures. The MMO agree with NE's advice to review the Collaboration on Offshore Wind Strategic Compensation (COWSC) library of strategic measures. The MMO also note that it would likely be premature to begin refining this list at this early stage in the project development.	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	4.1. The MMO agree with using the guidance presented to inform the design of the ranking criteria.	Noted.
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	4.2. In regard to the criteria being presented for the scoring of compensation measures, the MMO are unable to comment until the draft scoring table and matrix is provided for review.	The draft ranking/scoring document is provided for review as an annex to the response note to NE.
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	4.3. The MMO defer to Natural England regarding derogation documentation.	Noted.
MMO	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	In addition to this the MMO would welcome early engagement and review of any reports or modelling as part of the evidence plan process to ensure that only major topics of disagreement are discussed past the application stage.	This point is noted, and the Project welcomes early input and engagement from the MMO and reconfirms the intention to provide reports and modelling outcomes as part of the evidence plan process.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	Minutes comment: We find the wording here to be unclear. We think this is suggesting that if the DBD HRA or Round 4 Plan level HRA was submitted with the as built parameters for A,B,C and Sofia, would we still consider there to be AEoI on DB SAC? If so, the answer is yes. We would also consider this to be the case if A,B,C and Sofia were resubmitted with their as built parameters, the conclusion for these projects would now be AEoI. This is for the reasons given in the paragraph above and also that at the present time, as built parameters are not legally secured.	It is agreed that the quoted wording did not accurately convey the meeting discussion. This should be amended to note that “DK wished to clarify his understanding: that even if the HRA was based on as built parameters, as opposed to those consented, this would still be considered to constitute an AEoSI. LB confirmed this was correct.”
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	Agreement log: Natural England do not support the application of headroom calculations for Dogger Bank D. Whilst Dogger Bank A, B and C projects were concluded to have no adverse effect at the time of consent, our increased understanding of the impacts of OWFs and the condition of the site means that these same conclusions would not necessarily hold true today. Given the unfavourable condition of Dogger Bank SAC, it would be counterproductive to the site’s ‘restore’ conservation objectives if excess headroom (determined from worst-case scenario maximum design parameters) could be applied as an “allowance” to increase impact to the habitat. Furthermore, the as-built conditions of the A, B and C projects are not legally secured and so there is no mechanism in which headroom could be securely transferred between projects.	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	DAS response: Removal of Structures - Natural England advises that compensation measures which reduce/remove anthropogenic pressures impacting upon the favourable conservation status of the SAC features are most likely to deliver the compensation requirements from an ecological perspective. This includes the removal of redundant infrastructure which wouldn't normally be removed. However, unless the anthropogenic infrastructure is surface-laid or protected at the surface, we do not consider the removal to provide benefits to the site feature and therefore constitute compensation. We recognise that there are significant challenges associated with delivering this compensation, which will have implications on its delivery timeframe. However, we are open to consideration of secured compensation not necessarily delivering prior to works starting, if i) appropriate levels of confidence in the delivery and the effectiveness of the measure is provided and ii) it can be demonstrated that there would be an overall ecological benefit to the SAC over the lifetime of the project.	This comment is acknowledged. The Applicant would welcome further comment and discussions to identify additional pressures, other than presence of structures, which may be removed to benefit the SAC site conservation status.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	<p>DAS response: Sediment Volume Restoration - There is currently no evidence to demonstrate that UXO craters will not naturally restore within the site, that the impacts are sufficiently large to offset the scale of lasting habitat change/loss created by DBD and that the structure and function of the sandbank is sufficiently hindered to warrant remediation actions. If remediation is required the onus will be on developer to undertake this and therefore can't be considered as compensation.</p> <p>As highlighted, the source of sediment from outside of the site to within, will require detailed assessment in its own right. And it is noted for other Sandbank SACs that this type of intervention has limited benefit due to natural processes driving location, shape and structure of any sandbanks.</p>	This point is noted. The Project is currently preparing a Sediment Volume Restoration Technical Note to clarify the proposed approach to this compensation option and further the discussions from ETG 5 Meeting 1.
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	<p>DAS response: Extension of existing SAC/ New site designation- Whilst JNCC is not currently supportive of extending the Dogger Bank SAC; the SNCB's do acknowledge that there is ecological merit in extending other sandbank SACs and/or protecting further sandbanks and/or enhancing protection of sandbanks. However, DEFRA are not currently supportive of this as a compensation measure and thus there is currently no delivery mechanism available.</p>	Noted. The Project team are aware the Offshore wind industry body OWIC is seeking clarity from Defra on behalf of developers, on the status of MPA designation as a compensation option, and will continue to be part of those discussions.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	Noting that there are several other projects which require benthic compensation which will be in examination next year, there is a high probability that strategic compensation options will need to be further explored. Therefore, we suggest that all options with ecological merit are set out in any derogations case.	<p>This point is also noted and the Project can confirm that options identified as having ecological merit will be included and assessed in any derogation case that is submitted.</p> <p>The Project would appreciate further guidance from NE on potential options for extending other sandbank SACs and/or protecting further sandbanks and/or enhancing protection of sandbanks. Specifically, it would be useful to hear any which sandbank features should be considered, or the criteria NE would apply to determine suitability of sandbanks proposed for consideration by the Project.</p>
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	DAS response: Resolution of data gaps - The SNCBs advise that data collection may be consider as part of a package of measures, but couldn't be considered as a primary one, because there is no way of demonstrating how it has offset the loss of any habitat change loss. There would also need to be key actions identified and undertaken to 'restore' the site as a result the survey outcomes.	This comment is noted, and the Applicant will prepare additional detail on proposed measures that may be taken to address data gaps. These will be associated with specific actions to benefit conservation status.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	DAS response: Enhancement of harbour porpoise food supply - The SNCBs advise that improving food availability for harbour porpoise would be a compensation measure to offset direct impacts to harbour porpoise and not Annex I Sandbanks. Even when considering Dogger Bank SAC as a supporting habitat for harbour porpoise, the main reason for this would be because of the presence of sand eel within the sandbanks. Therefore, we are back to requiring a measure that maintains and protects sandbank feature.	Noted.
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	DAS response: Habitat Creation (other features) - SNCB's would not support Annex I reef creation within Dogger Bank SAC as compensation. We also consider that the creation of other features should be ranked low down as a possible option for sandbank compensation as reef creation is not 'like for like' and therefore doesn't provide the required compensation for Annex I sandbanks. We draw DBD's attention to comments included below: Whilst we acknowledge that seagrass and native oyster/shellfish reef restoration/recreation could provide compensation for some specific features, they are not a 'one stop shop' measure that will provide strategic compensation for all benthic impacts.	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
		<p>The SNCBs do not support the creation or restoration of intertidal habitat as compensation for subtidal features. We consider subtidal seagrass and subtidal native oyster restoration projects to still be at the trial stage in the UK. There is currently insufficient evidence on methods or the success of restoration projects to understand where and how this measure could work at scale. The potentially long timescales for some habitats (especially oyster reef) to reach ecosystem functionality is an additional consideration. It is important to consider the features for which these could provide benthic compensation before using them, and how use of these measures will meet the tests of the relevant legislation and maintain coherence of the MPA network. We are concerned that, used incorrectly, these measures will lead to a loss in some impacted features across the MPA network which will not be replaced. Careful consideration must be given to the appropriateness of creating/restoring one habitat at the expense (i.e. loss) of a different designated habitat. At present, Natural England's view is that the creation/restoration of alternative habitats to those impacted would not represent appropriate compensation. Consideration also must be given to historical evidence of past distribution and extent of the habitat being proposed for creation or restoration.</p>	

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
		Additionally, there is no evidence available as to what the pre-industrial fishing baseline would look like. However, the conservation objectives of the MPA network were set at the time of designation and we advise that these are used when identifying suitable compensation measures.	
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	DAS response: Threat Reduction: Marine debris removal: We refer DBD to the SNCB advice provided to BEIS (most recently in our January 2022 response regarding Hornsea Project Three) regarding the ineffectiveness of marine debris removal as a compensation measure in offsetting AEol from the placement of cable protection. In addition, an SNCB paper has recently been published, setting out our position on why we do not believe that the removal of marine debris can be considered as compensation to offset habitat change/loss (https://hub.jncc.gov.uk/assets/a2b71fd2-8687-4dc7-8224-d6b8c3beed95). We also anticipate evidence supporting this position becoming available in the public domain in the near future.	The SNCB's comments on the measures described are noted. The Project would welcome further clarification as to the reasons for the measure 'Management of Physical and Chemical Processes' only being applicable to coastal/near shore designated sites.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
		<p>Marine debris reduction awareness and engagement: The SNCBs continue to query how it could be demonstrated that an awareness campaign is having the desired positive outcome and is compensating for designated site impacts. In particular, how could it be demonstrated that the awareness campaign has reduced the amount of litter entering the marine environment, and if so has it benefitted the SAC where the compensation is required, and/or sufficiently helped to maintain the coherence of the national site network?</p> <p>Control of INNS: Again this might be part of a package, but could only be a very small proportion of that package, due to the overall benefit to Annex I sandbanks.</p> <p>Management of Physical and Chemical Processes: Natural England advises that this measure is relevant to more coastal/near shore designated sites and therefore is not an appropriate measure for Dogger Bank SAC.</p>	
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	<p>DAS response: Strategic Measures: Natural England advises speaking with Round 3 projects currently at the delivery end of benthic compensation measures, other extension projects and Round 4 projects who are about to submit their applications, as there may be options to work collaboratively.</p> <p>However, we note that they are experiencing similar issues in relation to available options as DBD.</p>	<p>The Project notes Natural England's position with respect to strategic measures. Given the developments regarding The Crown Estate's additional Plan Level HRA we would welcome Natural England's further clarification on this point.</p> <p>The Project defines strategic measures as measures that rely on more than one party to deliver and/or where government has a role in implementation.</p>

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
		NB: Current Plan Level HRA processes will need to conclude before some strategic compensation measures become formally available to DBD. Therefore the SNCBs are not permitted to further discuss measures associated with those processes.	The Project would welcome further guidance from SNCBs on how to engage on strategic measures as defined above, recognising there is likely to be overlap and synergies between the Round 4 process and the additional Plan Level HRA process/outcomes. The Project is also seeking guidance from The Crown Estate on how DBD can work collaboratively alongside the process that has been initiated by the Round 4 projects.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	DAS response: Natural England advise that the following fundamental questions are answered, when scoping possible compensation measures: a) Have all benthic mitigation measures been considered and implemented as appropriate? b) What are the remaining impacts which need to be offset? c) What are the designated site features which are being impacted? d) Will proposed compensation measure options have negative impacts on stie features of either Dogger Bank SAC, or another designated site? It would benefit DBD to review options against the 'Compensation Hierarchy' and assess if the option meets DEFRA's generic principles of compensation requirements Finally, Natural England has also developed a checklist of those aspects of compensatory measures that need to be described in detail when developers are submitting or updating applications where impacts on MPAs are anticipated. It lists key areas where sufficient detail is needed to provide the Secretary of State with appropriate confidence that compensatory measures can be secured [checklist provided in DAS response].	The Project thanks Natural England for providing advice on scoping compensation measures and for confirming the checklist of aspects of compensatory measures that need to be described in detail.
Natural England	Seabed Compensation ETG5 Meeting 1 (16/10/23) Agreement Log	Agreement log: Compensation updates and guidance: Does the ETG agree with using the guidance presented to inform the design of the ranking criteria? NE: Agreed on the basis that the environmental value is considered in alignment with DB SAC conservation objectives and site structure and function. Please also see comment below.	Noted. The Project has updated the compensation ranking approach document following this feedback and will submit in January to Natural England for further consideration and advice. This will complete the following question in the agreement log which is currently open: Does the ETG agree with using these criteria presented for scoring of compensation measures?

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed Compensation ETG5 Meeting 2 (2/05/24) Agreement Log	<p>1.1 Strategic compensation measures</p> <p>Natural England's stance is that it is too premature to engage in discussion with Dogger Bank D on strategic benthic compensation and we therefore won't be commenting on the questions concerning strategic measures at this stage. We hope that our explanation of the Plan Level HRA process in Annex 1 (attached in email) is helpful in explaining this decision. Please note that Annex 1 has also been shared with DEFRA, TCE and DESNZ.</p>	Noted.
Natural England	Seabed Compensation ETG5 Meeting 2 (2/05/24) Agreement Log	<p>1.1.1 Do we agree with the proposed ranking and scoring approach taken?</p> <p>Although Natural England are not commenting on strategic compensation measures currently, we will provide advice on the proposed ranking and scoring approach on the basis that it should hold relevance for future use and/or be applied to project-led measures. It is our understanding that the scoring approach was designed for the HRA derogations case, but we would welcome clarification as to whether the project also intend to use a similar approach when considering MEEB options, in which case, the below points are also applicable:</p> <ul style="list-style-type: none"> Natural England broadly support the proposed methodology based on the worked example we have seen but reserve full agreement until we have seen how it works for each measure. 	Noted. The Applicant thanks Natural England for the response and look forward to engaging in future conversations.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
		<ul style="list-style-type: none"> The current methodology lacks descriptors of the 'RAG' categories and we will be able to advise further once we have a better understanding of these. The measures must first and foremost prioritise the impacted feature of the European Site rather than achieve an overall net gain benefit, so care should be taken when scoring measures for wider 'Environmental Value'. Whilst wider environmental benefits are welcomed, this category should not carry enough weight to give preference to measures that are less beneficial for the target feature. Please be aware that DEFRA are due to update some of the guidance surrounding scoring and ranking approaches and so the project may be required to adapt their methodology before the anticipated 2026 submission. We will communicate any updates to the project as and when they are released. 	
Natural England	Seabed Compensation ETG5 Meeting 2 (2/05/24) Agreement Log	<p>1.2 Project-led compensation measures</p> <p>1.2.1 Removal of pressures</p> <p>Natural England do not support the removal of buried and/or surface-laid telecom cables within Dogger Bank SAC as a benthic compensation measure because the cables are generally too small to hinder the conservation objectives of the site.</p> <p>We are supportive in principle of the project purchasing effort from extractive aggregate industries.</p>	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Seabed Compensation ETG5 Meeting 2 (2/05/24) Agreement Log	<p>1.2.2 Sediment volume restoration</p> <p>Our main concern with the sediment restoration measure is the sourcing of sediment. All material disturbed through sand wave levelling should be re-deposited to aid recovery of the sandbank as standard mitigation, so this measure would not achieve additionality. Similarly, sediment from drill arisings will need to be deposited in similar sediment areas so this could not reasonably also be used for the infilling of craters. It is also hard to determine the efficacy of this measure as compensation, without knowing the number and size of expected craters/voids within the site. Evidence to date suggests that UXO craters in particular are infilling naturally. For this to be considered as part of a wider compensatory measure, Natural England would need considerably more detail on the methodology and extent of expected achievable restoration.</p>	Noted. The Project is currently preparing a Sediment Volume Restoration Technical Note to clarify the proposed approach to this compensation option and further the discussions from ETG 5 Meeting 1.
Natural England	Seabed Compensation ETG5 Meeting 2 (2/05/24) Agreement Log	<p>3. Approach to Surveys</p> <p>3.1 Do we agree with the proposed approach to surveys to support evidence discussion?</p> <p>Natural England support the project's proposed surveys techniques, but advise that survey design will be best informed once impacts to features have been quantified. Please also note that surveys would need to be completed in time to provide evidence in support of compensation measures presented at PEIR, as opposed to being carried out as a post-consent investigation.</p>	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Terrestrial Ecology and Ornithology			
The Planning Inspectorate	Scoping Opinion (18/07/24)	(Ref 3.1.4) The Inspectorate agrees that the effects on waves and tidal currents from equipment during construction can be scoped out in relation to the offshore environment. However, the ES should consider whether nearshore / cable landfall works may impact on waves and tidal currents, and subsequently other coastal processes including geomorphological changes and processes, and surge water levels.	There are no European designated sites within the ZoI along the landfall and nearshore zone of the Project.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Annex II Intertidal and Marine Ornithological Features			
Natural England	Scoping Opinion (02/08/24)	<p>We recognise that the definitive list of species to be included will depend on the result of the baseline surveys and that the list presented is indicative only. We also note that existing baseline survey data has not been presented and so comment on this is not possible at this time.</p> <p>We note that the seasonal definitions provided in Table 7-19 are likely to be appropriate for species at a broad population scale such as that assessed for EIA, unless more up-to-date information becomes available that suggests changes are required or the results of the baseline surveys indicate that a change is required.</p> <p>However, we recommend that colony and project-specific data be used to inform the seasons used in the HRA. As such, while the seasons presented in Table 7-19 are likely to be appropriate for the EIA, they are not necessarily appropriate for the HRA, and we would welcome further engagement with the Applicant on the appropriate seasonal definitions once results of baseline surveys are available.</p>	Information regarding the use of the Project area by seabird species seasonally is provided in PEIR Volume 2, Appendix 13.2 Offshore Ornithology Baseline Characterisation Report, the results of which have been used to inform assessment approaches provided within the PEIR and RIAA.
Natural England	Scoping Opinion (02/08/24)	We recognise that the full list of SPAs and Ramsar sites relevant to the project will be presented in the HRA screening report and therefore have no comment to make on these designated sites or their features at this time. This will be covered in HRA screening process.	The list of SPA and Ramsar sites screened in for assessment are provided within Section 7.3.3 of the RIAA.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	Scoping Opinion (02/08/24)	We welcome the inclusion of designated sites outwith the UK that are within foraging range of the project area.	Consideration of transboundary effects on designated sites within foraging range for key seabirds was considered by the Project within the Annex A.2 HRA Screening Report and HRA Screening Addendum Report. For all transboundary designated sites the potential for a Likely Significant Effect (LSE) was confidently ruled out.
Natural England	Scoping Opinion (02/08/24)	Natural England recognise that the full list of SPAs and Ramsar sites relevant to the project will be presented in the HRA screening report and look forward to further engagement with the Applicant on this.	The list of SPA and Ramsar sites screened in for assessment are provided within Section 7.3.3 of the RIAA.
Natural England	ETG2: Meeting 2 (23/05/2024)	<p>Does the ETG agree with the use of the SNH apportionment tool?</p> <p>The use of SNH apportionment tool is okay. SNH tool calculated a weighted distance on an English perspective, overestimating apportioning to larger distant colonies. Therefore, requires sense checking against tracking studies to ensure site-specific data on connectivity and bird distributions is used and factored in to calculations where possible. Natural England said it would be a case of recognising the bias rather than discounting it. Suggest start from site-specific data.</p>	<p>The SNH apportioning tool has been used for apportionment of impacts to individual designated sites. As suggested by Natural England, tracking studies (where available) have been used to inform the appropriateness of the SNH apportionment results and where necessary, amend conclusions accordingly. Details on applicable tracking studies are provided within PEIR Volume 2, Appendix 13.2 Offshore Ornithology Baseline Characterisation Report, whilst apportionment methods and results are presented within Annex A.3 Apportionment Report.</p>

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	ETG2: Meeting 2 (23/05/2024)	<p>Does the ETG agree with the use of a proportional approach to age classes?</p> <p>Natural England are of the view that unless birds are specifically classified as non-breeders they are to be assumed to be adult birds. Therefore, an Applicant's Approach and an SNCB Approach will be presented.</p>	The Project used site-specific data to calculate the age ratios of birds using the site. Where no age identification was given, birds were assumed as being adults as a precaution. This follows the advice provided by Natural England to inform age classes of species recorded. A full methodology of the HRA apportionment process is provided within Annex A.3 Apportionment Report.
Natural England	ETG2: Meeting 2 (23/05/2024)	<p>Does the ETG agree with the incorporation of sabbatical breeders in apportionment?</p> <p>Natural England do not consider sabbatical rates for apportionment and so an Applicant's Approach and a SNCB Approach will be taken forward.</p>	Sabbatical rates have not been considered as part of the apportionment process as per the recommendation of Natural England. A full methodology is provided within Annex A.3 Apportionment Report.
Natural England	ETG2: Meeting 2 (23/05/2024)	<p>Does the ETG agree with the non-breeding apportionment method using Furness (2015) as outlined in the Natural England best practice guidance?</p> <p>Yes, but with caveat that where there is site specific data a different approach should be taken. Natural England confirmed that this is still their preferred approach with caveat that exceptions where site-specific data warrants a different approach. Forthcoming BDMPS review expected soon and Natural England will inform the project on timeline for this.</p>	The approach for non-breeding apportionment using the Furness (2015) approach has been applied as per agreement with Natural England. A full methodology of the apportionment process is provided within Annex A.3 Apportionment Report.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	ETG2: Meeting 2 (23/05/2024)	<p>Does the ETG agree with the inclusion of offshore breeders in the apportionment process?</p> <p>Natural England are still considering their response to the Outer Dowsing incorporation of offshore breeders. They request that more details on methods would be welcomed. Providing with and without offshore breeder scenarios would be welcomed.</p>	To confirm, offshore breeders have not been included within the apportionment undertaken for the RIAA, however the Project is considering the feasibility of inclusion for the Final RIAA. A full methodology of the HRA apportionment process is provided within Annex A.3 Apportionment Report.
Natural England	ETG2: Meeting 2 (23/05/2024)	<p>Does the ETG agree with the use of Outer Dowsing data on offshore breeders?</p> <p>Natural England will be providing feedback on Outer Dowsing data and so use for DBD will be based on this response.</p>	Offshore breeders have not been included within the apportionment undertaken for the RIAA, however the Project is considering the feasibility of inclusion for the Final RIAA.
Natural England	ET2: Meeting 3 (21/10/2024)	<p>Would Natural England consider a mixture of DAS and other literature to form appropriate age classes? – Furness (2015) or Horswill and Robinson (2015) or latest guidance document on demographic rates (Natural England and NRW)?</p> <p>Natural England disagrees with the use of a theoretical generalized stable age structure to apportion impacts to adults from SPA colonies as it is unlikely to represent actual proportions of adults present and may lead to underestimation of impacts. There is currently a lack of research to inform where birds of different ages go, therefore if there is no site-specific evidence regarding ages and data based on tracking, Natural England's assumption is if it looks like an adult then they must presume it is an adult.</p>	As per the request of Natural England, site-specific data to determine age classes have been used, as derived from the DAS. In addition, where no site-specific information is available, the assumption is that 100% are adults. A full methodology of the HRA apportionment process is provided within Annex A.3 Apportionment Report.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
NatureScot	Introductory meeting (14/10/2024)	<p>With the Project being in English waters, the assessment will be following Natural England's approach. Is this okay with NatureScot?</p> <p>NatureScot will not be looking for Scottish assessment for English waters.</p>	<p>As per the agreement with NatureScot, the English assessment methods have been taken forward for the Scottish SPA assessments. Section 7.13 of the RIAA provides assessments of the Scottish sites. For additional context, the Applicant has also produced a separate Appendix (Annex A.4 Scottish Sites – Presentation of Quantitative Results) summarising the predicted impact apportioned to Scottish SPAs for ease of reference. This includes consideration of predicted impacts when following NatureScot's preferred approach to assessment of disturbance and displacement as detailed within NatureScot Guidance Note 8 (NatureScot, 2023).</p>
NatureScot	Introductory meeting (14/10/2024)	<p>NatureScot stated that some of the Scottish sites that have been screened in are unusual and that all sites should be reviewed by assessing tracking studies to understand connectivity.</p>	<p>As recommended by NatureScot, a review of the Scottish SPAs screened in for assessment was conducted and screening conclusions were updated accordingly, with details provided in Section 7.3 of the RIAA.</p>

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
NatureScot	Introductory meeting (14/10/2024)	<p>Effects on Scottish SPAs will be addressed in a stand-alone section for ease of access and review for NatureScot.</p> <p>Effects on Scottish SPAs will be addressed in a stand-alone section for ease of access and review for NatureScot.</p>	<p>As per agreement and appreciated from NatureScot, Scottish SPAs have been considered in a standalone section (Section 7.13 of the RIAA). Forth Islands SPA is also considered in Section 7.9 of the RIAA. For additional context, the Applicant has also produced a separate Appendix (Annex A.4 Scottish Sites – Presentation of Quantitative Results) summarising the predicted impact apportioned to Scottish SPAs for ease of reference. This includes consideration of predicted impacts when following NatureScot’s preferred approach to assessment of disturbance and displacement as detailed within NatureScot Guidance Note 8 (NatureScot, 2023).</p>

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Annex II Migratory Fish			
MMO	HRA Screening Report Response (26/01/2024)	The MMO agree with the approach to the HRA within the screening report regarding Fisheries matters.	Noted.
MMO	HRA Screening Report Response (26/01/2024)	<p>The MMO note that no project specific underwater noise modelling has been produced at this stage, and that the maximum distance of 19km for moderate avoidance behaviour occurring from piling activities, is based off Environmental Impact Assessments (EIAs) for other offshore windfarms. The MMO do not fully agree with this conclusion as the range of effect from underwater noise will vary greatly depending on project specific factors such as pile diameter, hammer energy, water depth, duration of piling, and whether simultaneous/concurrent piling is being undertaken.</p> <p>Once project specific underwater modelling becomes available, this modelling would be discussed in the HRA report and the ZOI would be expanded if found to be appropriate.</p>	Project specific underwater noise modelling has been conducted (PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report). In relation to the assessment of Annex II Migratory Fish and UXO clearance, this has been addressed in Section 8.4.2 and Section 8.4.3 of the RIAA and in PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology Section 11.7.1.4.2.1.4. A screening distance of 50km was set for Annex II fish species in the HRA Screening Report, based on previous experience of other wind farm projects, The maximum underwater noise impact range for fish has now been found to be 44km based on site-specific modelling (PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report) and therefore the screening distance of 50km remains valid.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	HRA Screening Report Response (26/01/2024)	The MMO agree with the screening in of the Humber Estuary SAC and Humber Estuary Ramsar sites (which list sea lamprey and river lamprey as qualifying features) for further assessment on the basis that these sites fall within the ZOI associated with the Onshore Project Area for indirect effects as a result of contamination of habitats from pollution via water and air.	The indirect effects from the Onshore Project Area have been screened out as stated in HRA Screening Addendum Report (Annex A.2 HRA Screening Report and HRA Screening Addendum Report) as there is no longer a pathway for effect (Section 8.3 of the RIAA). These sites remain screened in for indirect effects from the Offshore Project Area.
MMO	HRA Screening Report Response (26/01/2024)	The MMO agree with the Fisheries impacts which have been screened in within the LSE screening.	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	HRA Screening Report Response (26/01/2024)	Section 4.3.2.2.4 states that the only sources of underwater noise at the operational and maintenance stage arise from vessel movements related to intermittent maintenance activities and operational turbines. The MMO agree that compared to the construction phase, it is expected that operational and maintenance activities will result in more localised effects, however the statement that 'previous underwater noise modelling suggests that impact ranges for these activities are highly localised (<50 m)' is unclear.	The underwater noise modelling for operation and maintenance phase noise impacts upon fish has been undertaken on other windfarm projects, using Popper et al., (2014) impact thresholds for 'shipping and continuous sounds', namely 170dB rms for 48h and 158dB rms for 12h for recoverable injury and TTS, respectively. These impact thresholds relate to the most sensitive fish hearing group - where a swim bladder exists and is involved in hearing. It is the modelling of shipping and continuous sounds in these scenarios that has resulted in reported impact ranges of <50m on similar recent OWF projects. Site-specific modelling of the impact ranges of shipping and continuous sounds, based on Popper et al. (2014) thresholds, have been undertaken for the Project, see PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report and Section 11.7.2.5 in PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology.
MMO	HRA Screening Report Response (26/01/2024)	Barham and Mason (2021) assessed a range of activities, including cable laying, trenching, rock placement, drilling, suction dredging, vessels and operational turbines. The assessment concluded that there is a low to negligible risk (<50 m) of injury or Temporary Threshold Shift (TTS) in line with the Sound Pressure Level (SPLrms) noise exposure thresholds for fish and continuous sources as per Popper et al. (2014). Ultimately, the MMO defer to other relevant consultees on whether they are content for noise during the operational and maintenance stage to be scoped out for Annex II migratory fish.	

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	HRA Screening Report Response (02/02/2024)	We welcome further reasoning as to why there is no potential for in-combination impacts to affect migratory fish, including lamprey.	The indirect effects from the Onshore Project Area have been screened out as stated in HRA Screening Addendum Report (Annex A.2 HRA Screening Report and HRA Screening Addendum Report) as there is no longer a pathway for effect (Section 8.3 RIAA). In-combination effects of the Offshore Project Area have been assessed in Section 8.4.3, Section 8.5.3, and Section 8.6.3 of the RIAA.
Natural England	HRA Screening Report Response (02/02/2024)	We recommend that sandeels should also be considered for inclusion as they are a key prey species for several bird and cetacean species that have been scoped into the HRA and are known to use the vicinity of the OWF for spawning and nursey areas. Their benthic habits means that populations are sensitive to local impacts such as habitat loss, habitat change, and underwater noise. They should be considered for inclusion in the HRA during construction and when assessing in combination impacts. Screen in sandeels for construction and in combination impact pathways.	Assessed in Section 7.11 of the RIAA.
Natural England	HRA Screening Report Response (02/02/2024)	We consider INNS and accidental pollution are potential pathways to impact fish ecology. These potential effects should be included in the screening exercise.	The indirect effects from the Onshore Project Area have been screened out as stated in HRA Screening Addendum Report (Annex A.2 HRA Screening Report and HRA Screening Addendum Report) as there is no longer a pathway for effect (Section 8.3 of the RIAA).

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	HRA Addendum Response (19/09/2024)	Natural England accept the Project's justification for screening out both the introduction of substances and spread of INNS as impact pathways from offshore works to Humber Estuary migratory fish features and are satisfied that these can remain screened out.	Noted.
MMO/Cefas	HRA Addendum Response (10/10/2024)	As far as the MMO can reasonably determine, the HRA approach to screening for Annex II Migratory Fish Receptors does not appear to have significantly changed, and the MMO remain content with the proposed approach.	Noted.
MMO/Cefas	HRA Addendum Response (10/10/2024)	The MMO note that the applicant has reassessed the potential effects for Annex II Migratory Fish and these are updated in Table 8-1 of the HRA addendum. Initially the Onshore Project Area included the development of the Hydrogen Production Facility (HPF), which was located immediately adjacent to the Humber Estuary and therefore presented a direct pathway for onshore activities to impact the estuary at its protected features. As the HPF is no longer included within the project envelope, the onshore connection point will now connect into the Birkhill Wood substation in the East Riding of Yorkshire (Beverley), which is located nearly 8km from the Humber Estuary. The MMO is therefore content with the updated assessment that there is no pathway for direct impacts on the Humber Estuary Special Protection Area (SPA)/ SAC, or its Annex II Migratory Fish features.	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO/Cefas	HRA Addendum Response (10/10/2024)	The MMO note that Table 10-1 in the HRA Addendum relates to the summary of European sites and species screened in for the projects as of 2024. For fish receptors, river and sea lamprey at the River Derwent SAC, Humber Estuary SAC and Humber Estuary Ramsar sites have been screened into assessment of likely significant effects in relation to unexploded ordnance (UXO) clearance from offshore activities carried out in the offshore project area. The MMO agree that this is appropriate.	See Section 8 of the RIAA for the assessment of likely significant effects in relation to unexploded ordnance (UXO) clearance from offshore activities carried out in the Offshore Project Area.
MMO/Cefas	HRA Addendum Response (10/10/2024)	The MMO remain content that the ZOI defined for migratory fish, based on the maximum effect range from worst-case piling noise (50km) remain acceptable.	Noted.
MMO/Cefas	HRA Addendum Response (10/10/2024)	The MMO is content that the potential effects for Annex II Migratory Fish have been appropriately identified.	Noted.
MMO/Cefas	HRA Addendum Response (10/10/2024)	The MMO largely agree with the approach to the HRA set out in the Addendum and have no major reservations in relation to underwater noise.	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO/Cefas	HRA Addendum Response (10/10/2024)	The MMO note that there appears to be a few key changes to the HRA. In terms of 'Annex I Marine Habitats', the Humber Estuary SAC and Ramsar Site are now located a significant distance away from the Offshore Project boundary (in excess of 40km pathway distance). The report concludes that no LSE is therefore expected on Humber Estuary SAC and the Humber Estuary Ramsar site and they are scoped out from further consideration. Ultimately, the MMO defer to Natural England for their comments and recommendations.	No action required, other than to consider Natural England comments.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO/Cefas	HRA Addendum Response (10/10/2024)	Regarding 'Annex II Migratory Fish', the MMO note that the Applicant has presented a revised 'summary of potential effects' in Table 8-1 of the HRA Addendum. Previously the Onshore Project Area was immediately adjacent to the Humber Estuary, presenting a pathway for onshore activities to impact the estuary. This is no longer the case. The only pathway for effect arises from the Offshore Project Area, which is located over 40km north of the estuary mouth. A pathway for LSE still exists regarding underwater noise impacts from Unexploded Ordnance (UXO) clearance in the inshore section of the export cable corridor, and this remains screened in. Given the evolution of the Project, with the removal of the opportunity to include a HPF as part of the design envelope for Dogger Bank D, the report concludes that there is no pathway for direct effects on the Humber Estuary SAC, or these Annex II features in any other SAC. Therefore, there is no pathway for LSE from direct in-combination effects and the Humber Estuary SAC is now screened out. The distance of the Project's piling from sites designated for migratory species, means that species from these sites will be absent or low in abundance in the piling noise ZOI. Combined with the low hearing sensitivity of lamprey species, this contributes to the lack of pathway for LSE due to indirect in-combination effects. Provided that Natural England have no concerns, then the MMO is content with the revised assessment.	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO/Cefas	HRA Addendum Response (10/10/2024)	In summary, for Annex II Migratory Fish species (and the sites for which they are features) designated sites have been screened in due to: Individuals from sites being potentially disturbed/subject to mortality by potential UXO clearance in coastal waters.	The assessment of Annex II Migratory Fish and UXO clearance has been set out in Section 8.4.2, Section 8.4.3, Section 8.5.2, Section 8.5.3, Section 8.6.2, and Section 8.6.3 of the RIAA and in PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology Section 11.7.1.4.2.1.4.
MMO/Cefas	HRA Addendum Response (10/10/2024)	The MMO defers to the appropriate SNCBs as to whether they are content for noise during the Operational and Maintenance stage and Decommissioning to be scoped out for Annex II migratory fish (as per Table 8-1 in the HRA Addendum).	Noted.
Environment Agency	Expert Topic Group 1 Agreement Log 3 (30/10/2024)	<p>“Does the ETG agree with the screening of underwater noise effects on lamprey <i>Petromyzon marinus</i> and river lamprey <i>Lampetra fluviatilis</i> for Humber Estuary and River Derwent SACs in the HRA?”</p> <p>There were no comments on this approach in the ETG.</p> <p>Although not features, there are also records of the migratory species Atlantic salmon (<i>Salmo salar</i>), sea trout (<i>Salmo trutta</i>), Twaite shad (<i>Alosa fallax</i>) and European eel (<i>Anguilla anguilla</i>) within the Humber estuary transitional waterbody. Gransmoor drain (~3.5 km north of Skipsea) should also be noted as a migratory route for European eel. These must be considered in any HRA and WFD compliance assessment, particularly as regards barriers or disturbance created by EMF around the cable.</p>	<p>We acknowledge the potential presence of other migratory species within the Offshore Project Area and Screening ZOI of 50km. We have a transparent approach to screening sites and features into the HRA (i.e. screening distance based on worst-case noise impacts (50km)). Given that no sites designated for these species are screened into the RIAA, they are therefore appropriately assessed in PEIR Volume 1, Chapter 11 Fish and Shellfish Ecology Section 11.7.2.7, not in the RIAA.</p>

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	Expert Topic Group 1 Agreement Log 3 (30/10/2024)	<p>“Does the ETG agree with the screening of underwater noise effects on lamprey <i>Petromyzon marinus</i> and river lamprey <i>Lampetra fluviatilis</i> for Humber Estuary and River Derwent SACs in the HRA?”</p> <p>The MMO support that the effects of underwater noise on sea lamprey and river lamprey will be screened into the Habitats Regulations Assessment (HRA) for the Humber Estuary and River Derwent SACs. The MMO deter to Natural England as the statutory consultee for SACs for further comments.</p>	No action required, other than to consider Natural England comments.
Natural England	Expert Topic Group 1 Agreement Log 3 (30/10/2024)	<p>“Does the ETG agree with the screening of underwater noise effects on lamprey <i>Petromyzon marinus</i> and river lamprey <i>Lampetra fluviatilis</i> for Humber Estuary and River Derwent SACs in the HRA?”</p> <p>There were no comments on this approach in the ETG.</p>	Noted.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Annex II Marine Mammals			
MMO	HRA Screening Report Response DCO/2023/00001 26/01/2024	4.1. The MMO agree with the approach to the HRA within the screening report regarding Underwater Noise matters.	No further action required. Potential effects from underwater noise have been assessed for each designated site screened in for Annex II marine mammals in Section 9 of the RIAA.
MMO	HRA Screening Report Response DCO/2023/00001 26/01/2024	4.4. For marine mammals, the Screening Report concludes that underwater noise during operation and maintenance is considered unlikely to have the potential for a significant effect, however, this effect has been screened in for further site-specific assessment.	The Applicant screened in this impact to allow further consideration and validation of no LSE. Assessments under Section 9 in the RIAA have confirmed there are no adverse effects on Annex II marine mammal designated sites from underwater noise during operation and maintenance.
MMO	HRA Screening Report Response DCO/2023/00001 26/01/2024	4.5. The MMO defer to Natural England for comments on the ZOI used for underwater noise.	No action required, other than to consider Natural England comments.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO	HRA Screening Report Response DCO/2023/00001 26/01/2024	4.6. The MMO note that no project specific underwater noise modelling has been produced at this stage, and that the maximum distance of 19km for moderate avoidance behaviour occurring from piling activities, is based off EIAs for other offshore windfarms. Please note that the behavioural predictions are largely dependent on the threshold that was applied in the assessment. The Barham and Mason (2021) assessment (which was undertaken for Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects) provide a range of predictions for behavioural effects (i.e., ranging from 11 km to 34 km, depending on the threshold).	Project-specific UWN modelling has been conducted for the PEIR stage see PEIR Volume 2, Appendix 12.3 Underwater Noise Modelling Report, assessments in Section 9 of the RIAA have been based on this modelling.
Natural England	HRA Screening Report Response DAS UDS/A006626 02/02/2024 (Ref 463105)	"In addition to the potential for connectivity between marine mammals and the offshore project area, it is not clear to what extent the potential offshore substation and Hydrogen Production Facility (HPF), both of which could be within, or very close to, the Southern North Sea SAC are considered in the HRA. There seems to be little consideration on potential construction of a substation and of the cable route within the SAC and potential disturbance during the operation of the HPF. Clearly present the possible options for construction, including any offshore substations and Electrical Connection Opportunities which might impact the Southern North Sea SAC."	The HPF is no longer included within the project design and the offshore platforms will be located within the Array Area. Therefore, the offshore platform potential effects are included within the offshore project area assessments within Section 9 of the RIAA.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	HRA Screening Report Response DAS UDS/A006626 02/02/2024 (Ref 463105)	<p>"We would welcome more detail and consideration on how the construction and operation & maintenance of offshore substations and Electrical Connection Opportunities might affect seal haul-out sites.</p> <p>Provide detailed plans of the offshore substations and Electrical Connection Opportunities and assess how these will affect seal haul-out sites."</p>	The HPF is no longer included within the project design and the offshore platforms will be located within the Array Area. Therefore, the offshore platform potential effects are included within the offshore project area assessments within Section 9 of the RIAA.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	HRA Screening Report Response DAS UDS/A006626 02/02/2024 (Ref 463105)	<p>"Effects associated with increased suspended sediments have been screened out for direct and indirect impacts to harbour porpoise. It is important to consider the impacts of suspended sediment on harbour porpoise prey resource and habitat. The Dogger Bank area is an important site for sand eels, a prey resource for harbour porpoise. It is vital that habitat and prey resource is protected to meet the Conservation Objective 3 of the Southern North Sea SAC.</p> <p>Thoroughly assess the impacts of suspended sediment from construction, operation and decommissioning on harbour porpoise habitat and prey resource to understand the impact on harbour porpoise from the Southern North Sea SAC."</p>	Indirect and direct effects associated with increased suspended sediment during construction have been assessed for all species and Annex II designated sites under Impact 8: Potential Effects of Changes to Prey Resources and Habitat Quality and Impact 9: Potential Effects of Changes to Water Quality within Section 9 of the RIAA. Potential effects during operation and maintenance have been assessed under Impact 8: Potential Effects of Changes to Prey Resources. Information from other chapters (sediment and fish) have informed the marine mammal assessments within Section 9 of the RIAA.
Natural England	HRA Screening Report Response DAS UDS/A006626 02/02/2024 (Ref 463105)	<p>"We would welcome information on how the number of grey seals and harbour seals observed during the baseline surveys differ between the ECC and the offshore array area.</p> <p>Present densities observed in the offshore project area and the ECC separately."</p>	Due to the low number of grey and harbour seal sightings, absolute density and abundance estimates were not possible to derive from the site-specific surveys. Therefore, the SAC Carter et al., 2022 data was used to calculate both grey and harbour seal densities, in each designated site assessment the separate densities for the Array Area and offshore ECC have been presented in Section 9 of the RIAA. For further information on the site-specific survey data obtained see PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
Natural England	HRA Screening Report Response DAS UDS/A006626 02/02/2024 (Ref 463105)	We note that the second year of marine mammal baseline survey is not yet available. We advise that the full baseline is included in the PEIR if possible, or provided for consultation post-PEIR.	Full details of the two year site specific surveys which were undertaken between October 2021 and September 2023 are presented in the PEIR Volume 2, Appendix 12.2 Marine Mammals Technical Report.
Natural England	HRA Screening Report Response DAS UDS/A006626 02/02/2024 (Ref 463105)	<p>"The densities of grey and harbour seal are higher closer to the coast, and therefore more information on potential locations of HPF and any offshore substations outside of the array area is vital to assess the impacts on grey seals.</p> <p>Provide more information on locations of potential Electrical Connection Opportunities to accurately assess the impacts on grey seals from the Humber Estuary SAC, the Berwickshire and North Northumberland Coast SAC and the Isle of May SAC, and on harbour seals from the Wash and North Norfolk Coast SAC."</p>	The HPF is no longer included within the project design and the offshore platforms will be located within the Array Area. Therefore, the offshore platform potential effects are included within the offshore project area assessments within Section 9 of the RIAA.
Natural England	HRA Screening Report Response DAS UDS/A006626 02/02/2024 (Ref 463105)	<p>"As commented above, more detail on the EEC and potential HPF and offshore substations is required to fully assess the impact on harbour porpoise from the Southern North Sea SAC.</p> <p>Provide more information on locations of potential Electrical Connection Opportunities to accurately assess the impacts on harbour porpoise from the Southern North Sea SAC."</p>	The HPF is no longer included within the project design and the offshore platforms will be located within the Array Area. Therefore, the offshore platform potential effects are included within the offshore project area assessments within Section 9 of the RIAA.
MMO/ Cefas	Addendum, 10/10/2024	The MMO largely agree with the approach to the HRA set out in the Addendum and have no major reservations in relation to underwater noise.	No further action required.

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Stakeholder	Document / Meeting, Date	Comment	How and Where Addressed in the PEIR
MMO/ Cefas	Addendum, 10/10/2024	<p>"For Annex II Marine Mammal species, designated sites have been screened in due to:</p> <ul style="list-style-type: none"> • The sites are within the grey seal foraging distance (of 448 km) of Dogger Bank D, or they have been identified as having connectivity with DBD through the Carter et al. (2022) SAC relative density data; • Harbour porpoise from the site (Southern North Sea SAC) are assumed to be utilising the Dogger Bank D area; • There is potential connectivity between construction activities at Dogger Bank D and the coastal bottlenose dolphin population of the Moray Firth; and • It is assumed that all harbour porpoise in the Dogger Bank D project area, or areas of potential effect, are from the nearest European site for harbour porpoise." <p>The MMO consider that the above approach appears to be reasonable.</p> 	No further action required. All assessments for Annex II marine mammals are within Section 9 of the RIAA. The assessment of potential effects for the Southern North Sea SAC is under Section 9.4 and Section 9.10 of the RIAA covers the Moray Firth SAC.

References

NatureScot (2023). Guidance Note 8: Guidance to support Offshore Wind Applications: Marine Ornithology Advice for assessing the distributional responses, displacement and barrier effects of Marine birds. Version 1 Published January 2023. Available online: <https://www.nature.scot/doc/guidance-note-8-guidance-support-offshore-wind-applications-marine-ornithology-advice-assessing>