RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Report to Inform Appropriate Assessment

Habitats Regulations Assessment

Volume 6

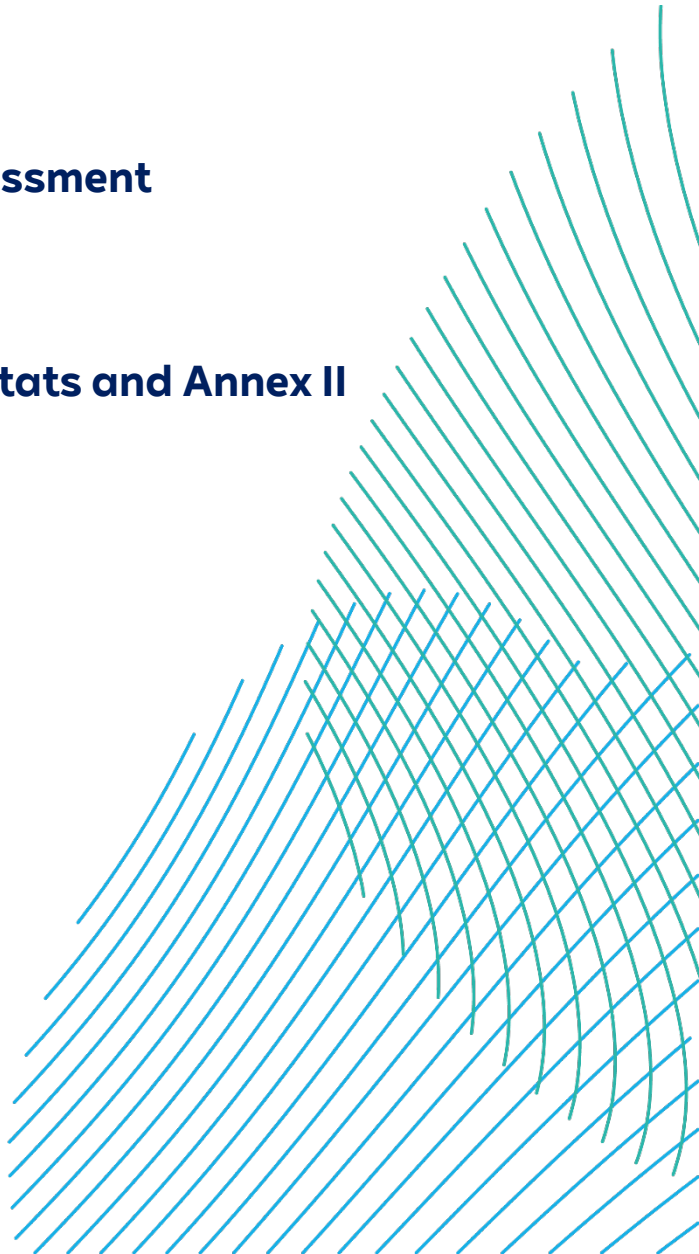
Part 2 of 4 – Annex I Offshore Habitats and Annex II Migratory Fish

June 2024

Application Reference: 6.1

APFP Regulation: 5(2)(g)

Revision: 02



Unrestricted

Company:	**RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited**	Asset:	**Development**
Project:	**Dogger Bank South Offshore Wind Farms**	Sub Project/Package:	**Consents**
Document Title or Description:	Report to Inform Appropriate Assessment Habitats Regulations Assessment - Part 2 of 4 – Annex I Offshore Habitats and Annex II Migratory Fish		
Document Number:	004300178-02	Contractor Reference Number:	PC2340-RHD-ZZ-ZZ-RP-Z-0137

Rev No.	Date	Status/Reason for Issue	Author	Checked by	Approved by
01	February 2024	Draft for PINS / TCE submission	RHDHV	RWE	RWE
02	June 2024	Final for DCO Application	RHDHV	RWE	RWE

Contents

Tables

Appendices

Glossary

Term	Definition
Accommodation Platform	An offshore platform (situated within either the DBS East or DBS West Array Area) that would provide accommodation and mess facilities for staff when carrying out activities for the Projects.
Array Areas	The DBS East and DBS West offshore Array Areas, where the wind turbines, offshore platforms and array cables would be located. The Array Areas do not include the Offshore Export Cable Corridor or the Inter-Platform Cable Corridor within which no wind turbines are proposed. Each area is referred to separately as an Array Area.
Array cables	Offshore cables which link the wind turbines to the Offshore Converter Platform(s).
Collector Platforms (CPs)	Receive the AC power generated by the wind turbines through the array cables, collect it and transform the voltage for onward transmission to the Offshore Converter Platforms (OCPs).
Concurrent Scenario	A potential construction scenario for the Projects where DBS East and DBS West are both constructed at the same time.
Construction Buffer Zone	1km zone around the Array Areas and Offshore Export Cable Corridor, and 500m zone around the Inter-Platform Cabling Corridor. Construction vessels may occupy this zone but no permanent infrastructure would be installed within these areas.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP).
Development Scenario	Description of how the DBS East and / or DBS West Projects would be constructed either in isolation, sequentially or concurrently.
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.
Electrical Switching Platform (ESP)	The Electrical Switching Platform (ESP), if required would be located either within one of the Array Areas (alongside an Offshore Converter Platform (OCP)) or the Export Cable Platform Search Area.

Term	Definition
Environmental Impact Assessment (EIA)	A statutory 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, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement (ES).
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
European Site	Terminology previously used to refer to sites designated for nature conservation under the Habitats Directive and Birds Directive, prior to the UK's exit from the European Union in 2020. This included candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and was defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Export Cable Platform Search Area	The Export Cable Platform Search Area is located mid-way along the Offshore Export Cable Corridor and is the area of search for the Electrical Switching Platform (ESP).
Habitats Regulations	Conservation of Habitats and Species Regulations 2017 and Conservation of Offshore Marine Habitats and Species Regulations 2017.
Habitats Regulations Assessment (HRA)	The process that determines whether or not a plan or project may have an adverse effect on the integrity of a European Site or European Offshore Marine Site.
Horizontal Directional Drill (HDD)	HDD is a trenchless technique to bring the offshore cables ashore at the landfall and can be used for crossing other obstacles such as roads, railways and watercourses onshore.

Term	Definition
In Isolation Scenario	A potential construction scenario for one Project which includes either the DBS East or DBS West array, associated offshore and onshore cabling and only the eastern Onshore Converter Station within the Onshore Substation Zone and only the northern route of the onward cable route to the proposed Birkhill Wood National Grid Substation.
Inter-Platform Cable Corridor	The area where Inter-Platform Cables would route between platforms within the DBS East and DBS West Array Areas, should both Projects be constructed.
Inter-Platform Cables	Buried offshore cables which link offshore platforms.
Intertidal	Area on a shore that lies between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS).
Landfall	The point on the coastline at which the Offshore Export Cables are brought onshore, connecting to the onshore cables at the Transition Joint Bay (TJB) above mean high water.
Mean High Water Springs (MHWS)	MHWS is the average of the heights of two successive high waters during a 24 hour period.
Mean Low Water Springs (MLWS)	MLWS is the average of the heights of two successive low waters during a 24 hour period.
Mean Sea Level	The average level of the sea surface over a defined period (usually a year or longer), taking account of all tidal effects and surge events.
National Policy Statement (NPS)	A document setting out national policy against which proposals for NSIPs will be assessed and decided upon.
National Site Network	The National Site Network comprises National Site Network sites (formerly referred to as European) in the UK that already existed (i.e., were established under the Nature Directives) on 31 December 2020 (or proposed to the EC before that date) and any new sites designated under the Habitats Regulations under an amended designation process.

Term	Definition
National Site Network sites	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.
Nearshore	The zone which extends from the swash zone to the position marking the start of the offshore zone (~20m).
Numerical modelling	Refers to the analysis of coastal processes using computational models.
Offshore Converter Platforms (OCPs)	The OCPs are fixed structures located within the Array Areas that collect the AC power generated by the wind turbines and convert the power to DC, before transmission through the Offshore Export Cables to the Project's Onshore Grid Connection Points.
Offshore Development Area	The Offshore Development Area for ES encompasses both the DBS East and West Array Areas, the Inter-Platform Cable Corridor, the Offshore Export Cable Corridor, plus the associated Construction Buffer Zones.
Offshore Export Cable Corridor	This is the area which will contain the offshore export cables (and potentially the ESP) between the Offshore Converter Platforms and Transition Joint Bays at the landfall.
Offshore Export Cables	The cables which would bring electricity from the offshore platforms to the Transition Joint Bays (TJBs).
Preliminary Environmental Information Report (PEIR)	Defined in the EIA Regulations as information referred to in part 1, Schedule 4 (information for inclusion in environmental statements) which has been compiled by the applicants and is reasonably required to assess the environmental effects of the development.
Scour protection	Protective materials to avoid sediment erosion from the base of the wind turbine foundations and offshore substation platform foundations due to water flow.
Sediment	Particulate matter derived from rock, minerals or bioclastic matter.
Sediment transport	The movement of a mass of sediment by the forces of currents and waves.

Term	Definition
Site of Community Importance (SCI)	Sites that have been adopted by the European Commission in accordance with the Habitats Directive, but not yet formally designated by the government of each country.
Special Area of Conservation (SAC)	Strictly protected sites designated pursuant to Article 3 of the Habitats Directive (via the Habitats Regulations) for habitats listed on Annex I and species listed on Annex II of the Directive
Statutory Nature Conservation Bodies (SNCBs)	Comprised of JNCC, Natural Resources Wales, Department of Agriculture, Environment and Rural Affairs/Northern Ireland Environment Agency, Natural England and Scottish Natural Heritage, these agencies provide advice in relation to nature conservation to government
The Applicants	The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and Masdar (49% stake).
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South Offshore Wind Farms).
Turbine string	Term referring to a number of cables installed in series on a single cable branch forming a string (or collection) circuit.
Wind turbine	Power generating device that is driven by the kinetic energy of the wind.

Acronyms

Term	Definition
AEoI	Adverse Effect on [Site] Integrity
CBRA	Cable Burial Risk Assessment
DCO	Development Consent Order
DML	Deemed Marine Licence
EGL	Eastern Green Link
EMF	Electromagnetic Field
ES	Environmental Statement
HRA	Habitats Regulations Assessment
INIS	Invasive Non-Indigenous Species
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
PAH	Polyaromatic Hydrocarbon
PEMP	Project Environmental Management Plan
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
SACO	Supplementary Advice on Conservation Objectives
SSSI	Site of Special Scientific Interest
TBT	Tributyltin
THC	Total Hydrocarbon Content

Term	Definition
UXO	Unexploded Ordnance
ZOI	Zone of Influence

6 Sites Designated For Offshore Annex I Habitats

6.1 Approach to Assessment

1. This section provides information in order to determine the potential for the Project to have an adverse effect on the integrity of sites designated for Annex I habitats.

2. For each site designated for Annex I habitats screened in for further assessment, the following has been provided:

   - A summary of the relevant qualifying features of the SAC screened into the assessment;
   - An assessment of the potential effects during the construction, operation, maintenance and decommissioning phases; and
   - An assessment of the potential for in-combination effects alongside other relevant developments and projects.

6.2 Consultation

3. The key elements of consultation to date have included the HRA Screening Report (**Volume 6, Appendix A (application ref: 6.1.1)**) and the ongoing technical consultation via the DBS Seabed Expert Topic Group. The feedback received has been considered in preparing this draft RIAA. **Table 6-1** provides a summary of how the consultation responses relevant to Offshore Annex I Habitats received to date have influenced the approach that has been taken.

Table 6-1 Consultation Responses Relevant to Offshore Annex I Habitats

Comment	Applicants Response
Draft HRA Screening Report Comments, MMO (30/01/2023)	
The MMO have no comments to make in regards to the Stage 1 screening report at this moment. MMO defer to comments made by Natural England (NE) and Environment Agency (EA) as Lead Competent Authorities on matters related to nature conservation. MMO wish to be included on future HRA discussions/reports so that we can consider whether any subsequent proposed mitigation, which are to be secured in an eventual Deemed Marine Licence (DML) meet the requirements of the MMO Enforcement Team. This means they must be drafted in a way that meets the following 5 criteria: 1) The condition must be necessary. 2) The condition must relate to the activity or development for which a DCO is sought. 3) The condition must be enforceable. 4) The condition must be precise. 5) The condition must be reasonable.	Noted with thanks, the Applicants will ensure that MMO are included in all future HRA consultation and discussions.
Draft HRA Screening Report Comments, Natural England (20/02/2023)	
Natural England welcomes the opportunity to review the HRA screening report and provide feedback on it. Additional sites we feel should be screened in can be found below and our detailed comments are provided in Annex I.	Noted with thanks.
Internationally designated sites Natural England can confirm that the proposed works are located within Dogger Bank Special Area of Conservation (SAC), Southern North Sea SAC, the Greater Wash Special Protection Area (SPA) and Flamborough and Filey Coast SPA, all of which have been correctly screened into the HRA assessment. Natural England have reviewed the other adjacent (or within the zone of influence (ZOI)) sites scoped into the assessment and advise the following additional designated sites also have the potential to be impacted and should therefore be screened in	Noted with thanks.
<u>Humber Estuary SAC</u> Natural England advise that the Humber Estuary SAC is screened into the HRA assessment due to potential impacts on sediment transportation along the Holderness coast as a result of cable installation activities. The Annex 1 habitats of the Humber Estuary which could be impacted are: • Estuaries; • Mudflats and sandflats not covered by seawater at low tide; • Sandbanks which are slightly covered by seawater all the time; • Coastal lagoons; • Salicornia and other annuals colonising mud and sand Atlantic salt meadows (*Glauco Puccinellietalia maritimae*)	Potential effects on the Humber Estuary SAC are presented in section 6.6 of this report.

Comment	Applicants Response
At present, the Project is unable to provide any information on the likely requirements for external cable protection within the nearshore zone. External cable protection (and cable crossings) in shallow water depths could potentially alter nearshore sediment transport processes. The Project's landfall location at Skipsea is south of the longshore drift divide. Thus, longshore drift, combined with residual currents, drive the southwards movement of material along the coast to Spurn Head. In addition, tidal currents flow southwards during the flood tide (northwards with the ebb tide) leading to a net southwards residual current. Fine sediments eroded from the Holderness cliffs are transported into the Humber Estuary by flood tides and these finer sediments are considered to play an important role in the sediment budgets of the Humber Estuary and the Wash. As several Projects of material consideration are due to be making landfall along this coastline there is also potential for these impacts to act in-combination. We also do not have any details of potential installation of ancillary infrastructure in the nearshore such as cofferdams, HDD exit pits etc, which could also affect longshore sediment transport. Therefore, in line with advice provided to other projects in this area, we advise that The Humber Estuary SAC be screened into the assessment.	
<u>Consideration of in-combination effects (Section 3.3.1)</u> Natural England note that the Project has adopted a three tier approach to rank other projects in the in-combination assessment. We highlight that NE Best Practice Guidance published in 2022 advises the use of a seven tier approach (Section 11.1, Phase III Best Practice for Data Analysis and Presentation at Examination, March 2022) which we advise is used in this assessment moving forward. We note that for several thematic areas, insufficient information has been provided regarding the approach to in-combination assessment and the Projects to be included for us to meaningfully comment at this time.	The in-combination assessment methodology has been updated to reflect the most recent version of the Phase III Best Practice for Data Analysis and Presentation at Examination guidance.
<u>Sites designated for Annex I Habitats (Section 4.1)</u> Natural England have concerns that the 50km in-combination search area for benthic impacts is not appropriate in all instances. We consider the HRA should take into consideration other offshore wind projects, especially those that are to be located within the Dogger Bank SAC (we note that Dogger Bank C is currently not considered). Where multiple projects impact a designated site, Natural England advise the screening area should be increased to encompass all projects impacting the features to be assessed within that site. Natural England advise that the Eastern Green Link 2 (EGL2) interconnect cable making landfall just south of Bridlington should be included in the assessment of in-combination impacts on Annex I habitats of Flamborough Head SAC. This project has submitted its licence application and is awaiting a decision so should be considered Tier 4 according to the NE Best Practice Guidance. Natural England request further evidence is provided to support the use of a 10km ZOI for suspended sediment. It is noted that the Project has based this on evidence from other offshore wind EIAs (such as the nearby Sofia and Dogger Bank C) [paragraph 92]. However, Natural England are concerned that these two projects follow a different export cable route and that this figure might not be suitable for the nearshore area where Dogger Bank South makes landfall. We highlight that recently examined offshore wind farms (OWF) such as Hornsea 4 used buffer zones 'scaled to represent the equivalent distance of tidal excursion on a mean spring tide', whereby two different values are used for tidal excursion noting the differences between the array area and offshore export cable corridor (approx. 10km for the array area and 15km for export cable corridor based on nearshore flows). We suggest a similar approach is taken for the Dogger Bank South Projects.	All offshore wind farms under planning, under construction or in operation within the Dogger Bank SAC will be considered in the in-combination assessment. The Eastern Link 2 HVDC cable, in addition to the Third Eastern Link HVDC cable (TGDC) and Fourth Eastern Link HVDC cable (E4L5) will also be considered in the in-combination assessment. The Zone of Influence (ZoI) for suspended sediment has been updated to 8km based on site specific physical processes modelling undertaken for the Projects (see **Volume 7, Appendix 8-3 (application ref: 7.8.8.3)** that accompanies this report for further information).

Comment	Applicants Response
Final HRA Screening Report Comments, MMO (17/07/2023)	
Table 4-1 states that PAH contamination is screened out for the operational phase, however as there is a possibility of fluids entering the marine environment these should be considered. For example hydraulic fluids used on the OWF, even in a 'closed' system, where top up is required may have the potential to be released into the marine environment. Whilst the risk may indicate that it is low, because there is potential for these chemicals and pollutants (from use and discharge as a result of operation and maintenance activity) reaching the marine environment this should be scoped in.	Polyaromatic hydrocarbon (PAH) contamination during the operation and maintenance phase of the Projects has been screened in for assessment for the Dogger Bank SAC in section 6.4.2.4.1.
The MMO is content that the synthetic compound contaminants have been scoped out for operation and decommissioning but are scoped in as part of the assessment for operation and maintenance. However, the table also suggest that the effects of transition elements and organo-metals like tributyl tin contamination are not relevant to the Projects activities. Many inorganic chemicals may be used offshore e.g., for cementing drilling and cleaning purposes, it is unclear here why the effects of the potential release of these chemicals in the marine environment are not relevant and the MMO suggest they are scoped in for consideration.	Potential effects of synthetic compound contaminants (including pesticides, antifoulants, pharmaceuticals) have been screened in for assessment for the Dogger Bank SAC in section 6.4.2.7.1.
Table 4-1 (and Section 4.1) has screened out seabed surface disturbance and changes in water clarity as impacts during operations and maintenance. The MMO does not consider that either can be screened out without further justification. Wakes in the lee of OWF foundations are likely to maintain sediment suspension in the water column at levels above those experienced in the absence of the OWF. However, the same table does indicate the consideration of smothering, seabed type change and siltation rate changes during operations, which would appear to be related. You should clarify how changes to siltation and smothering occur without related changes to suspension and water clarity. Based on recent evidence (e.g., Forster, 2018; Schultze *et al.*,, 2020; Christiansen *et al.*,, 2023), vertical sediment distribution changes in subsurface wakes should be considered as an impact throughout the operations phase.	Seabed surface disturbance and changes in water clarity during the operation and maintenance phase of the Projects have been assessed within sections 6.4.2.1.1 and 6.4.2.2.1 respectively.
Although Paragraph 80 provides consideration of the release of fines on water quality, and Paragraph 81 considers release of hydrocarbons as a result of the construction activity, there is mention of the quality of the sediments and potential for release of other contaminants (e.g., heavy metals) from sediment at depth (e.g., the drill arisings), this should be included for completeness. The MMO notes the comments in Paragraph 87 regarding the potential of plastic pollution as a result of paint flakes and welcome the comments on this topic.	Potential effects of heavy metal contamination are assessed in section 6.4.2.4.1.
The document scoped out the inclusion of hydrocarbons during operation activities. This, as well as all chemicals used and or discharged that may come into to contact the marine environment – should be considered within the assessment for all stages of the OWF lifetime.	Potential effects of hydrocarbon contamination during all phases of the Projects lifespan are assessed in section 6.4.2.4.1.
Final HRA Screening Report Comments, Natural England (17/07/2023)	
Natural England disagrees with abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids, and penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion being screened out for the operations and maintenance phase. We advise that these impacts are screened in for assessment.	The effects of abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids, and penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion have been assessed across all phases of the Projects lifespan in section 6.4.2.1.

Comment	Applicants Response
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.	Introduction or spread of invasive non-indigenous species (INIS) have been assessed across all phases of the Projects lifespan in section 6.4.2.5.1.
A ZOI of 10km has been used for sediment plumes based on evidence from the Teesside A&B EIA. NE advise that a tidal ellipse is used to estimate the zone of greatest influence for sediment plumes for the array area and export cable corridor. We understand that the Applicant intends to provide new, site-specific modelling which may address this point. We request that the new modelling is provided for review during the Evidence Plan Process.	The ZoI for suspended sediment has been updated to 8km based on site specific physical processes modelling undertaken for the Projects (see **Volume 7, Appendix 8-3 (application ref: 7.8.8.3)** that accompanies this application for further information).
Final HRA Screening Report Comments, Lincolnshire Wildlife Trust (17/07/2023)	
4. Cumulative Impacts on the Dogger Bank SAC While the Applicant outlines the need and methodology for a Cumulative Effects Assessment (CEA) in Chapter 6, Subsection 7.4., LWT would like to flag concern for the level of detail and consideration given to the CEA within the PEIR and so far throughout the pre-application process. Within the Planning Inspectorate's Advice Note Seventeen, Paragraph 2.1 clearly outlines that, '*The scale and nature of NSIPs will typically dictate a broad spatial and temporal zone of influence (ZOI)*'. Furthermore, Paragraph 2.2 states that, '*Stages 1-2 should be ideally undertaken early in the pre-application phase and ideally before requesting a Scoping Opinion. Applicants should make use of the EIA scoping process to provide information on the CEA and ensure that it is appropriate, focussed and proportionate.*' While LWT understands that Advice Note Seventeen does leave some contingency for open interpretation on appropriate CEA timelines, we nonetheless interpret the wording from Paragraphs 2.1 and 2.2 as impetus on developers to begin a broad CEA process early to ensure due diligence and best practice. Therefore, we are disappointed with the decision taken by the Applicant to wait until the later stages of the EIA and ES to appropriately conduct a CEA, as stated in Section 6.7.4.3, Paragraph 80: '*The available information regarding many other projects is continually changing as they move through the development process, for example, the Outer Dowsing PEIR (by Q2 2023), the decision on Hornsea Project Four (Q3 2023), and the Sheringham Shoal and Dudgeon Extension Projects examination (Q3 2023). The information that is made public from these and other relevant projects will alter the details presented in the CEA for the Projects. As such, a final CEA will be included in the later stages of the EIA and completed and reported on in the ES, when the main assessments of the DBS East and/or DBS West proposals have been undertaken and the extent to which other plans, programmes or projects might lead to cumulative effects can be fully considered.*'	Noted. A full Cumulative Effects Assessment with regard to the Dogger Bank SAC is included within section 6.4.2 of this report.

6.3 Assessment of Potential Effects

6.3.1 Embedded and Standard Mitigation Measures

4. **Table 6-2** outlines the embedded and standard mitigation measures incorporated into the design of the Projects relevant to the assessment for Annex I habitats.

Table 6-2 Embedded Mitigation Measures Relevant for Annex I Habitats

Parameter	Embedded Mitigation Measures	Where commitment is secured?
Offshore Export Cable Corridor	The offshore cable corridor was selected in consultation with key stakeholders to select route options which minimised impacts on designated sites, such as minimising its length within the Dogger Bank Special Area of Conservation (SAC), avoiding permanent overlaps with the Annex I Smithic Bank sandbank, as well as avoiding overlaps with the Flamborough Head SAC. See **Volume 7, Chapter 4 Site Selection and Assessment of Alternatives (application ref: 7.4)**.	DCO Schedule 1
Minimise use of scour and external cable protection	Following industry best-practice the Applicants will seek to minimise the use of scour protection and external cable protection for any stretches of unburied cables and cable crossings. This is presented in two Cable Burial Risk Assessments and secured in Cable Protection Plans, produced in line with the detail outlined in the **Cable Statement (application ref: 8.20)** that has been submitted with the DCO application, and which will be updated in accordance with conditions attached to the Deemed Marine Licences (DMLs) in the **Draft DCO (application ref: 3.1)**. In addition, the Applicants will seek to minimise the use of foundation scour protection. This is presented in the **Outline Scour Protection Plan (application ref: 8.27)** that has been submitted with the DCO application, and which will be updated in accordance with conditions attached to the DMLs in the **Draft DCO (application ref: 3.1)**.	Scour Protection Plan Cable Statement DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11

Parameter	Embedded Mitigation Measures	Where commitment is secured?
Cable Burial Risk Assessment (CBRA)	Final Cable Burial Risk Assessments and Cable Protection Plans will be produced in line with the detail provided in the **Cable Statement (application ref: 8.20)** that has been submitted with the DCO application, and in accordance with conditions attached to the DMLs in the **Draft DCO (application ref: 3.1)**. This will aid in determining where shallow areas of glacial till may be located within the Offshore Development Area. If required, the use of micro-siting is required to avoid any such features will be discussed and agreed with the MMO in consultation with Natural England post-consent.	DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11
Electromagnetic Fields (EMF)	The Applicants are committed to burying offshore export cables to 0.5-1.5m (depending on cable location) where practicable (subject to a cable burial risk assessment (see **Cable Statement (application ref: 8.20)**). This will increase the distance between the offshore export cables and the seabed surface, resulting in a lower field strength and area affected by EMF at the seabed surface (see **Cable Statement (application ref: 8.20)**).	Cable Statement DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 – Condition 11
Employ biosecurity measures	The risk of spreading INNS will be reduced by employing biosecurity measures in accordance with the following requirements: • International Convention for the Prevention of Pollution from Ships (MARPOL); • The Merchant Shipping (Control and Management of Ships' Ballast Water and Sediments) Regulations 2022); and The Environmental Damage (Prevention and Remediation (England) Regulations 2015.	Project Environmental Management Plan (PEMP) Marine Pollution Contingency Plan (MPCP) DML 1 &2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11

Parameter	Embedded Mitigation Measures	Where commitment is secured?
Cable Protection	Any offshore export cables associated with the Projects will be buried within the intertidal zone at landfall, and 350m seaward of Mean Low Water Springs (MLWS). No surface cable protection will be used within these areas. Cable protection will be limited to 10% of the cumulative length of all cables laid between 350m seaward of MLWS and the 10m depth contour as measured against the lowest astronomical tide before the commencement of construction.	DML 3 & 4 - Condition 3
Pollution Prevention Measures	Due to the presence and movements of construction and operation and maintenance vessels / equipment there is the potential for spills and leaks which could result in changes to water quality. All vessels involved will be required to comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78. The production of one or more Project Environmental Management Plans (PEMPs) is a Condition of the five Deemed Marine Licences (DMLs). The final PEMP(s) would be in accordance with the **Outline PEMP (application ref: 8.21)** and would detail all procedures and measures (in the form of a Marine Pollution Contingency Plan (MPCP)) to be followed during the different phases of the Projects to minimise the risk of, and effects in, the event of an accidental spill. The final PEMP will identify all potential sources and types of accidental pollution for the relevant project phase and set out the proposed mitigation measures and will be developed in consultation with key stakeholders for approval by the MMO. The individual Projects and phases may require separate final PEMP(s). In addition separate PEMPs may also be produced for individual packages.	PEMP MPCP DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11

Parameter	Embedded Mitigation Measures	Where commitment is secured?
Sediment Removal	Any sediment removed from within the Dogger Bank Special Area of Conservation during construction of the authorised scheme must be disposed of within that part of the Dogger Bank Special Area of Conservation which falls within the Order limits.	DML 1 & 2 - Condition 15 DML 3 & 4 - Condition 13 DML 5 - Condition 11

5. Although not considered mitigation, the following commitments have been made by the Applicants in line with the conclusions of The Crown Estate's Round 4 Plan Level HRA (The Crown Estate, 2022):

- The use of gravity base structures and suction caisson monopile foundations have been removed as foundation options within the boundary of the Dogger Bank SAC.
- A maximum 10% of cable length within the Dogger Bank SAC may use remedial protection measures.

6.3.2 Worst Case Scenario

6. The Projects final design will be confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. In order to provide a precautionary but robust assessment at this stage of the development process, realistic worst-case scenarios have been defined in terms of the potential effects that may arise. These are presented in **Table 6-3**.

Table 6-3 Worst-Case Scenario for Annex I Habitats Assessment

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
Construction **In the instance of sequential development of the two Projects, up to a two-year lag between construction activities is possible, final overall area would be identical to the concurrent design scenario.**				
Abrasion/disturbance of the substrate on the surface of the seabed **Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion** **Habitat structure changes – removal of substratum (extraction)** **Physical change (to another seabed or sediment type)**	**Total area of disturbance within Dogger Bank SAC – 15,499,199m²** <u>Array and Inter-platform Cables</u> **Maximum area disturbed (trenching + sandwave levelling) – 9,900,000m²** Array cable trench area (325,000m x 20m boulder plough width) – 6,500,000m² Inter-platform cable trench area (115,000m x 20m disturbance width) – 2,300,000m² Maximum seabed area disturbed by sandwave levelling – 1,100,000m² <u>Foundations and Vessel Impacts</u> **Maximum area disturbed (foundations, platforms, vessel jack-up locations and anchoring) – 1,307,499m²** Seabed preparation area for 100 small turbine monopile foundations (including scour protection) – 358,498m² Seabed preparation area for four offshore platforms (monopile foundations), including scour protection – 24,889m² Area of seabed contact for vessel jack-up assuming six jack-up locations per turbine (275m² per jack up leg x four legs x six operations per turbine x 100 small turbines) - 660,000m² Area of seabed contact for vessel jack-up for all platforms in Array Areas (1,100m²	**Total area of disturbance within Dogger Bank SAC – 13,370,924m²** <u>Array and Inter-platform Cables</u> **Maximum area disturbed (trenching + sandwave levelling) – 10,210,500m²** Array cable trench area (325,000m x 20m boulder plough width) – 6,500,000m² Inter-platform cable trench area (129,000m x 20m disturbance width) – 2,576,000m² Maximum seabed area disturbed by sandwave levelling – 1,134,500m² <u>Foundations and Vessel Impacts</u> **Maximum area disturbed (foundations, platforms, vessel jack-up locations and anchoring) – 1,307,499m²** Seabed preparation area for 100 small turbine monopile foundations (including scour protection) – 358,498m² Seabed preparation area for four offshore platforms (monopile foundations), including scour protection – 24,889m² Area of seabed contact for vessel jack-up – assuming six jack-up locations per turbine (275m² per jack up leg x four legs x six operations per turbine x 100 small turbines) – 660,000m² Area of seabed contact for vessel jack-up for all platforms in Array Areas (1,100m² combined	**Total area of disturbance within Dogger Bank SAC – 31,430,392m²** <u>Array and Inter-platform Cables</u> **Maximum area disturbed (trenching + sandwave levelling) – 22,309,875m²** Array cable trench area (650,000m x 20m boulder plough width) – 13,000,000m² Inter-platform cable trench area (342,000m x 20m disturbance width) – 6,831,000m² Maximum seabed area disturbed by sandwave levelling – 2,478,875m² <u>Foundations and Vessel Impacts</u> **Maximum area disturbed (foundations, platforms, vessel jack-up locations and anchoring) – 2,614,968m²** Seabed preparation area for 200 small turbine monopile foundations (including scour protection) – 716,966m² Seabed preparation area for eight offshore platforms (monopile foundations), including scour protection – 49,778m² Area of seabed contact for vessel jack-up vessel jack-up assuming six jack-up locations per turbine (275m² per jack up leg x four legs x six operations per turbine x 200 small turbines) – 1,320,000m² Area of seabed contact for vessel jack-up for all platforms in Array Areas (1,100m²	Total area of disturbance includes array cable, inter-platform cable and offshore export cable trenching, sandwave levelling, foundation installation and vessel jack-up and anchoring impacts, Figure totals include a mix of large and small turbine parameters to represent an absolute worst-case situation. As such covers for a scenario where a mix of small and large turbines are utilised in the build-out of the Projects. Pre-lay grapnel run (PLGR) activities will fall within the area of the cable trench disturbance width of 20m. In situations where a number does not divide into an integer between DBS East and DBS West (e.g.113 large turbines), the numbers presented in this table have been rounded up to higher number (e.g. 57 large turbines as opposed to 56.5). Anchoring events assumes four activities per turbine

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
	combined leg area x five operations per platform x four platforms) – 22,000m²	leg area x five operations per platform x four platforms) – 22,000m²	combined leg area x five operations per platform x eight platforms) – 44,000m²	foundation installation + one activity for topside installation per turbine.
	Anchoring area (116m² area x four anchors per activity x five activities requiring the deployment of anchors x 100 small turbines + four offshore platforms) – 242,112m²	Anchoring area (116m² area x four anchors per activity x five activities requiring the deployment of anchors x 100 small turbines + four offshore platforms) – 242,112m²	Anchoring area (116m² area x four anchors per activity x five activities requiring the deployment of anchors x 200 small turbines + eight offshore platforms) – 484,224m²	In some instances the projects in sequence / concurrently are not double those of the projects in isolation. For example, there is only ever one accommodation platform and one ESP under any design scenario. To ensure the WCS has been assessed, however, such platforms are accounted for in each possible scenario.
	<u>Offshore Export Cable Corridor</u>	<u>Offshore Export Cable Corridor</u>	<u>Offshore Export Cable Corridor</u>	Final totals are based on the unrounded figures of the above parameters. As such there is a small variation in the total figures stated in the table compared to the figure reached when adding the rounded figures of each parameter.
	Total temporary area disturbed for export cable installation within the Dogger Bank SAC (trenching, sandwave levelling and anchoring) – 4,291,700m²	**Total temporary area disturbed for export cable installation within the Dogger Bank SAC (trenching, sandwave levelling and anchoring) – 1,852,925m²**	**Total temporary area disturbed for export cable installation within the Dogger Bank SAC (trenching, sandwave levelling and anchoring) – 6,505,549m²**	
	Total offshore cable length per cable within Dogger Bank SAC – 40.7km	Total offshore cable length per cable within Dogger Bank SAC – 16.72km	Total offshore cable length per cable within Dogger Bank SAC – 40.7km for DBS East, 16.72km for DBS West	
	Maximum number of cables required – Two	Maximum number of cables required – Two	Maximum number of cables required – Four	
	Maximum offshore cable length for all cables within Dogger Bank SAC – 81.4km	Maximum offshore cable length for all cables within Dogger Bank SAC – 33.4km	Maximum offshore cable length for all cables within Dogger Bank SAC – 116km	
	Note – Assumes a worst-case of a separate cable trench for each cable, spaced 50m apart.	*Note – Assumes a worst-case of a separate cable trench for each cable, spaced 50m apart.*	*Note – Assumes a worst-case of a separate cable trench for each cable, spaced 50m apart.*	
	Maximum temporary disturbance area for cable installation within Dogger Bank SAC – 1,628,000m² (based on 81,400m distance x 20m width of temporary disturbance)	Maximum temporary disturbance area for cable installation within Dogger Bank SAC – 668,000m² (based on 33,400m distance x 20m width of temporary disturbance)	Maximum temporary disturbance area for cable installation within Dogger Bank SAC – 2,320,000m² (based on 116,000m distance x 20m width of temporary disturbance)	
	Maximum estimated seabed area disturbed by sandwave levelling within Dogger Bank SAC – 2,658,924m²	Maximum estimated seabed area disturbed by sandwave levelling within Dogger Bank SAC – 1,182,517m²	Maximum estimated seabed area disturbed by sandwave levelling within Dogger Bank SAC – 4,178,044m²	Sandwaves were divided into three categories: small bedforms (maximum height <0.4m); medium bedforms (maximum height <0.4m to 0.75m); and large or very large bedforms (maximum height 5m), as per the Ashley (1990) bedform classification.
	Maximum estimated area impacted by anchoring – 4,776m²	Maximum estimated total impacted by anchoring – 2,408m²	Maximum estimated area impacted by anchoring – 7,505m²	The total sandwave levelling volumes were calculated by estimating the profile area

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
				of a trenched sandwave (separately for small, medium and large or very large) and multiplying this figure by the estimated worst-case length of each export cable route where bedforms of each classification may be encountered. The separate figures for small, medium and large or very large bedforms were then added together and multiplied by the maximum number of offshore export cables for that particular scenario to give the final estimated volume of sediment disturbed by sandwave levelling activities.
Changes in suspended solids (water clarity) **Smothering and siltation rate changes (Light and Heavy)** **Hydrocarbon & Polyaromatic Hydrocarbon (PAH) contamination**	**Total displaced sediment within Dogger Bank SAC – 11,368,000m³** **Total displaced sediment by array and inter-platform cable installation – 3,430,500m³** Array cable – 1,950,000m³ (325,000m length x 6m width x 1m depth) Inter-platform cables – 1,035,000m³ (115,000m length x 6m width x 1.5m depth) Maximum volume of sandwave material to be dredged/relocated – 445,500m³ **Total displaced sediment by offshore export cable installation within Dogger Bank SAC – 7,910,118m³**	**Total displaced sediment within Dogger Bank SAC – 7,103,876m³** **Total displaced sediment by array and inter-platform cable installation – 3,570,473m³** Array cable – 1,950,000m³ (325,000m length x 6m width x 1m depth) Inter-platform cables – 1,161,000m³ (129,000m length x 6m width x 1.5m depth) Maximum volume of sandwave material to be dredged/relocated – 459,473m³ **Total displaced sediment by offshore export cable installation within Dogger Bank SAC – 3,499,021m³**	**Total displaced sediment within Dogger Bank SAC – 20,361,344m³** **Total displaced sediment by array and inter-platform cable installation – 7,981,944m³** Array cable – 3,900,000m³ (650,000m length x 6m width x 1m depth) Inter-platform cables – 3,078,000m³ (342,000m length x 6m width x 1.5m depth) Maximum volume of sandwave material to be dredged/relocated – 1,003,944m³ **Total displaced sediment by offshore export cable installation within Dogger Bank SAC – 12,311,240m³**	Maximum burial depth for array and inter-platform cables is 1m. Maximum burial depth for offshore export cables is 1.5m. These depths has been assumed across the entire length of the each cable type to determine the worst-case volume of sediment disturbed. 6m disturbance width based on worst-case pre-lay ploughing width

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
Synthetic compound contaminant (including pesticides, antifoulants, pharmaceuticals) **Transition elements & organo-metal (e.g. TBT) contamination**	Export cable – 732,600m³ (81,400m length x 6m width x 1.5m depth) Maximum volume of sandwave material to be dredged/relocated – 7,170,518m³ **Maximum volume of drill arisings (57 turbines) – 34,382m³** Maximum volume arisings per pile (large turbines) – 12,064m³ Maximum % of locations using drilling – 5%	Export cable – 300,600m³ (33,400m length x 6m width x 1.5m depth) Maximum volume of sandwave material to be dredged/relocated – 3,198,421m³ **Maximum volume of drill arisings (57 turbines) – 34,382m³** Maximum volume arisings per pile (large turbines) – 12,064m³ Maximum % of locations using drilling – 5%	Export cable – 1,044,000m³ (114,800m length x 6m width x 1.5m depth) Maximum volume of sandwave material to be dredged/relocated – 11,267,240m³ **Maximum volume of drill arisings (113 turbines) – 68,160m³** Maximum volume arisings per pile (large turbines) – 12,064m³ Maximum % of locations using drilling – 5%	
Introduction or spread of invasive non-indigenous species (INIS)	Up to 80 construction vessels within the Dogger Bank SAC simultaneously and up to 3,857 round trips to port.	Up to 80 construction vessels within the Dogger Bank SAC simultaneously and up to 3,857 round trips to port.	Up to 134 construction vessels within the Dogger Bank SAC simultaneously and up to 7,510 round trips to port.	
Operation				
Abrasion/disturbance of the substrate on the surface of the seabed	**Array Area** Area of seabed disturbance from jacking-up activities over Projects lifetime – **306,900m²** (10,230m² per year x 30 year lifespan) Area of seabed disturbance from array cable repairs over Projects lifetime – **54,000m²** (Nine events x 6,000m² per event) Area of seabed disturbance from inter-platform cable repairs over Projects lifetime – **12,000m²** (Two events x 6,000m² per event)	**Array Area** Area of seabed disturbance from jacking-up activities over Projects lifetime – **306,900m²** (10,230m² per year x 30 year lifespan) Area of seabed disturbance from array cable repairs over Projects lifetime – **54,000m²** Nine events x 6,000m² per event) Area of seabed disturbance from inter-platform cable repairs over Projects lifetime – **12,000m²** (Two events x 6,000m² per event)	**Array Areas and Inter-Platform Cable Corridor** Area of seabed disturbance from jacking-up activities over Projects lifetime – **613,800m²** (20,460m² per year x 30 year lifespan) Area of seabed disturbance from array cable repairs over Projects lifetime – **102,000m²** (17 events x 6,000m² per event) Area of seabed disturbance from inter-platform cable repairs over Projects lifetime – **36,000m²** (Six events x 6,000m² per event)	N/A

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
	Offshore Export Cable Corridor Area of export cable repairs - seabed disturbance over Projects lifetime – **18,000m²** (Three events x 6,000m² per event)	**Offshore Export Cable Corridor** Area of export cable repairs - seabed disturbance over Projects lifetime – **18,000m²** (Three events x 6,000m² per event)	**Offshore Export Cable Corridor** Area of export cable repairs - seabed disturbance over Projects lifetime – **36,000m²** (Six events x 6,000m² per event)	
Changes in suspended solids (water clarity) **Smothering and siltation rate changes (Light and Heavy)** **Hydrocarbon & Polyaromatic Hydrocarbon (PAH) contamination** **Synthetic compound contaminant (including pesticides, antifoulants, pharmaceuticals)** **Transition elements & organo-metal (e.g. TBT) contamination**	**Maximum estimated volume of displaced sediment during maintenance activities in the Array Areas – 1,666,500m³** Volume of displaced sediment from array cable repairs over Projects lifetime – 108,000m³ (Nine events x 12,000m³ per event) Volume of displaced sediment from inter-platform cable repairs - over Projects lifetime – 24,000m³ (Two events x 12,000m³ per event) Volume of displaced sediment from jacking-up activities over Projects lifetime – 1,534,500m³ (51,150m³ per year x 30 year lifespan) **Maximum estimated volume of displaced sediment during maintenance activities in the Offshore Export Cable Corridor – 36,000m³** Volume seabed disturbance from export cable repairs - over Projects lifetime – 36,000m³ (Three events x 12,000m² per event)	**Maximum estimated volume of displaced sediment during maintenance activities in the Array Areas – 1,666,500m³** Volume of displaced sediment from array cable repairs r Projects lifetime – 108,000m³ (Nine events x 12,000m³ per event) Volume of displaced sediment from inter-platform cable repairs - over Projects lifetime – 24,000m³ (Two events x 12,000m³ per event) Volume of displaced sediment from jacking-up activities over Projects lifetime – 1,534,500m³ (51,150m³ per year x 30 year lifespan) **Maximum estimated volume of displaced sediment during maintenance activities in the Offshore Export Cable Corridor – 36,000m³** Volume seabed disturbance from export cable repairs - over Projects lifetime – 36,000m³ (Three events x 12,000m² per event)	**Maximum estimated volume of displaced sediment during maintenance activities in the Array Areas – 3,345,000m³** Volume of displaced sediment from array cable repairs over Projects lifetime – 204,000m³ (17 events x 12,000m³ per event) Volume of displaced sediment from inter-platform cable repairs - over Projects lifetime – 72,000m³ (Six events x 12,000m³ per event) Volume of displaced sediment from jacking-up activities over Projects lifetime – 3,069,000m³ (102,300m³ per year x 30 year lifespan) **Maximum estimated volume of displaced sediment during maintenance activities in the Offshore Export Cable Corridor – 72,000m³** Volume seabed disturbance from export cable repairs - over Projects lifetime – 72,000m³ (Six events x 12,000m² per event)	Jack-up vessel footprint assumes a maximum penetration depth of 5m Cable repairs assume a maximum depth of 2m. The cable is buried 0.5-1.5 but repairs also account for potential additional mobile sand coverage.

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
Physical change (to another seabed or sediment type)	**Total area of habitat loss within the Dogger Bank SAC from Array Area and Offshore Export Cable Corridor footprints combined – 1,026,799m²** **Array Area** **Total area of habitat loss within the Dogger Bank SAC in relation to the Array Area (foundations, scour protection, cable protection and cable crossings) – 890,879m²** Total worst case turbine foundation area, including scour protection – 311,725m² (100 small turbines x 3,117m² total area per turbine) Total worst-case offshore platforms foundation area, including scour protection– 21,642m² (4 monopiles x 5,411m² total area per platform) Total area of array and inter-platform cable protection – 496,212m² (312,900m² array cable protection + 183,312m² inter-platform cable protection) Estimated number of array/inter-platform cable pipeline/cable crossings - 19 Total area of pipeline / cable crossing material (array + inter-platform cables) – 61,300m² **Offshore Export Cable Corridor** **Total area of habitat loss within the Dogger Bank SAC in relation to the Offshore Export Cable Corridor – 135,920m²**	**Total area of habitat loss within the Dogger Bank SAC from Array Area and Offshore Export Cable Corridor footprints combined – 973,800m²** **Array Area** **Total area of habitat loss within the Array Area (foundations, scour protection, cable protection and cable crossings) – 922,971m²** Total worst case turbine foundation area, including scour protection - 311,725m² (100 small turbines x 3,117m² total area per turbine) Total worst-case offshore platforms foundation area, including scour protection – 21,642m² (4 monopiles x 5,411m² total area per platform) Total area of array and inter-platform cable protection – 516,004m² (310,500m² array cable protection + 205,504m² inter-platform cable protection) Estimated number of array/inter-platform cable pipeline/cable crossings - 27 Total area of pipeline / cable crossing material (array + inter-platform cables) – 73,600m² **Offshore Export Cable Corridor** **Total area of habitat loss within the Dogger Bank SAC in relation to the Offshore Export Cable Corridor – 50,829m²** Total area of export cable protection – 50,829m² Estimated number Offshore Export Cable Corridor pipeline/cable crossings - 0	**Total area of habitat loss within the Dogger Bank SAC from Array Areas and Offshore Export Cable Corridor footprints combined – 2,253,922m²** **Array Areas and Inter Platform Cable Corridor** **Total area of habitat loss within the Array Areas and Inter Platform Cable Corridor (foundations, scour protection, cable protection and cable crossings) – 2,053,218m²** Total worst case turbine foundation area, including scour protection – 623,449m² (200 small turbines x 3,117m² total area per turbine) Total worst-case offshore platforms foundation area, including scour protection – 43,285m² (8 monopiles x 5,411m² total area per platform) Total area of array and inter-platform cable protection – 1,159,884m² (623,400m² array cable protection + 536,484m² inter-platform cable protection) Estimated number of array/inter-platform cable pipeline/cable crossings - 61 Total area of pipeline / cable crossing material (array + inter-platform cables) – 226,600m² **Offshore Export Cable Corridor** **Total area of habitat loss within the Dogger Bank SAC in relation to the Offshore Export Cable Corridor – 200,704m²**	N/A

	Parameter			
	DBS East in isolation	**DBS West in isolation**	**DBS West and DBS East concurrently and / or in sequence**	**Notes and rationale**
	Total area of export cable protection – 123,728m² Estimated number Offshore Export Cable Corridor pipeline/cable crossings - 2 Total area of pipeline / cable crossing material – 12,192m²		Total area of export cable protection – 176,320m² Estimated number Offshore Export Cable Corridor pipeline/cable crossings - 4 Total area of pipeline / cable crossing material – 24,384m²	
Electromagnetic Changes	Minimum target burial depth – **0.5m** *Note - In exceptional circumstances, there may be lengths of cable where it will not be possible to achieve the minimum target burial depth.* N/A			
Introduction or spread of invasive non-indigenous species (INIS)	**Vessels** Maximum number of operation & maintenance (O&M) vessels on site at any one time – **20** (See long-term habitat loss row for infrastructure that could be colonised)	**Vessels** Maximum number of O&M vessels on site at any one time – **20** (See long-term habitat loss row for infrastructure that could be colonised)	**Vessels** Maximum number of O&M vessels on site at any one time – **21** (See long-term habitat loss row for infrastructure that could be colonised)	The risk of introducing INNS during construction is primarily related to vessel activities should vessels come from other marine bioregions. Based on simultaneous presence of jack-up vessels, service operations vessels, accommodation vessels, small CTV vessels, lift vessels, cable maintenance vessels and auxiliary vessels.
Decommissioning				
No final decision regarding the final decommissioning policy for the offshore project infrastructure including landfall, has yet been made. It is also recognised that legislation and industry best practice change over time. It is likely that offshore project infrastructure will be removed above the seabed and reused or recycled where practicable. 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. A decommissioning plan for the offshore works would be submitted prior to any decommissioning commencing.			

6.4 Dogger Bank SAC

6.4.1 Site Description

7. This section relates to Annex I habitats designated for the Dogger Bank SAC. The Dogger Bank is an extensive sublittoral sandbank in the southern North Sea formed by glacial processes and submergence through sea-level rise. A large part of the southern area of the bank is covered by water seldom deeper than 20m below chart datum (JNCC, 2024).

8. 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 one 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* occured 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.

9. Sandeel are included in the characteristic communities discussion by JNCC (2022). Further information on the presence of sandeel within the SAC is presented in **Volume 6, Appendix B (application ref: 6.1.2)**. Sandeel are also considered in relation to the function of the sandbank feature through provision of nutrition to predator species (see Section 6.4.1.2.3).

6.4.1.1 Qualifying Features

10. The site is designated under article 4(4) of the Directive (92/43/EEC) for the following Annex I habitat:

- Sandbanks which are slightly covered by sea water all the time.

6.4.1.2 Conservation Objectives

11. The conservation objectives set for the designated sandbank feature and sub-features of Dogger Bank are (JNCC, 2022a):

12. 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. 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.

6.4.1.3 Condition Assessment

13. In the most recent condition assessment of the Dogger Bank SAC, it was determined that the Annex I sandbank feature is currently in unfavourable condition (JNCC, 2022c), with a restore objective being 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.

6.4.1.1.3 Extent, distribution and structure

14. 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, 2022c) 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.*"

15. The restore objective for 'Attribute: Structure and Function' (JNCC, 2022c) 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.*"

16. 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.

17. JNCC note 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. However, 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. before any offshore wind farms were consented).

18. Although the SACO (JNCC, 2022c) states that it is not possible to quantify the spatial effects on the Dogger Bank SAC, it is important to understand what these are in order to undertake any form of assessment. In order to understand the likely quantum of effect which has led to the unfavourable condition, there are some estimates available.

19. BEIS (2019) state that should all four consented offshore wind farms within the Dogger Bank SAC (Dogger Bank A, B and C and Sofia (formerly Creyke Beck A and B and Teesside A and B)) be constructed an estimated 3.0km^2 of seabed may be physically lost to the presence of infrastructure. A further 15km^2 is estimated for cabling, totalling 18km^2 of habitat loss for these projects. The Applicants own calculations (based on consented parameters and publicly available information on final designs) are that 11.71km^2 of habitat loss was consented, with the final refined designs estimated to result in 5.71km^2 of habitat loss[1]. BEIS (2019) estimated that other infrastructure (cables and oil and gas infrastructure) accounted for approximately 1.7km^2 of habitat loss. In total, the habitat loss based on the BEIS estimates, equates to 0.16% of the area of the SAC. Using the Applicants revised figures the habitat loss would be 7.41km^2, approximately 0.06% of the area of the SAC.

20. By comparison, fisheries impacts were considered to have affected 8,700km^2 of the SAC (70.5% of the SAC) based upon VMS data from 2016 alone (BEIS, 2019). The area of this impact is three orders of magnitude greater than that of habitat loss. This is not a permanent effect, although some areas would have been subject to repeated disturbance akin to a permanent effect.

[1] This demonstrates the 'headroom' between the worst case consented footprint and the actual build-out scenario, in other words a reduction in effect since consent

21. At the time of the Round 3 Dogger Bank consents the Secretary of State (DECC, 2015) ruled out an adverse effect on site integrity from those projects, in spite of the unfavourable condition, because habitat loss would not be permanent provided there was comprehensive decommissioning in the future. This was effectively a position that the operational phase of the wind farm could be considered as a temporary impact. However, more recent precedent is available from the decision for Hornsea Three (BEIS, 2020) where the Secretary of State concluded that "*cable protection measures are likely to impede the restoration of the Annex 1 habitats for the duration that they are in place*". It can therefore be inferred that although a negligible area of the SAC (a worst case of 0.16% based on BEIS (2019)) is affected by (existing and consented) habitat loss, a different conclusion on AEoI for the Round 3 projects may be made if that decision was made now.

22. It is worth noting that although the SACO (JNCC, 2022c) refers to impacts from offshore wind, the SACO was published (December 2022) at a time when no offshore wind farms were operational, with construction within the SAC only having started on Dogger Bank A (formerly Dogger Bank Creyke Beck A) that year. Piling at Dogger Bank A was completed in September 2023. Sofia (formerly Dogger Bank Teesside A) commenced works within the SAC in 2023. In April 2024, installation of the Dogger Bank B offshore substation took place (OffshoreWIND.Biz, 2024b), with installation of the Dogger Bank C offshore export cable commencing also commencing in April 2024 (OffshoreWIND.Biz, 2024a).

23. The Dogger Bank SAC (Specified Area) Bottom Towed Fishing Gear Byelaw 2022 came into force on the 13th June 2022 and was enacted to protect the entirety of the Dogger Bank SAC from the impacts of bottom-towed fishing gear. Therefore, impacts from fishing will be significantly reduced as long as the byelaw remains in place. In addition, 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. Therefore, since 2022, there will have been recovery from bottom-towed fisheries effects on the Dogger Bank SAC.

6.4.1.2.3 Function

24. The SACO (JNCC, 2002) list three ecosystem services which "*may be provided by the sandbank feature*";

- 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.
- 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

25. The SACO goes on to state that:

"*…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.*"

26. In terms of practical advice, the SACO (JNCC, 2022) states 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.*"

27. The Applicants note 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). Geology underlying sandbanks is not considered within the Interpretation Manual of European Union Habitats (EC, 2013).

28. As noted above, the cessation of bottom-towed fishing within the SAC since 2022 should lead to recovery.

6.4.2 Assessment

29. **Table 6-4** below lists the potential effects in relation to the construction, operation and maintenance and decommissioning phases of the Projects screened into the assessment. Effect names are based on the standardised pressure names outlined in Natural England's' Phase III Best Practice Advice for Evidence and Data Standards (Natural England, 2022). Note that in the assessment effects have been grouped where relevant and assessed together to avoid repetition. Any operational and decommissioning impacts, where not explicitly mentioned, are at worst the same as impacts during the construction phase. Therefore where no AEOI is determined for construction impacts, the same is assessed for operation and decommissioning.

Table 6-4 Potential effects identified for the Dogger Bank SAC (screened in (✓) and screened out(×)) for the Projects alone

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Abrasion / disturbance of the substrate on the surface of the seabed	✓	✓	✓
Penetration and / or disturbance of the substratum below the surface of the seabed, including abrasion	✓	×	✓
Habitat structure changes – removal of substratum (extraction)	✓	×	×
Changes in suspended solids (water clarity)	✓	✓	✓
Smothering and siltation rate changes (Heavy)	✓	✓	✓
Smothering and siltation rate changes (Light)	✓	✓	✓
Electromagnetic changes	×	✓	×

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Hydrocarbon & Polyaromatic Hydrocarbon (PAH) contamination	✓	✓	✓
Introduction or spread of invasive non-indigenous species (INIS)	✓	✓	✓
Physical change (to another seabed type)	✓	✓	✓
Physical change (to another sediment type)	✓	✓	✓
Synthetic compound contaminant (including pesticides, antifoulants, pharmaceuticals)	×	✓	×
Transition elements & organo-metal (e.g. TBT) contamination	✓	✓	✓

6.4.2.1 Assessment of potential effects of the Projects alone

30. Any effects relating to the Projects activities within the Offshore Development Area that overlap with the Dogger Bank SAC occur within the Annex I sandbank habitat for which the SAC is designated. As such, there exists limited differences in footprint within the SAC for DBS East or DBS West in isolation (as detailed in section 6.3.2), with impacts for each effect being broadly similar across both Projects. Therefore, to reduce repetition, only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

6.4.2.1.1 Abrasion/disturbance of the substrate on the surface of the seabed / Penetration and/or disturbance of the substratum below the surface of the seabed / Habitat structure changes – removal of substratum (extraction)

31. Construction, operation and maintenance and decommissioning activities will result in abrasion / disturbance of the substrate on the surface of the seabed / penetration and / or disturbance of the substratum below the surface of the seabed. In addition, dredging or sandwave clearance could result in habitat structure changes – removal of substratum (extraction). These effects are considered together as 'abrasion/disturbance of the seabed'.

32. As detailed within **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)**, the biotopes found within the Projects Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor within the Dogger Bank SAC are characteristic of highly disturbed environments, and typically have medium to high recoverability and will recover rapidly from disturbance[2]. The only exception is the 'piddock' biotopes associated with a small area of DBS East.

33. **Volume 6, Appendix B (application ref: 6.1.2)** presents information on the presence of sandeel within the SAC. The presence of sandeels, and consequently characteristic predator species, show that the Dogger Bank supports species of wider importance across the North Sea and is an important area for connectively across the MPA network (JNCC, 2022). Other fish species, such as cod, plaice, dab, sole are important to Dogger Bank as discussed in the SACO (JNCC, 2022), although sandeel are described as being 'more resident'. **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**, considers fish in relation to the Fish and Shellfish study are and concludes that the area affected by the Projects is limited when compared to wider seabed available across the North Sea.

[2] All conclusions on sensitivity within this assessment are based upon the evidence within the Marine Evidence based Sensitivity Assessment (MarESA) (MarLIN, 2021).

34. The Array Areas are of medium to high habitat potential for sandeel (see **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** for habitat modelling methodology and discussion) and sandeel were observed at 26 out of 104 stations investigated, with sightings largely falling within the area of high habitat potential identified within the DBS West Array Area. **Volume 6, Appendix B (application ref: 6.1.2)** shows that the Array Areas cover 5.7% of the medium to high potential habitat for sandeel of the SAC. Historically, sandeel fishing grounds overlapped the sites. A byelaw has been place since 2022 and bottom trawling has been banned in Dogger Bank SAC. In addition, from April 2024 there will be a permanent ban on sandeel fishing in the English North Sea.

35. Sandeel are demersal spawners and their eggs form batches which attach to the seabed, sandeel larvae are planktonic for approximately 3-months, before settling down into the seabed. Sandeel display a high level of site fidelity and so importance is placed on maintaining suitable habitat, as sandeel spawn in and within the vicinity of the sediments which they inhabit (see **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)**.

36. 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 DBS East and DBS West combined, representing 0.2% of the area of the Dogger Bank SAC and 0.23% of the medium to high potential habitat for sandeel of the SAC. This disturbance would be episodic, associated with discrete locations across the Offshore Development Area at any one time and occur over the five-year duration of construction (assuming a worst case of concurrent construction), not as a single event. Sediments would settle rapidly, the majority in close proximity to the disturbance (see **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8))** so there would be limited indirect effect outwith the activity footprint.

37. RPS (2019) reviews monitoring data from numerous offshore wind farms in UK waters (e.g. Barrow, Burbo Bank, Sheringham Shoal and Robin Rigg) and collates information on how the seabed has recovered from various different impacts in various different marine conditions. The report demonstrates that areas with sandy seabed types usually recover rapidly and in full following seabed levelling and trenching. Where evidence of sandwave levelling or cable trenching does remain following cable installation this occurs in areas with higher fine sediment content (muds and silts). RPS (2019) also demonstrates that where recovery has not occurred completely in sandy habitats, these examples were limited to areas with low levels of sediment transport (i.e. less dynamic areas with low seabed mobility). Notwithstanding the fact that the Dogger Bank sandbank is a geological feature rather than the sandbank areas considered in RPS (2019) (which are formed by hydrological processes), the Dogger Bank is subject to 'frequent natural disturbance' (Eggleton *et al.*,, 2017) and has predominantly coarse sediments, suggesting that these findings would be relevant to the Projects.

38. There is limited direct evidence of recovery from offshore wind activities within the Dogger Bank itself. As such, the Applicants commissioned a geophysical survey to look at potential recovery of the seabed following the installation and removal of two met masts (monopiles on 15m diameter suction caissons) which were located in the Dogger Bank Wind Farm zone between 2013 and 2017 in the Dogger Bank B and Dogger Bank C wind farms (see **Volume 7, Appendix 8-2 Met Mast Survey Analysis (application ref: 7.8.8.2)**). A comparison of pre-installation and post-removal geophysical survey data was undertaken. The analysis showed no significant seabed features resulting from the presence of met masts across four years and showed that trawl marks and localised depressions visible in the pre-installation surveys had infilled over the 10 year period since installation of the met masts in March / September 2013.

39. The met mast study provides some evidence of physical recovery of the seabed. In terms of ecological recovery of disturbed areas, Eggleton *et al.*, (2017) note that sandy habitats such as those characteristic of the Dogger Bank are typified by fauna that are adapted to high rates of mortality and natural disturbance. Diesing *et al.*, (2013) indicated that modelled natural disturbance on the Dogger Bank exceeds that attributed to fishing disturbance, which would be similar to some of the construction effects of the Projects. In a study of the effects of fishing activity on the Dogger Bank, Eggleton *et al.*, (2017) found that faunal communities did not noticeably differ along an abrasion pressure gradient. This may have been a result of methodological artefacts, but the authors suggest could also have been attributed community resilience. Given recovery of the physical structure of the sandbank (as evidenced by the met mast example above) and the absence of physical barriers to communities re-establishing post-construction (other than in locations of above-surface infrastructure), ecological recovery is likely from 'abrasion/disturbance of the seabed' caused by the Projects.

40. As detailed within **Volume 8, Disposal Site Characterisation Report (application ref: 8.18)**, any sediment removed from within the Dogger Bank SAC during construction activities will be disposed of within the Offshore Development Area located within the SAC boundary, ensuring no sediment is lost from the sandbank habitat. While any removed sediment may result in a change to the underlying habitat, as detailed in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** due to the dynamic nature of the underlying sediment and strong tidal currents within the Array Areas, such areas of sediment removal would be expected to be filled in with sediment from the surrounding area within a matter of days (Tillin *et al.*,, 2022).

41. In addition, by the time of construction, the seabed will have been in recovery from the effects of bottom-towed fishing for at least four years, which, as described in section 6.4.1.3, had extensive impacts across the majority of the SAC.

42. Given the low sensitivity of the biotopes within the SAC (in particular due to their high recoverability); the relatively small footprint; the small area of effect in relation to available sandeel and other fish habitat (both within the SAC and beyond); and the episodic nature of the effect it is considered that abrasion / disturbance of the seabed for the Projects together 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 finer scale topography and sediment composition and distribution; and.
- The **biological structure and function** in terms of the key and influential species and characteristic communities present.

43. Given the minimal understanding of ecosystem services as defined in the SACO (JNCC, 2022) and based on the 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*" effects on sandbank feature function are also considered in terms the physical effects listed above. This methodology is applied to all effects throughout this assessment. Given the low sensitivity of the biotopes within the SAC; the small area of effect in relation to available sandeel habitat; and the episodic nature of the effect it is considered that abrasion/disturbance of the seabed for the Projects together would not significantly affect:

- The **function of the feature within the site**.

44. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to abrasion / disturbance of the seabed from the Projects together.

45. Whilst the Plan Level HRA (The Crown Estate, 2022) considers 'direct physical damage' as contributing to its conclusion of AEoI for the Projects, the Applicants do not consider that this is evidenced in that assessment. In addition, the Applicants consider that conclusion to be out of step with the Hornsea Project Three decision (BEIS, 2020) which only relates to permanent effects impeding restoration and is in line with the earlier Round 3 decisions (DECC, 2015).

6.4.2.2.1 Changes in suspended solids (water clarity) / Smothering and siltation rate changes (Heavy and Light)

46. Construction, operation and maintenance and decommissioning activities will lead to the dispersal of sediments within the SAC, resulting in changes in suspended solids within the water column and deposition of those sediments potentially causing smothering.

47. Project-specific marine physical processes modelling (**Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**) shows that in the worst case (trenching activities within the Offshore Export Cable Corridor) suspended sediment concentrations of up to 5mg/l occur within 1km of the point of disturbance, with values returning to background levels within 5-7km of the cable corridor. The maximum predicted deposition will be up to 5cm within, and immediately adjacent to, the area of trenching, with a maximum change of up to 0.25m occurring in localised hotspots. During foundation installation suspended sediment concentrations may increase by over 5mg/l and typically return to baseline conditions within 5km of the area of disturbance and would be suspended in the water column for up to 1.5 hours. It is expected that the maximum predicted deposition resulting from a sediment plume will be <0.5cm in localised areas immediately adjacent to the foundation installation area.

48. As detailed within **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)**, the biotopes found within the Projects Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor 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.

49. As detailed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** the short-term and localised nature of changes in suspended sediment are unlikely to cause any population-level effects to sandeel due to an increase in individual energy expenditure. Whilst some evidence suggests sandeel are tolerant to changes in suspended sediment (Messieh *et al.*,, 1981; Kiørboe *et al.*,, 1981; Utne-Palm, 2004), sediment settlement is likely to represent a greater risk to these species. **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** predicts no material effects on any other species across the Fish and Shellfish Ecology study area which includes the Dogger Bank SAC.

50. Given the low sensitivity of the biotopes within the SAC (in particular due to their high recoverability; the small area of effect in relation to available sandeel and other fish habitat (both within the SAC and beyond); and the episodic nature of the effect it is considered that changes to suspended solids 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**.

51. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to changes to suspended solids from the Projects alone.

6.4.2.3.1 Electromagnetic changes

52. There is potential for array cables, inter-platform cables and offshore export cables to produce electromagnetic fields (EMFs) that interfere with the behaviour of benthic species. EMFs are produced when electricity passes through a conductor (e.g. subsea cables). EMF have the potential to cause barrier / attraction effects dependent on the species and the spatial scale of EMF. EMF comprises both an electric field (E field) and a magnetic field (B field). The E field is confined within the cable itself through the use of insulating and shielding layers whilst the B field penetrates most materials, and, therefore, is emitted into the marine environment.

53. The strength of the EMFs produced by underwater cables is dependent on a variety of factors including distance from the cable, whether the cable is in sediment or sea water, speed and direction of water flow, and strength of the magnetic field. EMF strength dissipates rapidly with increasing distance from the source; for example, the average windfarm array cable buried 1m below the seabed will decrease from 7.85 µT directly next to the cable (0m) to 1.47 µT at 4m distance (Normandeau *et al.*,, 2011). Given the worst case burial depth of 0.5m or use of external cable protection, therefore, no receptor species would be exposed to EMFs within 0.5 m of the source.

54. For unburied cables, work conducted for the Moray offshore wind farms found that changes to EMF above that of the Earth's magnetic field were detectable up to 5m in the worst case (Moray Offshore Renewables Ltd, 2019),

55. The effects of EMF on benthic communities are not well understood, although studies (e.g. Sherwood *et al.*,, 2016) suggest that benthic communities growing along offshore export cables routes are similar to those in nearby areas beyond the likely reach of EMF. It is important to note, any observed changes could be the result of the physical presence of the cable and surface properties, rather than an EMF effect (Gill and Desender, 2020).

56. As detailed within **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)**, 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, 2022) does not list electromagnetic changes as a pressure.

57. As detailed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** demersal (including sandeel), pelagic, and migratory fish species have a high level of adaptability and tolerance to EMF effects.

58. Given lack of sensitivity of the biotopes within the SAC; low sensitivity of sandeel 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;
- The **function of the feature within the site**.

59. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to electromagnetic changes from the Projects alone.

6.4.2.4.1 Hydrocarbon and Polyaromatic Hydrocarbon (PAH) and Transition elements and organo-metal (e.g. TBT) contamination

60. Construction, operation and maintenance and decommissioning activities may lead to the disturbance of contaminated sediments within the Annex I sandbank habitat, resulting in an adverse effect on the existing communities.

61. Sediment data collected for the Projects **(Volume 7, Appendix 9-3 (application ref: 7.9.9.3)** indicates that for all parameters, sediment contaminant concentrations are low within the Offshore Development Area. All stations sampled within the Array Areas were found to feature Total Hydrocarbon Content (THC) or poly-aromatic hydrocarbons (PAH) levels below marine sediment quality guidelines. As noted in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)**, any instances of contaminated sediment would be rapidly dispersed from the water column, settling within close proximity of its source.

62. As detailed in **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9)** the biotopes within the Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor within the Dogger Bank SAC are not considered sensitive to chemical or heavy metal contamination.

63. As detailed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** sandeel are considered to have a low sensitivity to chemical or heavy metal contamination.

64. Given lack of sensitivity of the biotopes within the SAC (in particular due to their high recoverability); low sensitivity of sandeel; and low levels of contaminants found to be present; it is considered that contamination from hydrocarbon and PAH and transition elements and organo-metal contamination 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**.

65. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to contamination from hydrocarbon and PAH and transition elements and organo-metal contamination from the Projects alone.

6.4.2.5.1 Introduction or spread of invasive non-indigenous species (INIS)

66. Hard substrate introduced via infrastructure such as foundations, scour and cable protection could act as potential 'stepping stones' or vectors for INIS.

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

68. Of the biotopes identified within the Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor **(Volume 7, Appendix 9-3 (application ref: 7.9.9.3)**, three biotopes[3] are considered to be highly sensitive to INIS. Key INIS species which are of concern are the slipper limpet *Crepidula fornicata*, colonial ascidian *Didemnum vexillum* and the whelk *Rapana venosa*, all species which may be able to establish themselves within these biotopes and lead to a reduction in the characteristic bivalve populations or, in the case of *D. vexillum*, smother the existing habitat (Tillin, 2022a; 2022b; Tillin and Budd, 2023).

[3] *Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in Atlantic circalittoral coarse sand or gravel (MC3212); *Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (MC5212); and *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (MC5214)

69. Due to the embedded and standard mitigation measures outlined in section 6.3, the risk of spreading INIS during all phases of the Projects will be reduced by employing a range of industry standard biosecurity measures. As such, the risk of introduction of INIS from is limited, with any potential spread of INIS arising from those already within the Dogger Bank and wider North Sea, such as those found in the site-specific surveys for the Projects.

70. Given the mitigation measures that will be employed during the Projects lifespan, it is considered that introduction or spread of invasive INIS 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**.

71. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to the introduction or spread of invasive INIS from the Projects alone.

6.4.2.6.1 Physical change (to another seabed / sediment type)

72. Installation of infrastructure (above the seabed) will lead to the physical change to the seabed and sediment within the Annex I sandbank habitat, resulting in a reduction in habitat extent and permanent habitat loss.

73. As detailed in **Volume 7, Chapter 9 Benthic and Intertidal Ecology (application ref: 7.9),** the benthic communities found within the Array Areas, Inter-Platform Cable Corridor and Offshore Export Cable Corridor within the Dogger Bank SAC are considered to be sensitive to long-term habitat loss. However, the communities in the Projects site-specific surveys are typical to those found within the SAC, being dominated by the amphipod *Bathyporeia elegans* and the polychaete *Nephtys cirrosa,* in line with the overall community composition noted in the SACO (JNCC, 2022c) for the south-western area of the SAC. As such, any loss in habitat for these communities will be minimal in the context of the remaining habitat still available for these communities.

74. As detailed within **Volume 7, Chapter 10 Fish and Shellfish Ecology (application ref: 7.10)** sandeel display a high level of site fidelity and so importance is placed on maintaining suitable habitat, as sandeel spawn in and within the vicinity of the sediments which they inhabit. As with the benthic communities, any loss in habitat for sandeel will be minimal in the context of the remaining habitat still available (see **Volume 6, Appendix B (application ref: 6.1.2))**.

75. The worst case area of habitat loss within the SAC from the presence of the Projects is estimated to be 2.25km² (see section 6.3.2). This area represents 0.018% of the Dogger Bank SAC's overall extent of 12,332km², and 0.018% of the medium to high potential habitat for sandeel of the SAC. As noted in section 6.3, the Applicants are committed to minimising the use of scour protection and external cable protection measures where possible. As such the final area of permanent habitat loss within the SAC is likely to be lower than that estimated as a worst case in this assessment.

76. Although the extent of habitat loss is minimal, as discussed in section 6.4.1.3, 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 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. Given that the restore objectives were in place from the designation of the Dogger Bank SAC (i.e. before any wind farms were present) and that the objectives apply at the fine scale it is clear that *any permanent footprint* would be considered to hinder the restore objectives no matter how small (even in comparison to the historic fishing impacts which affected at least 70% of the site).

77. Therefore, it is considered that physical change to the seabed and sediment would significantly 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**.

78. Therefore, an AEoI of the Dogger Bank SAC in relation to physical change to the seabed and sediment from the Projects alone cannot be ruled out.

79. The conclusion of the Plan Level HRA led The Crown Estate to develop a strategic compensation scheme for the Round 4 wind farms and to which the Applicants are active and willing participants. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Appendix 3 Project Level Dogger Bank Compensation Plan (application ref: 6.2.3)**.

6.4.2.7.1 Synthetic compound contaminant (including pesticides, antifoulants, pharmaceuticals)

80. Operation and maintenance activities may lead to the release of synthetic compounds within the SAC, resulting in an adverse effect on the existing communities.

81. Paint flakes from the wind turbines may be shed throughout the life of the Projects as fine particles. 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 **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** 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 Areas. 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 Projects.

82. In addition, the Applicants are committed to ensuring any paint utilised for the Projects would be approved for use in the marine environment by the relevant bodies.

83. There is also potential for the release of metals from sacrificial anodes associated with the Projects infrastructure. Ebeling *et al.*,, (2023) investigated the potential metal emissions from galvanic anodes in offshore wind farms into the North Sea sediments. Results showed that mass fractions of the legacy pollutants cadmium, lead and zinc were mostly within the known variability of North Sea sediments with no evidence of an accumulation of metals in sediments caused by galvanic anodes used in OWFs.

84. Given the limited and episodic nature of any release of synthetic compounds, mitigation committed to by the Applicants 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**.

85. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to contamination from synthetic compound contaminants from the Projects alone.

6.4.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

86. There is the potential for an AEoI of the Dogger Bank SAC from in-combination effects with other plans and projects. Schemes that could overlap spatially and temporally with the Projects and have an in-combination effect on the SAC are detailed in **Table 6-5**.

Table 6-5 List of Schemes Screened In For In-Combination Assessment for the Dogger Bank SAC

Tier	Plan / Project	Distance to Offshore Development Area Within the Dogger Bank SAC	
		Export Cable Corridor	Array Areas
Offshore Wind Farms			
2	Dogger Bank A	3.9km	6.5km
2	Dogger Bank B	7.55km	17km
2	Dogger Bank C	35km	56km
2	Sofia	35km	40km
6	Dogger Bank D	11km	0km*

**Export cable route adjacent to DBS East*

87. **Table 6-6** below details the potential effects in relation to the construction, operation and maintenance and decommissioning phases of the Projects that have been screened in for the in-combination assessment. Note that in the assessment effects have been grouped where relevant and assessed together to avoid repetition. Any operational and decommissioning impacts, where not explicitly mentioned, are at worst the same as impacts during the construction phase. Therefore where no AEOI is determined for construction impacts, the same is assessed for operation and decommissioning.

Table 6-6 Potential effects identified for Annex I habitats (screened in (✓) and screened out (×) screened in for in combination assessment

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Abrasion/disturbance of the substrate on the surface of the seabed	✓	✓	✓
Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	✓	×	✓
Habitat structure changes – removal of substratum (extraction)	✓	×	×
Changes in suspended solids (water clarity)	✓	✓	✓
Smothering and siltation rate changes (Heavy)	✓	✓	✓
Smothering and siltation rate changes (Light)	✓	✓	✓
Electromagnetic changes	×	✓	×
Introduction or spread of invasive non-indigenous species (INIS)	✓	✓	✓
Physical change (to another seabed type)	✓	✓	✓
Physical change (to another sediment type)	✓	✓	✓

6.4.2.1.2 Abrasion / disturbance of the substrate on the surface of the seabed / Penetration and/or disturbance of the substratum below the surface of the seabed / Habitat structure changes – removal of substratum (extraction)

88. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;
- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

89. Construction, operation and maintenance and decommissioning activities of schemes within the Dogger Bank SAC will result in abrasion/disturbance of the substrate on the surface of the seabed / penetration and/or disturbance of the substratum below the surface of the seabed. In addition, dredging or sandwave clearance could result in habitat structure changes – removal of substratum (extraction). These effects are considered together as 'abrasion/disturbance of the seabed'.

90. As noted in section 6.4.2.1.1, analysis of the seabed recovery from two met masts that were located in the Dogger Bank SAC between 2013 and 2017 found no significant seabed features resulting from the presence of met masts and showed that trawl marks and localised depressions visible in the pre-installation surveys had infilled over the 10 year period. As such, it is expected that areas of seabed affected abrasion / disturbance of the seabed from the Dogger Bank A, B, C and Sofia construction activities will have recovered or be recovering by the time of construction beginning on the Projects.

91. When construction commences on the Projects, overlap in construction activities would potentially occur only with Dogger Bank D. No estimated temporary disturbance areas are publicly available for Dogger Bank D at the time of writing. However, as with the Projects any abrasion/disturbance of the seabed from these schemes will occupy a minimal area of the seabed in comparison to the overall size of the Dogger Bank SAC, with effects being temporary in nature.

92. **Volume 6, Appendix B (application ref: 6.1.2)** shows that the Offshore Development Area and Dogger Bank D cover 7.7% of the medium to high potential habitat for sandeel of the SAC, although the actual footprints of construction activity within these (and Offshore Export Cables Route etc) would be much less.

93. In addition, by the time of construction, the seabed will have been in recovery for at least four years from the effects of bottom-towed fishing, which as described in section 6.4.1.3, had extensive impacts across the majority of the SAC.

94. Given the low sensitivity of the biotopes within the Dogger Bank SAC (in particular due to their high recoverability); the relatively small footprint; the small area of effect in relation to available sandeel and other fish habitat (both within the SAC and beyond); and the episodic nature of the effect it is considered that abrasion/disturbance of the seabed 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 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**.

95. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to abrasion/disturbance of the seabed in combination with other schemes.

96. As noted previously in section 6.4.2.1.1, whilst the Plan Level HRA (The Crown Estate, 2022) considers 'direct physical damage' as contributing to its conclusion of AEoI for the Projects, the Applicants do not consider that this is evidenced in that assessment. In addition, the Applicants consider that conclusion to be out of step with the Hornsea Project Three decision (BEIS, 2020) which only relates to permanent effects impeding restoration in line with the earlier Round 3 decisions (DECC, 2015).

6.4.2.2.2 Changes in suspended solids (water clarity) / Smothering and siltation rate changes (Heavy and Light)

97. Construction, operation and maintenance and decommissioning activities will lead to the dispersal of sediments within the SAC, leading to changes in suspended solids within the water column and deposition of those sediments potentially leading to smothering.

98. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;
- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

99. As detailed in section 6.4.2.2.1 above, suspended sediment concentrations within the Array Areas may reach values of up to 5mg/l within 1km of the point of disturbance, with values returning to background levels within 5-7km of the cable corridor, settling out of the water column within 1.5 hours in the worst case. These areas of elevated sediment concentration may overlap with sediment disturbed during operational activities for Dogger Bank A or B. Given the distances between the Array Areas and Dogger Bank C and Sofia there will not be any overlaps of increases in suspended sediment concentrations from any sediment disturbed during operational activities, although there could be additive effects. There is potential for some overlap of increases in suspended sediment concentrations from construction of the Projects and the installation of the Dogger Bank D export cables and additive effects during construction and operation of the wind farms.

100. For all schemes, the potential for a release of sediment from the seabed will be short term, temporary and localised, with levels falling to within background rapidly within the SAC boundary. Only construction activities for Dogger Bank D may occur simultaneously with those of the Projects, with in-combination effects for the remaining schemes being limited to their operational phases, where changes in suspended solids will be limited to localised maintenance activities.

101. Given low sensitivity of the biotopes within the Dogger Bank SAC (in particular due to their high recoverability; the small area of effect in relation to available sandeel or other fish habitat (both within the SAC and beyond); and the episodic nature of the effect it is considered that changes to suspended solids 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**.

102. Therefore there is no potential for an AEoI of the Dogger Bank SAC in relation to changes to suspended solids in combination with other schemes.

6.4.2.3.2 Electromagnetic changes

103. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;
- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

104. The Offshore Export Cable Corridor, Array Cables or Inter-Platform Cables for the Projects will not cross any other offshore cables associated with another plan/project within the Dogger Bank SAC.

105. Given that the effects of EMF have been found to be detectable up to only 5m from any unburied cables (Moray Offshore Renewables Ltd, 2019), there is no potential for overlap of EMF effects to occur between the Projects and other schemes. There would be additive effects but as discussed for the Projects alone (see section 6.4.2.3.2) these would be minimal for each project.

106. Given the lack of sensitivity of the biotopes within the Dogger Bank SAC; low sensitivity of sandeel and other fish species 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**.

107. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to electromagnetic changes in-combination with other schemes.

6.4.2.4.2 Introduction or spread of invasive non-indigenous species (INIS)

108. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;

- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

109. The potential risk of the spread of INIS by the other plans and projects identified is similar to that of the Projects given the similarities in development type. The mitigation measures proposed for the Projects are considered to be industry standard, and as such have either been committed to already (in the case of the Dogger Bank A, B, C and Sofia offshore wind farms) or are expected to be included within the Dogger Bank D development application.

110. Given the mitigation measures that will be employed during the Projects and other schemes lifespans, it is considered that introduction or spread of invasive INIS 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**.

111. Therefore, there is no potential for an AEoI of the Dogger Bank SAC in relation to the introduction or spread of invasive INIS in combination with other schemes.

6.4.2.5.2 Physical change (to another seabed/sediment type)

112. Installation of infrastructure (above the seabed) will lead to the physical change to the seabed and sediment within the Annex I sandbank habitat, resulting in a reduction in the habitats extent and permanent habitat loss.

113. The schemes identified in **Table 6-5** above with the potential to contribute to an in-combination effect on the Dogger Bank SAC are:

- Dogger Bank A offshore wind farm;
- Dogger Bank B offshore wind farm;
- Dogger Bank C offshore wind farm;
- Dogger Bank D offshore wind farm; and
- Sofia offshore wind farm.

114. Based on the publicly available information for the schemes listed above, an area of approximately 11.71km² may be permanently lost within the Dogger Bank SAC[4], representing 0.16% of the total SAC area. Permanent habitat loss as a result of the Projects would equate to an additional 0.02% of the total SAC area (see section 6.3.2).

115. Although the extent of habitat loss is minimal, as discussed in section 6.4.1.3, 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 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. As discussed in section 6.4.2.6.1 *any permanent footprint* would be considered to hinder the restore objectives no matter how small.

116. As such, it is considered that physical change (to another seabed / sediment type) in combination with other schemes would significantly affect:

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

117. Therefore, an AEoI of the Dogger Bank SAC in relation to physical change (to another seabed / sediment type) in combination with other schemes cannot be ruled out.

118. The conclusion of the Plan Level HRA led The Crown Estate to develop a strategic compensation scheme for the Round 4 wind farms and to which the Applicants are active and willing participants. Further details on the proposed compensation measures are provided in the accompanying **Volume 6, Project Level Dogger Bank Compensation Plan (application ref: 6.2.3)**.

[4] Based on the consented footprints and not including Dogger Bank D for which figures are not available at the time of writing.

6.4.2.3 Summary

119. In conclusion, the majority of effects resulting from the Projects alone and in combination with other schemes will not result in an AEoI on the designated features of the Dogger Bank SAC. However, given the restore objectives there is potential AEoI for the Projects alone or in combination with other schemes in relation to physical change (to another seabed / sediment type). Therefore, the Annex I sandbank feature of the Dogger SAC may not be maintained as favourable in the long term without the implementation of any additional compensation measures.

6.5 Flamborough Head SAC

6.5.1 Site Description

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

6.5.1.1 Qualifying Features

121. The site is designated under article 4(4) of the Directive (92/43/EEC) for the following relevant Annex I habitats:

- *Reefs; and*
- *Submerged or partially submerged sea caves*

6.5.1.2 Conservation Objectives

122. With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change (Natural England, 2018a);

123. 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;

- The structure and function (including typical species) of qualifying natural habitats; and
- The supporting processes on which qualifying natural habitats rely.

6.5.1.3 Condition Assessment

124. There is no current publicly available information regarding the current condition of the qualifying features of the Flamborough Head SAC (Natural England, 2024a). However, information on the Unit condition of the Flamborough Head SSSI (which encompasses the same geographical footprint as that of the SAC) indicates the habitat is in good overall condition (Natural England, 2021). Of the locations assessed within the SSSI, 67.3% is noted as being in favourable condition, 3.81% in unfavourable recovering and 28.89% as unfavourable declining.

6.5.2 Assessment

125. **Table 6-7** below details the potential effects in relation to the construction, operation and maintenance and decommissioning phases of the Projects. Effect names are based on the standardised pressure names outlined in Natural England's' Phase III Best Practice Advice for Evidence and Data Standards (Natural England, 2022).

Table 6-7 Potential effects identified for the Flamborough Head SAC (screened in (✓) and screened out(✗)) for the Projects alone

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Smothering and siltation rate changes (Heavy and Light)	✓	✓	✓

6.5.2.1 Assessment of potential effects of the Projects alone

126. In line with the approach taken to the assessment in section 6.4.2.1, to reduce repetition only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

6.5.2.1.1 Smothering and siltation rate changes (Heavy and Light)

127. Suspended sediment disturbed by the Projects construction, operation and maintenance and decommissioning activities have the potential to result in an indirect impact on the qualifying features of the Flamborough Head SAC.

128. Project specific physical processes modelling (see **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** for further details) indicates that sediment disturbed by the construction activities will primarily be deposited within 1km of the source of disturbance. Due to the Flamborough Head SAC being located approximately 3km from the closest point of the Projects Offshore Export Cable Corridor, there is no pathway for effect between heavy smothering and siltation rate changes and the SAC.

129. There does exist the potential for light smothering and siltation rate changes to occur however, with sediment plumes exceeding 0.5mg/l being dispersed up to 28.5km from the point of disturbance in the nearshore. Such plumes would result in an average sediment deposition of 1-5mm within 10km of the disturbance and is less than 0.5mm within 35km. Surface turbidity within the area of the Flamborough Head SAC (represented by suspended particulate matter) is generally low, with average monthly concentrations typically less than 5 mg/l across the whole year (Cefas, 2016), with minimal seasonal variation.

130. The reef habitat found within the Flamborough Head SAC is classified as subtidal chalk reef (JNCC, 2022a). Communities typically associated with this habitat are known to be tolerant of light increases in sediment smothering, owing to mobile nature of characterising species and the existing sediment mobility found within such habitat (De-Bastos and Hill, 2016). Any sediment disturbed by the Projects activities that reaches the Flamborough Head SAC would be expected to settle at a minimal overlaying depth and be dispersed within a matter of days, representing a temporary increase over the natural baseline.

131. In regards to the *Submerged or partially submerged sea caves* within the SAC, given the minimal settling depth and short-term nature of any sediment deposition within the SAC resulting from the Projects activities, it is expected that any sediment that may enter such cave features would be rapidly dispersed, with any effects being a temporary localised effect.

132. As such, given the tolerant nature of the receptors within the SAC to light sediment deposition and the localised and temporary nature of any light smothering events, it is concluded that the sites conservation objectives will be maintained in the long-term. There is, therefore, no potential for an AEoI to Annex I habitats within the Flamborough Head SAC in relation to smothering and siltation rate changes (Heavy and Light) from the Projects alone and therefore, subject to natural change, the Annex I habitat features will be maintained in the long term as favourable.

6.5.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

6.5.2.1.2 Smothering and siltation rate changes (Heavy and Light)

133. There exists the potential for an AEoI on the Annex I habitat features of the Flamborough Head SAC in-combination with other plans and projects. Plans and projects that could overlap spatially and temporally with the Projects in relation to smothering and siltation rate changes (heavy and light) are listed below:

- Hornsea Project Four Offshore Wind Farm
- Eastern Green Link (EGL) 2, 3 and 4
- Bridlington A Disposal Site (Open)

134. Previous assessment of the Bridlington A disposal site on the Flamborough Head SAC (Cefas, 2009) concluded that there would be no LSE on the Annex I habitat features of the SAC as a result of the disposal of dredged material at Bridlington A.

135. The cumulative effects assessment conducted **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** determined that any increases in SSC in-combination with Hornsea Project Four, EGL2,3 and 4 or the Bridlington A disposal site would not result in any significant impacts due to the likely minimal overlap in disturbed sediment plumes and minimal potential for these events to overlap temporally with each other.

136. Overall, it is concluded that there is no potential for an AEoI to the conservation objectives of the reef and submerged cave features of the Flamborough Coast SAC in relation to increases in suspended sediment from the Projects in-combination with other plans or projects and therefore, subject to natural change, the Annex I habitat features will be maintained as favourable in the long term.

6.5.2.3 Summary

137. In conclusion, due to the tolerant nature of the Annex I habitats within the Flamborough Head SAC to changes in SSC, and the short-term and localised nature of the effect, there is no potential for an AEoI to Annex I habitat features in relation to smothering and siltation rate changes (Heavy and Light) impacts from the Projects both alone and in combination with other plans and projects. Therefore, subject to natural change, the Annex I habitat features of the Flamborough Head SAC will be maintained as favourable in the long term.

6.6 Humber Estuary SAC

6.6.1 Site Description

138. The Humber Estuary is a large estuary with a high tidal range (macro-tidal). The high suspended sediment loads in the estuary 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.

139. 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, 2024b).

6.6.1.1 Qualifying Features

140. The site is designated under article 4(4) of the Directive (92/43/EEC) for the following Annex I habitats relevant to this assessment:

- Sandbanks which are slightly covered by seawater all the time; and
- Mudflats and sandflats not covered by seawater at low tide.

6.6.1.2 Conservation Objectives

141. With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change (Natural England, 2018b);

142. 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;
- The structure and function (including typical species) of qualifying natural habitats; and
- The supporting processes on which qualifying natural habitats rely.

6.6.1.3 Condition Assessment

143. There is no current publicly available information regarding the current condition of Annex I sandbank habitat within the Humber Estuary SAC (Natural England, 2024c), or overlapping Humber Estuary SSSI (Natural England, 2024e).

6.6.2 Assessment

144. **Table 6-8** below details the potential effects in relation to the construction, operation and maintenance and decommissioning phases of the Projects. Effect names are based on the standardised pressure names outlined in Natural England's' Phase III Best Practice Advice for Evidence and Data Standards (Natural England, 2022).

145. It should be noted that potential effects of oxides of Nitrogen (NOx) and ammonia above Critical Levels were screened in for assessment after the publication of the final HRA Screening Report, following consultation with Natural England. Such effects are assessed under the introduction of other substances (solid, liquid or gas) standard pressure definition.

Table 6-8 Potential effects identified for the Humber Estuary SAC (screened in (✓) and screened out(×)) for the Projects alone

Potential Effect	Construction	Operation and Maintenance	Decommissioning
Smothering and siltation rate changes (Heavy and Light)	✓	✓	✓
Introduction of other substances (solid, liquid or gas)	✓	×	×

6.6.2.1 Assessment of potential effects of the Projects alone

146. In line with the approach taken to the assessment in section 6.4.2.1, to reduce repetition only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

6.6.2.1.1 Smothering and Siltation rate changes

147. Suspended sediment disturbed by the Projects construction, operation and maintenance and decommissioning activities or changes to nearshore sediment transport processes from Project infrastructure (including potential cable protection and cofferdams) have the potential to result in an indirect impact on the qualifying features of the Humber Estuary SAC.

148. Sediment transport processes in the region of the Offshore Export Cable Corridor, through longshore drift and residual currents in the nearshore area, drive fine sediment eroded from the Holderness cliffs in a southerly direction (Pye and Blott, 2015), and feed into the sediment process within the Humber Estuary. Should any infrastructure for the Projects in the nearshore (e.g. cable protection measures) disrupt this flow of fine sediment, the sandbank habitat within the Humber Estuary SAC may see a reduction in available sediment.

149. The Applicants have committed to not installing cofferdams in the exit pits. The exit pits will be excavated up to 3m below ground level, potentially creating localised sediment sinks. Considering beach sediments are relatively thin along the Holderness coast, significant accumulations of sediment within the pits are not expected and as the construction activities require the pits to remain open for up to four months, if sediment begins to accumulate in the pits, it will be excavated and returned to the beach where it can be transported alongshore to the south, as per the prevailing sediment transport regime.

150. Upon completion of trenchless duct installation and following export cable installation within the trench between the bore pits and MLWS, the trenches will be backfilled to reinstate the intertidal zone close to its original morphology. This activity would result in some localised and short-term disturbance of sediment on the beach, but there would be no long-term effect on sediment transport processes in the wider region.

151. During the operational phases of the Projects, the presence of cable protection measures in the nearshore environment could potentially have an effect on sediment transport in the nearshore and along the coast.

152. As detailed in **Volume 7, Chapter 8 Marine Physical Environment (application ref: 7.8)** that accompanies this report, evidence indicates that there will no interruption of wave-driven alongshore sediment supply to the Humber Estuary SAC. This is because the entirety of the export cables across the most active zone of wave-driven sediment transport will be buried and will have no effect on sedimentary processes. As detailed in section 6.3, the Applicants have committed to burial across the intertidal zone from Mean High Water Springs (MHWS) to 350m seaward of MLWS.

153. Further offshore, where the seabed is composed of mobile sand, it can be transported under existing tidal conditions. If the protection does present an obstruction to this bedload transport the sediment would first accumulate on one side or both sides of the obstacle (depending on the gross and net transport at that location) to the height of the protrusion (up to 1.4m). With continued build-up, it would then form a 'ramp' over which sediment transport would eventually occur by bedload processes, thereby bypassing the protection. The gross patterns of bedload transport across the export cables would therefore not be affected significantly.

154. As such, given the minimal reduction in sediment transport predicted to occur as a result of nearshore cable protection for the Projects, it is concluded that the sites conservation objectives will be maintained in the long-term. There is, therefore, no potential for an AEoI to Annex I habitats within the Humber Estuary SAC in relation to siltation rate changes from the Projects alone and therefore, subject to natural change, the Annex I habitat features will be maintained in the long term as favourable.

6.6.2.2.1 Introduction of other substances (solid, liquid or gas)

155. Air quality assessments in **Volume 7, Chapter 26, Air Quality (application ref: 7.26)** indicated that an area of mudflat and sandflat habitat not covered by seawater at low tide of the Humber Estuary SAC could potentially be affected by an increase over 1% in the critical level of NOx and the lower critical level for NH_3. The area of habitat is not predicted to experience an impact in exceedance of 1% of the upper Critical Level for NH_3. This impact results from road traffic related to the onshore construction of the Projects in-combination with other plans and projects (i.e. DBS project traffic, growth from the base year (2022) to future year (2026) and EIA committed developments), as per the requirement of the assessment methodology. When the results of the in-combination assessment are compared against the Projects alone impact, it shows that only a small percentage of impact experienced at the Humber Estuary SAC is due to the contribution from the Projects. Further to this, the contribution from Projects alone does not result in impacts in excess of 1% of the respective Critical Levels for NO_x or NH_3 (see **Volume 7, Chapter 26 Air Quality (application ref: 7.26**) for further information). The contribution of the Projects is based upon worst case assumptions for vehicle movements.

156. The air quality assessments also calculated the total concentrations of NOx and NH_3 experienced at the Humber Estuary SAC (i.e., the impact of in-combination traffic combined with the background concentration) (see **Volume 7, Chapter 26, Air Quality (application ref: 7.26).** Due to elevated background NH_3 concentration which is already in exceedance of the lower Critical Levels, total pollutant concentrations of NH_3 exceed the lower NH_3 Critical Level but not the upper Critical Level. The NOx concentrations do not exceed the Critical Level of 30 µg m^{-3} at the Humber Estuary SAC.

157. The mudflat and sandflat habitat not covered by seawater at low tide feature covers an extent of 89.97km^2 within the site (Natural England, 2024d). Effects arising from a potential increase in NOx and NH_3 at the Humber Estuary SAC arise only in a localised area of mudflat and sandflat habitat along the River Hull, adjacent to the A63 trunk road. This represents an area of approximately 0.17km^2 in the worst-case, representing 0.18% of the total mudflat and sandflat habitat within the SAC. Any effect in exceedance of 1% of the respective Critical Levels for NOx and NH_3 would only occur during a short period of construction, resulting in short-term peak in airborne pollutants from the construction vehicles. The 1% critical load would only be marginally exceeded (see **Volume 7, Chapter 26 Air Quality (application ref: 7.26)** for further information).

158. Given the small exceedance, limited duration and footprint of effect there is, therefore, no potential for an AEoI to the Humber Estuary SAC from introduction of other substances (solid, liquid or gas) from the Projects alone or in combination with other plans and projects and therefore, subject to natural change, the qualifying features of the Humber Estuary SAC will be maintained in the long term.

6.6.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

6.6.2.1.2 Smothering and Siltation rate changes

159. There is potential for an AEoI on the Annex I habitat features of the Humber Estuary SAC in-combination with other plans and projects. Plans and projects that could overlap spatially and temporally with the Projects in relation to smothering and siltation rate changes (heavy and light) are listed below:

- Hornsea Project Four Offshore Wind Farm; and
- EGL2, 3 and 4.

160. The worst-case design scenario for Hornsea Project Four does not account for any infrastructure (e.g. cable protection) to be located in the nearshore environment (Orsted, 2021). In addition, due to Hornsea Project Four and EGL 2 being expected to begin construction prior to the Projects, there will be no overlap in nearshore construction activities. As such, there is no potential for an in-combination effect to occur to nearshore sediment processes in-combination between Hornsea Project Four and the Projects.

161. Due to the early stages of development that the EGL3 and 4 projects are currently in, there is no publicly available information to determine if any nearshore infrastructure will be utilised for these projects. As such, any in-combination effects between EGL3 and 4 and the Projects will need to be considered within the assessments conducted for those projects.

6.6.2.2.2 Introduction of other substances (solid, liquid or gas)

162. The assessment of increases in NOx and NH_3 over the 1% critical load as part of assessment in section 6.6.2.2.1 is inherently cumulative, due to the this assessment including background traffic growth (from 2022 to 2026, which represents regional growth due to residential and employment developments), and associated cumulative developments (see section 26.6.1.3.1.2 and section 26.6.1.3.2.2 **Volume 7, Chapter 26 Air Quality (application ref: 7.26)** for further information).

163. As such, the previous conclusion reached in section 6.6.2.2.1 remains applicable. There is, therefore, no potential for an AEoI to the Humber Estuary SAC from introduction of other substances (solid, liquid or gas) from the Projects alone or in combination with other schemes and therefore, subject to natural change, the qualifying features of the Humber Estuary SAC will be maintained in the long term.

6.6.2.3 Summary

164. Due to the minimal changes in sediment transport to the Humber Estuary SAC resulting from the presence of the Projects, there is no potential for an AEoI to Annex I habitat features in relation to siltation rate changes from the Projects both alone and in combination with other schemes. Due to the minimal levels of introduction of NOx and NH_3 modelled to occur within the SAC, there is no potential for an AEoI to Annex I habitat features in relation to introduction of other substances (solid, liquid or gas) from the Projects both alone and in combination with other schemes. Therefore, subject to natural change, the Annex I habitat features of the Humber Estuary SAC will be maintained as favourable in the long term.

7 Sites Designated For Annex II Migratory Fish

7.1 Approach to Assessment

165. This section provides information to allow the determination of the potential for the Projects to have an adverse effect on the integrity of sites designated for Annex II migratory fish species.

166. For each site designated for fish species screened in for further assessment, the following have been provided:

- A summary of the ecology of the fish species considered for assessment for each European site;
- An assessment of potential effects during the construction, operation, maintenance and decommissioning phases of the Projects; and
- An assessment of the potential for in-combination effects alongside other relevant developments and projects.

7.2 Consultation

167. The key elements of consultation to date have included the HRA Screening Report (**Volume 6, Appendix A (application ref: 6.1.1)**) and the ongoing technical consultation via the DBS Seabed Expert Topic Group. The feedback received has been considered in preparing this RIAA. **Table 7-1** provides a summary of how the consultation responses received to date have influenced the approach that has been taken.

Table 7-1 Consultation Responses Relevant to Offshore Annex II Migratory Fish

Comment	Applicants Response
Final HRA Screening Report, MMO (17/07/2023)	
The document correctly identifies that UWN generated by construction activities has the potential to displace fish from supporting habitats or migratory routes by acting as an acoustic barrier. UWN is screened out as a likely significant effect on migratory fish as it is considered that the range of impact for TTS would be 48km from the source, and as the Projects are located more than 100km from the coast, a pathway for potential impacts does not exist. The MMO notes that this statement is supported with a footnote stating; 'there are no numerical criteria available for behavioural effects on fish from underwater noise, therefore TTS range is used as a proxy here for behaviour'. This is not entirely accurate. Whilst the MMO agrees that there is no known numerical threshold for behavioural responses in fish (except for the recommended 135dB for clupeids), it should be understood that TTS and behavioural responses are not the same thing. TTS is a physical effect which causes a temporary reduction in hearing sensitivity caused by exposure to intense sound and is not the same as a behavioural response. This should be corrected in the ES.	The Applicants acknowledge that TTS and behavioural responses are different. As detailed in this comment, TTS ranges were utilised as a proxy in place of an estimated behavioural response range due to the lack of suitable behavioural criteria. In addition, The Applicants note that the referenced 135dB for clupeids is not relevant to the lamprey species present within the sites screened in for further assessment.

7.3 Assessment of Potential Effects

168. The HRA Screening report (**Volume 6, Appendix A (application ref: 6.1.1)**) identified the following potential effect to be taken forward for further assessment in relation to the construction, operation and maintenance and decommissioning phases of the Projects for Annex II migratory fish:

- Underwater noise and vibration impacts to hearing sensitive species due to Unexploded Ordnance (UXO) clearance

7.3.1 Embedded Mitigation

169. **Table 7-2** outlines the embedded and standard mitigation measures incorporated into the design of the Projects relevant to the assessment for Annex II migratory fish species.

Table 7-2 Embedded Mitigation Measures Relevant for Annex II Migratory Fish

Parameter	Mitigation measures embedded into the design of the Project
Underwater Noise	Low-yield methods will be utilised for the detonation of UXO where viable. This will have the effect of mitigating underwater noise impacts on any fish and shellfish species sensitive to noise.

170. Mitigation will be required for any potential UXO clearance but a separate Marine Licence would be submitted following a detailed UXO survey prior to construction, and a detailed assessment based on that latest available information (including potential UXO locations, size, type, and number) has been undertaken.

171. A summary report will be provided following conclusion of any UXO clearance activities to provide detail on the activities and mitigation undertaken.

7.3.2 Worst Case Scenario

172. The final design of the Projects will be confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. In order to provide a precautionary but robust impact assessment at this stage of the development process, realistic worst-case scenarios have been defined in terms of the potential effects screened into the assessment. These are presented in the ES and **Table 7-3**.

Table 7-3 Worst-Case Scenario for Annex II Migratory Fish Assessment

Impact	Worst Case Scenario	Notes
Construction		
Underwater noise and vibration impacts to hearing sensitive species due to UXO clearance	**UXO** Various possible types and sizes of UXO: Up to 698kg (net explosive quantities NEQ) Final numbers of UXO are unknown at this stage. However, predictive numbers have been produced (Ordtek, 2023) which indicate a potential for 41 total UXO across the offshore development area, of which 25 may be located within the offshore export cable corridor (see section 7.4.2.1.1 below).	Impact ranges for noise associated with UXO clearance are included in the underwater noise modelling report that accompanies this submission (**Volume 7, Appendix 11-3 (application ref: 7.11.11.3**).

7.4 River Derwent SAC

7.4.1 Site Description

173. 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 lampreys *Lampetra fluviatilis* and sea lampreys *Petromyzon marinus* populations that spawn in the lower reaches (Natural England, 2005).

7.4.1.1 Qualifying Features

174. The site is designated under article 4(4) of the Directive (92/43/EEC) as it hosts the following Annex II fish species:

- Sea lamprey; and
- River lamprey (present as a qualifying feature, but not a primary reason for site selection).

7.4.1.2 Conservation Objectives

175. The conservation objectives of the SAC 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 the habitats of qualifying species rely;
- The populations of qualifying species; and
- The distribution of qualifying species within the site.

7.4.1.3 Condition Assessment

176. At the time of writing, the latest available information for the River Derwent SAC states that both sea lamprey and river lamprey are in unfavourable recovering condition (Natural England, 2023). The current population of adult returning sea lamprey is estimated to be 1-15 individuals, with the current population of adult returning river lamprey is estimated to be 1,000 individuals (Natural England, 2022).

7.4.2 Assessment

7.4.2.1 Assessment of potential effects of the Projects alone

177. In line with the approach taken to the assessment in section 6.4.2.1, to reduce repetition only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

7.4.2.1.1 Underwater noise and vibration impacts due to UXO clearance

178. Of all the senses used by fish to obtain information about their surrounding environment, sound is one of the most important due to its three-dimensional nature (Popper *et al.*,, 2019; Popper and Hawkins, 2019). As each species has a unique sensitivity to noise, the potential impact of noise on fish varies. 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).

179. Few experiments on the hearing of fishes have been carried out under suitable acoustic conditions, and only a few species have valid data that provide actual thresholds of effect (Popper and Hawkins, 2019). Recent papers on the effects of underwater noise on fish and shellfish species have highlighted the lack of clear evidence to support setting thresholds for impacts on fish and shellfish receptors (Popper *et al.*,, 2014; Hawkins and Popper, 2017). These have highlighted some of the shortcomings of impact assessments, including the use of broad criteria for injury and behavioural effects based on limited studies. The effects of particle motion are not well understood but are considered to be more important for many fish and species, than sound pressure which has been the main consideration in noise impact assessments to date (Popper and Hawkins, 2018).

180. 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: Fishes lacking swim bladders that are sensitive only to sound induced particle motion and show sensitivity to a narrow band of frequencies (includes flatfishes and elasmobranchs);
- Group 2: Fishes 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 (includes salmonids and some tuna);
- Group 3: Fishes with swim bladders that are close, but not intimately connected to the ear. These fishes are sensitive to both particle motion and sound pressure and show a more extended frequency range than groups 1 and 2, extending to about 500 Hz (includes gadoids and eels); and
- Group 4: Fishes that have special structures mechanically linking the swim bladder to the ear. These fishes 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 fishes in Groups 1, 2 and 3 (includes clupeids such as herring, sprat and shads).

181. Lamprey species lack specialist hearing structures and are considered to have low noise sensitivity (Popper, 2005), falling under the Group 1 definition as detailed in Popper *et al.*, 2014.

182. It is possible that there will be a requirement for UXO clearance during the construction phase of the Projects. The underwater noise output resulting from a given charge will vary depending on both the charge weight (size of the explosive charge within the UXO) and the clearance method used. Three clearance methods are described in detail within the Underwater Noise Modelling Report produced for the Projects (**Volume 7, Appendix 11-3 (application ref: 7.11.11.3)** and summarised below:

- High-order clearance (detonation of the charge using a donor charge);
- Low-order clearance (slow burning of the charge); and

- Low-yield clearance (e.g. use of the HYDRA UXO clearance system (or similar) to burn and disintegrate the charge).

183. Impact ranges for a number of UXO detonation scenarios in relation to the potential impact on fish species is provided in **Table 7-4.** As UXO clearance is a single noise event, it is assumed that receptors will not engage in fleeing behaviour.

Table 7-4 Summary of the impact ranges for UXO detonation using the unweighted SPLpeak¬ explosion noise criteria from Popper et al., (2014) for species of fish

Popper *et al.*, (2014) Unweighted SPL_{RMS}	**Mortality and potential mortal injury range (m)**	
	234 dB	**229 dB**
Low yield	130	210
Low order (0.25kg)	40	65
25 kg + 0.5kg donor	170	290
55 kg + 0.5kg donor	230	380
120 kg + 0.5kg donor	300	490
240 kg + 0.5kg donor	370	620
525 kg + 0.5kg donor	490	810
698 kg + 0.5kg donor	530	890

184. Specific surveys to identify potential locations of UXO would not be undertaken until the DCO for the Projects is granted. This is to allow more detailed engineering work to be carried out on the cable routes and locations of wind turbines to allow a targeted survey for potential UXO to be undertaken.

185. Ordtek (2023) has produced a report predicting the number of potential UXO that may be found within the Offshore Development Area. This report reviewed data sources including past potential UXO quantities seen on similar projects, site-specific geophysical data and historic use of the Offshore Development Area. It should be noted that real-world number of UXO may differ from these predicted figures. **Table 7-5** below details these predictive UXO numbers across the Offshore Development Area.

Table 7-5 Predicted UXO Numbers Requiring Clearance Within the Offshore Development Area

UXO Type	Nearshore Cable Route (<10m LAT)	Offshore Cable Route (>10m LAT)	DBS East Array Area	DBS West Array Area	Subtotal
German SC-50 Bomb	1	2	0	0	3
British 250lb MC Bomb	1	1	0	0	2
WWI German Mine	0	3	2	2	7
WWI British Mine	0	2	1	1	4
British 500lb MC Bomb	3	3	1	1	8
WWI U-Boat Torpedo (Multiple Variants)	0	1	0	0	1
German SC-250 Bomb	0	1	1	1	3
WWII British Buoyant Mine	0	2	1	1	4
German SC-500 Bomb	0	1	1	1	3
British 1000lb MC Bomb	0	1	1	1	3
WWII U-Boat Torpedo (Multiple Variants)	0	1	0	0	1
British 2000lb MC Bomb	0	0	0	0	0
German LMB Mine	0	1	0	0	1
German TMB Mine	0	0	0	0	0
German SC-1000 Bomb	0	1	0	0	1
German TMC Mine	0	0	0	0	0

UXO Type	Nearshore Cable Route (<10m LAT)	Offshore Cable Route (>10m LAT)	DBS East Array Area	DBS West Array Area	Subtotal
Totals	5	20	8	8	41

186. Both river and sea lamprey are a normally anadromous species (i.e. spawning in freshwater but completing part of its life cycle in the coastal waters) (JNCC, 2023). While no impacts will occur to fish within the River Derwent SAC due to its location inland, due to its connectivity to the Humber Estuary SAC there exists the potential for individuals from the site to be found in coastal waters near the Humber Estuary SAC.

187. The mouth of the Humber Estuary SAC is located approximately 46km from the offshore export cable corridor at its closest point. As the worst case impact range for UXO clearance is estimated to be 890m, UXO clearance activities would not directly impact any individuals within or in the vicinity of the Humber Estuary. However, adult river and sea lamprey could be found within the vicinity of UXO clearance activities in the nearshore offshore export cable corridor. As detailed in **Table 7-5,** it is estimated that up to five UXO found within this area.

188. There is little evidence available to suggest that river and sea lamprey are found in significant numbers within the Offshore Export Cable Corridor. As such, there is a minimal likelihood that any individuals would be found within 890m of a UXO detonation, the largest distance at which potential mortality or mortal injury could occur.

189. The range at which behavioural effects could occur is unknown and no suitable metric exists. However, given lamprey species low sensitivity to underwater noise (Popper *et al.*,, 2014), distance from the SAC and population size, it is considered unlikely that significant numbers of individuals would be disturbed by any detonation activities.

190. To mitigate any potential impacts of UXO detonation, low-order or low-yield UXO detonation methods would be used where possible to further reduce the distance at which any individuals could be impacted by UXO detonation events.

191. There is, therefore, no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects alone and therefore, subject to natural change, the migratory fish features will be maintained in the long term.

7.4.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

7.4.2.1.2 Underwater noise and vibration impacts due to UXO clearance

192. Plans and projects that could overlap spatially and temporally with the Projects and are likely to require UXO detonation activities are listed below:

- Aminth subsea cable;
- Continental Link;
- Dogger Bank D;
- Eastern Green Link (EGL) 2, EGL3 and EGL4;
- Hornsea Project Four;
- Northern Endurance carbon capture and storage (CCS) project;
- CCS projects within leasing areas CS020, CS025 and CS028; and
- Outer Dowsing offshore wind farm.

193. As detailed in section 7.4.2.1.1, sea and river lamprey are considered to not be sensitive to underwater noise due to their lack of specialist hearing structures.

194. At present, there is no publicly available information regarding the potential number of UXO planned to be cleared by other plans and projects within the vicinity of the Offshore Development Area. However, given the minimal numbers of UXO estimated to require clearance in this area for the Projects, it is likely that the other nearby plans and projects will also require similar levels of clearance. The same mitigation measures as detailed in section 7.4.2.1.1 are industry standard approaches to mitigating for UXO detonation, and would be expected to be required by the other plans and projects. Given the low sensitivity of lamprey, levels of UXO clearance likely required and mitigation employed across projects and lack of evidence of the species presence within the Offshore Development Area, a minimal number of individuals could be impacted by UXO detonation events.

195. There is, therefore, no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects in combination with other plans and projects and therefore, subject to natural change, the migratory fish features of the River Derwent SAC will be maintained in the long term.

7.4.2.3 Summary

196. Due to the minimal numbers of UXO clearance activities required within the nearshore for the Projects, low sensitivity to underwater noise changes for lamprey species and mitigation measures available, there is no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects both alone or in combination with other plans and projects.

197. Therefore, subject to natural change, the migratory fish features of the River Derwent SAC will be maintained in the long term.

7.5 Humber Estuary SAC

7.5.1 Site Description

198. The Humber Estuary is a large estuary with a high tidal range (macro-tidal). The high suspended sediment loads in the estuary 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.

199. 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, 2024b). The migratory fish species river lamprey and sea lamprey are known to route through the estuary to breed in the rivers of the Humber catchment.

7.5.1.1 Qualifying Features

200. The site is designated under article 4(4) of the Directive (92/43/EEC) as it hosts the following Annex II fish species:

- Sea lamprey; and
- River lamprey.

7.5.1.2 Conservation Objectives

201. The conservation objectives of the SAC 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 the habitats of qualifying species rely;
- The populations of qualifying species; and
- The distribution of qualifying species within the site.

7.5.1.3 Condition Assessment

202. There is no current publicly available information regarding the condition of river lamprey or sea lamprey populations within the Humber Estuary SAC (Natural England, 2024c), or overlapping Humber Estuary SSSI (Natural England, 2024e).

7.5.2 Assessment

7.5.2.1 Assessment of potential effects of the Projects alone

203. In line with the approach taken to the assessment in section 6.4.2.1, to reduce repetition only the Projects together assessment has been included, with the only difference between the Projects together or in isolation being the scale of the assessed effects. Any conclusion reached for the Projects together applies to DBS East or DBS West in isolation.

7.5.2.1.1 Underwater noise and vibration impacts due to UXO clearance

204. As detailed in section 7.4.2.1.1, lamprey species lack specialist hearing structures and are considered to have low noise sensitivity (Popper, 2005), being defined as fishes lacking swim bladders that are sensitive only to sound particle motion and show sensitivity to a narrow band of frequencies (includes flatfishes and elasmobranchs) (Popper *et al.*, 2014). The Humber Estuary SAC is located approximately 46km from the offshore export cable corridor at its closest point.

205. Predictive UXO numbers estimated for the Projects indicate up to five UXO may require clearance in the nearshore environment (<10km of Lowest Astronomical Tide), where migratory fish species from the Humber Estuary SAC may be found. There is little available evidence to suggest that river lamprey or sea lamprey are found in significant numbers within the vicinity of the Projects' Offshore Export Cable Corridor. As such, there is a minimal likelihood that any individuals would be found within 890m of a UXO detonation, the largest distance at which potential mortality or mortal injury could occur.

206. The range at which behavioural effects could occur is unknown and no suitable metric exists. However, given lamprey species low sensitivity to underwater noise (Popper *et al.*,, 2014) and distance from the SAC, it is considered unlikely that significant numbers of individuals would be disturbed by any detonation activities.

207. To mitigate any potential impacts of UXO detonation, low-order or low-yield UXO detonation methods would be used where possible to further reduce the distance at which any individuals could be impacted by UXO detonation events.

208. There is, therefore, no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects together and therefore, subject to natural change, the migratory fish features will be maintained in the long term.

7.5.2.2 Assessment of potential effects of the Projects in combination with other plans and projects

7.5.2.1.2 Underwater noise and vibration impacts due to UXO clearance

209. The in-combination assessment for the Humber Estuary SAC is the same as that presented above for the River Derwent SAC (see section 7.4.2.2).

210. There is, therefore, no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects in combination with other plans and projects and therefore, subject to natural change, the migratory fish features of the Humber Estuary SAC will be maintained in the long term.

7.5.2.3 Summary

211. Due to the minimal numbers of UXO clearance activities required within the nearshore for the Projects, low sensitivity to underwater noise changes for lamprey species and mitigation measures available to reduce the impacts of UXO detonation, there is no potential for an AEoI to migratory fish species in relation to underwater noise and vibration impacts from the Projects both alone or in combination with other plans and projects.

212. Therefore, subject to natural change, the migratory fish features of the Humber Estuary SAC will be maintained in the long term.

References

The Crown Estate (2022) Record of the Habitats Regulations Assessment Undertaken under Regulation 63 of The Conservation of Habitats and Species Regulations 2017 and Regulation 28 of The Conservation of Offshore Marine Habitats and Species Regulations 2017 Offshore Wind Leasing Round 4

BEIS. (2019). Record Of The Habitats Regulations Assessment Undertaken Under Regulation 5 Of The Offshore Petroleum Activities (Conservation Of Habitats) Regulations 2001 (As Amended). [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/799510/Dogger_Bank_Decommissioning_Strategic_HRA_rev3.0.pdf [Accessed February 2024].

BEIS. (2020). Hornsea Three - Secretary of State Decision Letter. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-003265-EN010080%20Hornsea%20Three%20-%20Secretary%20of%20State%20Decision%20Letter.pdf [Accessed February 2024].

De-Bastos, E. and Hill, J. (2016). Echinocardium cordatum and Ensis spp. in lower shore and shallow sublittoral slightly muddy fine sand: Marine Evidence–based Sensitivity Assessment (MarESA) Review. [Online]. Available at: doi:10.17031/MARLINHAB.124.1 [Accessed January 2024].

DECC. (2015). Record Of The Habitats Regulations Assessment Undertaken Under Regulation 61 Of The Conservation Of Habitats And Species Regulations 2010 (As Amended) And Regulation 25 Of The Offshore Habitats Regulations For An Application Under The Planning Act 2008 (As Amended). [Online]. Available at: https://doggerbank.com/wp-content/uploads/2020/06/Habitats-Regulations-Assessment.pdf [Accessed February 2024].

Defra. (2024). Consultation on spatial management measures for industrial sandeel fishing - Government response. [Online]. GOV.UK. Available at: https://www.gov.uk/government/consultations/consultation-on-spatial-management-measures-for-industrial-sandeel-fishing/outcome/government-response [Accessed February 2024].

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

Ebeling, A. *et al.*, (2023). Investigation of potential metal emissions from galvanic anodes in offshore wind farms into North Sea sediments. Marine Pollution Bulletin, 194, p.115396.

EC. (2013). Interpretation Manual of Europoean Habitats. [Online]. Available at: https://www.mase.gov.it/sites/default/files/archivio/allegati/rete_natura_2000/int_manual_eu28.pdf [Accessed February 2024].

Eggleton, J., Murray, J., Mcilwaine, P., Mason, C., Noble-James, T., Hinchen, H., Nelson, M., Mcbreen, F., Ware, S., and Whomersley, P. (2017). Dogger Bank SCI 2014 Monitoring Survey Report, JNCC/Cefas Partnership Report No. 11, JNCC, Peterborough, UK. Available at: http://jncc.defra.gov.uk/page-7368.

Hawkins, A. D. and Popper, A. N. (2017). A sound approach to assessing the impact of underwater noise on marine fishes and invertebrates. ICES Journal of Marine Science, 74 (3), pp.635–651. [Online]. Available at: doi:10.1093/icesjms/fsw205.

JNCC and Natural England. (2013). Inner Dowsing, Race Bank and North Ridge candidate Special Area of Conservation: Formal advice under Regulation 35(3) of The Conservation of Habitats and Species Regulations 2010 (as amended), and Regulation 18 of The Offshore Marine Conservation Regulations (Natural Habitats, &c.) Regulations 2007 (as amended).

JNCC. (2022a). Conservation Objectives for Dogger Bank Special Area of Conservation. [Online]. Available at: https://data.jncc.gov.uk/data/26659f8d-271e-403d-8a6b-300defcabcb1/dogger-bank-conservation-objectives-v2.pdf [Accessed August 2024].

JNCC. (2022b). Dogger Bank SAC Advice on Operations. [Online]. Available at: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fdata.jncc.gov.uk%2Fdata%2F26659f8d-271e-403d-8a6b-300defcabcb1%2Fdogger-bank-aooworkbook-v2.xlsx&wdOrigin=BROWSELINK [Accessed February 2024].

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

JNCC. (2022d). Supplementary Advice on Conservation Objectives for Dogger Bank Special Area of Conservation: December 2022. [Online]. Available at: https://data.jncc.gov.uk/data/26659f8d-271e-403d-8a6b-300defcabcb1/dogger-bank-saco-v2.pdf [Accessed January 2024].

JNCC. (2023). River lamprey (Lampetra fluviatilis) - Special Areas of Conservation. [Online]. Available at: https://sac.jncc.gov.uk/species/S1099/ [Accessed November 2023].

JNCC. (2024). Dogger Bank - Special Areas of Conservation. [Online]. Available at: https://sac.jncc.gov.uk/site/UK0030352 [Accessed January 2024].

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

Moray Offshore Renewables Ltd. (2019). Technical Appendix 4.3 D- Electromagnetic Field Modelling. [Online]. Available at: https://marine.gov.scot/datafiles/lot/morl/Environmental_statement/Volumes%208%20to%2011%20-%20Technical%20Appendices/Volume%2010%20Part%201%20-%20Biological%20Environment%20Technical%20Appendices/Appendix%204.3%20D%20-%20Electromagnetic%20Fields%20Modelling.pdf [Accessed January 2024].

Natural England. (2005). Citation for Special Area of Conservation (SAC) - River Derwent SAC. [Online]. Available at: https://publications.naturalengland.org.uk/file/6411914439557120 [Accessed November 2023].

Natural England. (2018a). Flamborough Head SAC Conservation Objectives. [Online]. Available at: https://publications.naturalengland.org.uk/file/6625807107883008.

Natural England. (2018b). Humber Estuary SAC Conservation Objectives. [Online]. Available at: https://publications.naturalengland.org.uk/file/6294287600058368.

Natural England. (2021). Flamborough Head SSSI Condition Summary. [Online]. Available at: https://designatedsites.naturalengland.org.uk/ReportUnitConditionSummary.aspx?SiteCode=S1002289&ReportTitle=Flamborough%20Head%20SSSI [Accessed January 2024].

Natural England. (2022a). Phase III Best Practice for Data Analysis and Presentation at Examination, Version 1.

Natural England. (2022b). River Derwent SAC - Supplementary advice on conserving and restoring site features. [Online]. Available at: https://designatedsites.naturalengland.org.uk/TerrestrialAdvicePDFs/UK0030253.pdf [Accessed November 2023].

Natural England. (2023). River Derwent SAC - Monitored Units. [Online]. Available at: https://designatedsites.naturalengland.org.uk/SiteSACFeaturesMatrix.aspx?SiteCode=UK0030253&SiteName=River%20Derwent%20SAC [Accessed November 2023].

Natural England. (2024a). Flamborough Head SAC Feature Condition. [Online]. Available at: https://designatedsites.naturalengland.org.uk/Marine/MarineFeatureConditionDirect.aspx?SiteCode=UK0013036&SiteName=flamborough&SiteNameDisplay=Flamborough%20Head%20SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality= [Accessed January 2024].

Natural England. (2024b). Humber Estuary SAC. [Online]. Available at: https://designatedsites.naturalengland.org.uk/SiteGeneralDetail.aspx?SiteCode=UK0030170&SiteName=humber&countyCode=&responsiblePerson=&SeaArea=&IFCAArea= [Accessed January 2024].

Natural England. (2024c). Humber Estuary SAC Feature Condition. [Online]. Available at: https://designatedsites.naturalengland.org.uk/SiteSACFeaturesMatrix.aspx?SiteCode=UK0030170&SiteName=Humber%20Estuary%20SAC [Accessed January 2024].

Natural England. (2024d). Humber Estuary SAC Supplementary Advice on Conservation Objectives. [Online]. Available at: https://designatedsites.naturalengland.org.uk/Marine/FAPMatrix.aspx?SiteCode=UK0030170&SiteName=humber&SiteNameDisplay=Humber+Estuary+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=8 [Accessed April 2024].

Natural England. (2024e). Humber Estuary SSSI Feature Condition. [Online]. Available at: https://designatedsites.naturalengland.org.uk/SiteFeatureCondition.aspx?SiteCode=S2000480&SiteName=Humber%20Estuary%20-%202000480%20SSSI [Accessed January 2024].

OffshoreWIND.Biz (2024a). Export Cable Installation to Start at Third Dogger Bank Wind Farm Phase. Offshore Wind. [Online]. Available at: https://www.offshorewind.biz/2024/03/26/export-cable-installation-to-start-at-third-dogger-bank-wind-farm-phase/ [Accessed May 2024].

OffshoreWIND.Biz. (2024). Dogger Bank B Offshore Substation Installed. Offshore Wind. [Online]. Available at: https://www.offshorewind.biz/2024/04/17/dogger-bank-b-offshore-substation-installed/ [Accessed May 2024].

Orsted. (2021). Hornsea Project Four: Environmental Statement (ES) Volume A2, Chapter 1: Marine Geology, Oceanography and Physical Processes. [Online]. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010098/EN010098-000703-A2.1%20ES%20Volume%20A2%20Chapter%201%20Marine%20Geology%20Oceanography%20and%20Physical%20Processes.pdf [Accessed January 2024].

Popper, A. (2005). A Review of Hearing by Sturgeon and Lamprey.

Popper, A. *et al.*, (2014). Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report. In: pp.33–51. [Online]. Available at: doi:10.1007/978-3-319-06659-2_7.

Popper, A. N. *et al.*, (2019). Examining the hearing abilities of fishes. The Journal of the Acoustical Society of America, 146 (2), pp.948–955. [Online]. Available at: doi:10.1121/1.5120185.

Popper, A. N. and Hawkins, A. D. (2019). An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. Journal of Fish Biology, 94 (5), pp.692–713. [Online]. Available at: doi:10.1111/jfb.13948.

RPS (2019). Review of Cable Installation, Protection Mitigation and Habitat recoverability. Commissioned by the Crown Estate.

Schrieken, N. *et al.*, (2013). Marine fauna of hard substrata of the Cleaver Bank and Dogger Bank. Nederlandse Faunistische Mededelingen, 41, pp.69–78.

Tillin, H. *et al.*, (2022). What are the benefits of assisted versus natural recovery? Development of a decision making framework.

Wieking, G. and Kröncke, I. (2003). Macrofaunal communities of the Dogger Bank (central North Sea) in the late 1990s: Spatial distribution, species composition and trophic structure. Helgoland Marine Research, 57:34-46.

RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire, SN5 6PB