Hornsea Project Four: Environmental Statement (ES)

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Volume A2,
Chapter 12: Cumulative and Transboundary Effects Offshore Summary

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Glossary

Term	Definition
Cumulative Effects	The combined effect of Hornsea Four acting cumulatively with the effects of a number of different projects, on the same single receptor/resource. Cumulative impacts are those that result from changes caused by other past, present or reasonably foreseeable actions together with Hornsea Four.
Design Envelope	A description of the range of possible elements that make up the Hornsea Four design options under consideration, as set out in detail in the project description. This envelope is used to define Hornsea Four for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
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).
EIA Directive	European Union Directive 85/337/EEC, as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC and then codified by Directive 2011/92/EU of 13 December 2011 (as amended in 2014 by Directive 2014/52/EU).
EIA Regulations	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Mitigation	A term used interchangeably with Commitment(s) by Hornsea Four. Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, Preliminary Environmental Information Report (PEIR), or ES).
National Policy Statement (NPS)	A document setting out national policy against which proposals for Nationally Significant Infrastructure Projects (NSIPs) will be assessed and decided upon.
Order Limits	The limits within which Hornsea Four (the 'authorised project) may be carried out.
Orsted Hornsea Project Four Ltd	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Planning Inspectorate (PINS)	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).
Scoping	An early part of the EIA process by which the key potential significant impacts of the project are identified and methodologies identified for how these should be assessed. This process gives the regulator and key consultees opportunity to comment and define the full extent of the final EIA – which can also then be tailored through the consultation process.

Term	Definition
Transboundary Impacts	Transboundary effects arise when impacts from the development within one European Economic Area (EEA) state affects the environment of another EEA state(s).

Acronyms

Acronym	Definition
AfL	Agreement for Lease
BDMPS	Biologically Defined Minimum Population Scale
BEIS	Department of Business, Enterprise and Industrial Strategy
CAA	Civil Aviation Authority
CCS	Carbon Capture Storage
CEA	Cumulative Effects Assessment
CME	Cooperative Maritime Etaploise
CNS	Communication, Navigation and Surveillance
CPA	Closest Point of Approach
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
ECC	Export Cable Corridor
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ERCoP	Emergency Response Cooperation Plan
ERYC	East Riding of Yorkshire Council
ES	Environmental Statement
EU	European Union
FIR	Flight Information Regions
GIS	Geographic Information System
HDD	Horizontal Directional Drilling
HRA	Habitats Regulations Assessment
HSE	Health and Safety Executive
HVAC	High Voltage Alternating Current
LVNL	Luchtverkeersleiding Nederland
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MOD	Ministry of Defence
MPA	Marine Protected Area
MPS	Marine Policy Statement
MW	Megawatt
NPS	National Policy Statements
NSIP	Nationally Significant Infrastructure Project
NZT	Net Zero Teeside
OWF	Offshore Wind Farms
PEIR	Preliminary Environmental Information Report

Acronym	Definition
PINS	Planning Inspectorate
REWS	Radar Early Warning System
RIAA	Report to Inform the Appropriate Assessment
RWS	Rijkswaterstaat
SLVR	Seascape, Landscape and Visual Resource
SoS	Secretary of State
SSC	Suspended Sediment Concentrations
TCPA	Time to Closest Point to Approach
UXO	Unexploded Ordnance
WHPS	Wellhead Protection Structure
WTG	Wind Turbine Generator
ZCH	Zero Carbon Humber
ZoI	Zone of Influence

Units

Unit	Definition
km	Kilometre
km^2	Square kilometre
MW	Megawatt
nm	Nautical mile

12.1 Introduction

12.1.1.1 Orsted Hornsea Project Four Limited (hereafter the 'Applicant') is proposing to develop the Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four') which will be located approximately 69 km from the East Riding of Yorkshire in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network (see **Volume A1, Chapter 4: Project Description** for full details on the Project Design).

12.1.1.2 The Hornsea Four Agreement for Lease (AfL) area was 846 km^2 at the Scoping phase of project development. In the spirit of keeping with Hornsea Four's approach to Proportionate Environmental Impact Assessment (EIA), the project has given due consideration to the size and location (within the existing AfL area) of the final project that is being taken forward to Development Consent Order (DCO) application. This consideration is captured internally as the "Developable Area Process", which includes Physical, Biological and Human constraints in refining the developable area, balancing consenting and commercial considerations with technical feasibility for construction.

12.1.1.3 The combination of Hornsea Four's Proportionality in EIA and Developable Area process has resulted in a marked reduction in the array area taken forward at the point of DCO application. Hornsea Four adopted a major site reduction from the array area presented at Scoping (846 km^2) to the Preliminary Environmental Information Report (PEIR) boundary (600 km^2), with a further reduction adopted for the Environmental Statement (ES) and DCO application (468 km^2) due to the results of the PEIR, technical considerations and stakeholder feedback. The evolution of the Hornsea Four Order Limits is detailed in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives** and **Volume A4, Annex 3.2: Selection and Refinement of the Offshore Infrastructure**.

12.1.1.4 This chapter of the ES provides a summary of the Cumulative Effects Assessment (CEA) and transboundary impact assessment for the offshore topics of the Hornsea Four ES. Whilst each technical assessment chapter within the ES provides its own cumulative and transboundary impact assessment sections in relation to that topic, the purpose of this chapter is to present an overview of all potential offshore cumulative and transboundary impacts of the project. This chapter is also provided to meet the requirement to consider transboundary impacts required by The Convention on Environmental Impact Assessment in a Transboundary Context, UN treaty No. 34028 (termed the Espoo Convention) which was signed 10 September 1997. The Espoo Convention is implemented by the EIA Directive and transposed into UK law by way of the EIA Regulations.

12.1.1.5 A fundamental requirement of undertaking the CEA is to identify those projects, plans and activities with which Hornsea Four may interact to produce a cumulative impact.

12.1.1.6 Transboundary impacts relate to those impacts that may arise from an activity within one European Economic Area (EEA) state, that significantly affect the environment or other interests of another EEA state.

12.1.1.7 This chapter describes the requirement for CEA and transboundary impact assessment, the guidance for completing CEA in relation to Nationally Significant Infrastructure Projects (NSIP), and the consultation undertaken to inform the approach that the Applicant has adopted.

12.1.1.8 It should be noted that an in-combination assessment has been undertaken as part of the Habitats Regulations Assessment (HRA) process. There are elements of the approach to CEA that are mirrored by the in-combination HRA process, in particular the method used to identify other plans, projects and activities that are taken forward in each assessment. Information to support the HRA process is presented within **B2.2 Report to Inform Appropriate Assessment** (RIAA). HRA screening for European sites is provided in Appendix A of the RIAA.

12.1.1.9 This chapter draws information from, and should be read in conjunction with:

- **Chapter 1: Marine Geology, Oceanography and Physical Processes**;
- **Chapter 2: Benthic and Intertidal Ecology**;
- **Chapter 3: Fish and Shellfish Ecology**;
- **Chapter 4: Marine Mammals**;
- **Chapter 5: Offshore and Intertidal Ornithology**;
- **Chapter 6: Commercial Fisheries**;
- **Chapter 7: Shipping and Navigation**;
- **Chapter 8: Aviation and Radar**;
- **Chapter 9: Marine Archaeology**;
- **Chapter 10: Seascape, Landscape and Visual Resources**; and
- **Chapter 11: Infrastructure and Other Users**.

12.2 Legislation, Policy and Guidance

12.2.1 Cumulative Effects Legislation, Policy and Guidance

12.2.1.1 The Planning Act 2008 underpins the consenting regime for certain types of development classed as NSIPs. Hornsea Four is an NSIP as it is an offshore generating station with a capacity of more than 100 megwatts (MW). The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 implement the requirements of the EIA Directive into UK law in respect of NSIP projects.

12.2.1.2 The overarching National Policy Statement (NPS) for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a) and the NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b) both identify the need to address the maximum potential adverse impacts. Matters considered to affect the maximum adverse impact are topic impacts, inter-relationships between topics, and cumulative impacts. The Maximum Design Scenario (MDS) is also sometimes referred to as the 'Rochdale Envelope'.

12.2.1.3 The Planning Inspectorate (PINS) have produced 'Advice Note 9: Rochdale Envelope' (2018) setting out the views of PINS regarding how this approach should be used in the context of the Planning Act 2008. The Rochdale Envelope approach is a well understood concept that involves ensuring that any EIA is based on assessing the realistic MDS where flexibility or a range of options is sought as part of the consent application. This guidance confirms that in order to ensure a robust application of the Rochdale Envelope principle to the EIA process, this principle must also be applied to the CEA as well as the assessment of project specific, individual effects.

12.2.1.4 PINS have produced 'Advice Note 17: Cumulative Effects Assessment' (2019), which provides guidance on a staged process that can be used for cumulative effects assessments for NSIPs. Advice Note 17 details a four-step process that can be followed by developers and which has been applied here.

12.2.1.5 The Marine Policy Statement (MPS) (HM Government 2011) sets out the need to address cumulative effects, i.e. 'when considering potential benefits and adverse effects, decision-makers should also consider any multiple and cumulative impacts of proposals in the light of other projects and activities'.

12.2.2 Transboundary Legislation, Policy and Guidance

12.2.2.1 The need to consider transboundary impacts has been embodied by The United Nations Economic Commission for Europe Convention on Environmental Impact Assessment in a Transboundary Context, adopted in 1991 in the Finnish city of Espoo and commonly referred to as the 'Espoo Convention'. The Convention requires that assessments are extended across borders between Parties of the Convention when a planned activity may cause significant adverse transboundary impacts.

12.2.2.2 The Espoo Convention has been implemented in the EU via the EIA Directive which (as noted above) is transposed into UK law by the EIA Regulations. Regulation 32 of the EIA Regulations requires that where the Secretary of State is of a view that an EIA application will have significant effects on the environment of another EEA State, or the Secretary of State receives a request for involvement from another EEA State, it must undertake a prescribed process of consultation and notification.

12.2.2.3 PINS Advice Note 12: Transboundary Impacts and Process (2020) sets out the procedures for consultation in association with an application for a DCO, where such development may have significant transboundary impacts. The note sets out the roles of PINS, other EEA States and developers. In respect of the latter, developers have no formal role under the Regulation 32 process, as the duties prescribed by Regulation 32 in notifying and consulting with other EEA States on potential transboundary impacts are the responsibility of the Secretary of State. However, developers are advised to:

- Carry out preparatory work to complete a transboundary screening matrix to assist the Secretary of State in determining the potential for likely significant effects on the environment in other EEA States;
- To submit the transboundary screening matrix along with the scoping request, if a scoping opinion is sought by the developer and with the DCO application; and
- Consider, when preparing documents for consultation and application, whether to undertake their own consultations with relevant EEA states.

12.2.3 Policy

12.2.3.1 The Hornsea Four CEA and transboundary assessments have been undertaken with specific reference to the relevant NPS. These are the principal decision making documents for NSIPs, and those relevant to Hornsea Four are:

- Overarching NPS for Energy (EN-1) (DECC 2011a); and
- NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b).

12.2.3.2 The specific requirements of the NPS in relation to CEA and the transboundary impact assessment, relevant to Hornsea Four, are summarised in **Table 12.1** which also includes reference to where they are addressed within the Hornsea Four ES.

Table 12.1: Summary of NPS EN-1 and EN-3 policy relevant to CEA and transboundary impact assessment and consideration of the Hornsea Four assessment.

Summary of NPS EN-1 and EN-3 provisions	How and where considered in the ES
"When considering cumulative effects, the ES should provide information on how the effects of the applicant's proposal would combine and interact with the effects of other development (including projects for which consent has been sought or granted, as well as those already in existence)." (Paragraph 4.2.5 of NPS EN-1).	Offshore cumulative effects assessments are presented in **Chapters 1 – 11** of **Volume A2** of the Hornsea Four ES.
"Any assessment on aviation or other defence interests… should also assess the cumulative effects of the project with other relevant projects in relation to aviation and defence." (Paragraph 5.4.12 of NPS EN-1).	A cumulative assessment in relation to aviation and radar is presented in Section 2.12 of **Chapter 8: Aviation and Radar**.
"Where cumulative effects on intertidal habitats are predicted as a result of the cumulative effects of multiple export cable routes, it may be appropriate for applicants of various schemes to work together to ensure that the number of cable crossings are minimised and installation and decommissioning phases are coordinated to ensure that disturbance is also reasonably minimised." (Paragraph 2.6.89 of NPS EN-3).	A cumulative assessment in relation to benthic and intertidal ecology is presented in Section 8.12 of **Chapter 2: Benthic and Intertidal Ecology**. The Applicant has made a commitment to install the cables at landfall using Horizontal Directional Drilling (HDD) or other trenchless method underneath the intertidal area (Co187 - see **A4.5.2: Commitments Register**), with the HDD works exit pits located within the subtidal area (below Mean High Water Springs (MHWS)).
"Where necessary, assessment of the effects on marine mammals should include details of… duration of the potentially disturbing activity including cumulative/in-combination effects with other plans or projects." (Paragraph 2.6.92 of NPS EN-3).	The marine mammals assessment presented in Section 4.12 of **Chapter 4: Marine Mammals** considers the cumulative impacts of Hornsea Four and other relevant plans or projects.
"Where cumulative effects on subtidal habitats are predicted as a result of the cumulative effects of multiple cable routes, it may be appropriate for applicants of various schemes to work together to ensure that the number of cable crossings are minimised and installation and decommissioning phases are coordinated in order to ensure that disturbance is reasonably minimised." (Paragraph 2.6.120 of NPS EN-3).	A cumulative assessment in relation to benthic and intertidal ecology is presented in Section 2.12 of **Chapter 2: Benthic and Intertidal Ecology**.
"In some circumstances, transboundary issues may be a consideration as fishermen from other countries may fish in waters within which offshore windfarms are sited." (Paragraph 2.6.124 of NPS EN-3).	A transboundary assessment in relation to commercial fisheries is presented in Section 6.13 of **Chapter 6: Commercial Fisheries**.
"In some circumstances, vessels from other countries may sail in waters within which offshore wind farms are sited." (Paragraph 2.6.152 of NPS EN-3).	A cumulative assessment in relation to shipping and navigation is presented in Section 7.12 of **Chapter 7: Shipping and Navigation**.
"The navigation risk assessment will for example necessitate… cumulative and in-combination risks associated with the development and other developments (including other wind farms) in the same area of sea." (Paragraph 2.6.157 of NPS EN-3).	As part of Hornsea Four compliance with Marine Guidance Note (MGN) 654 an Emergency Response Cooperation Plan (ERCoP) will be developed for all phases, as noted in Section 7.8.2 of **Chapter 7: Shipping and Navigation**. It is noted

Summary of NPS EN-1 and EN-3 provisions	How and where considered in the ES
	post consent that Hornsea Four will be required to comply with Health and Safety Executive (HSE) and Maritime and Coastguard Agency (MCA) regulatory expectations for emergency response arrangements for the offshore renewable energy industry (HSE & MCA 2019). Additionally, the Applicant has made a commitment to comply with MGN 654 where appropriate (Co99 - **Volume A4, Annex 5.2: Commitments Register**).
"In considering what interference, obstruction or danger to navigation and shipping is likely and its extent and nature, the IPC should have regard to the likely overall effect of the development in question and to any cumulative effects of other relevant proposed, consented and operational offshore wind farms." (Paragraph 2.6.169 of NPS EN-3).	A cumulative assessment in relation to shipping and navigation is presented in Section 7.12 of **Chapter 7: Shipping and Navigation**.
"Where appropriate, cumulative seascape and visual impact assessment *(SVIA) should be undertaken in accordance with the policy on cumulative assessment outlined in Section 4.2 of EN-1."* (Paragraph 2.6.206 of NPS EN-3).	As agreed with the relevant stakeholders (East Riding of Yorkshire Council, Natural England and PINS), all Seascape, Landscape and Visual Resources (SLVR) impacts (including cumulative effects) have either been scoped out based on PINS Scoping Opinion, or agreed to be not considered in detail in the ES (further details in Table 10.3 of **Chapter 10: Seascape, Landscape and Visual Resources** and Table 1.1 and Annex 4 of **B1.1 Consultation Report**). As such, no cumulative SLVR CEA has been undertaken as there is no pathway to lead to a significant cumulative effect.

12.3 Consultation

12.3.1 Transboundary Consultation

12.3.1.1 An overview of the key areas of transboundary consultation is provided within **Volume A1, Chapter 6: Consultation** and **Volume A4, Annex 5.7: Transboundary Screening Report**, but any relevant transboundary consultation is also summarised in the topic-specific ES chapters. As part of this consultation, the following European Union (EU) ministers, industries and organisations have been consulted with:

- Dutch Ministry of Infrastructure and the Environment;
- German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety;
- Flemish Government Environment, Nature and Energy Department, International Environmental Policy Division;
- Environmental Protection Agency, Ministry of the Environment and Food of Denmark;
- Norwegian Environment Agency;
- French Ministère de l'écologie, du développement durable et de l'énergie Commissariat général au développement durable;
- Icelandic Ministry for Foreign Affairs;

- Irish Environmental Planning Policy, Department of Housing, Planning & Local Government;
- EU commercial fisheries organisations:
  - Rederscentrale (Belgian);
  - From Nord (French);
  - Cooperative Maritime Etaploise (CME.) Producer Organisation (French);
  - VisNed (Dutch);
  - Danish Fishermen's Producer Organisation;
  - Swedish Pelagic Federation Producers Organisation;
  - Danish Pelagic Producers Organisation; and
  - Erzeugergemeinschaft der Nord- und Osteefischer GmbH (German).

12.3.1.2 Hornsea Four have also consulted with, and will continue to do so where required, any additional consultees provided by the EU ministries, industries and organisations.

12.3.2 CEA Consultation

12.3.2.1 A summary of consultation responses from PINS and other key stakeholders relevant to the CEA is provided in Table 12.2 below.

Table 12.2: Consultation relating to the CEA.

Comment	How and where considered in the ES
Scoping Opinion – November 2018	
Cumulative effects during decommissioning: Decommissioning is not proposed to be addressed in the cumulative assessment on the basis that it is too far in the future for enough information to be available to form a robust assessment. The Inspectorate notes the intention to assess this phase of the Proposed Development and to commit to a decommissioning plan at the relevant time and is content with this approach. The Inspectorate agrees to scope cumulative effects during decommissioning out of the cumulative assessment; however, the Applicant should take into account comments in Section 3, Paragraph 2.3.11 of the Scoping Opinion.	Noted. Hornsea Four will submit an offshore decommissioning plan for approval prior to the start of offshore construction. Hornsea Four have committed to developing a Decommissioning Plan (Co181) (see **A4.5.2: Commitments Register**).
Cumulative effects on offshore environment: The proposed cumulative effects assessment does not include any detail of what aspects of the offshore environment will be assessed, however it is noted that the approach set out will examine effects on a receptor basis as part of the refinement of the list of projects/plans to be considered. The ES should explain fully the results of this process and set out what aspects and receptors have been assessed. The Inspectorate notes the intention to follow the advice in Advice Note 17.	**Volume A4, Annex 5.3: Offshore Cumulative Effects** sets out the approach to the CEA with the long list of projects, plans and activities presented in Appendix A of that document. Topic-specific CEA assessments are presented in **Chapters 1 – 11** of **Volume A2** of the ES.
ZOIs for cumulative assessment: The Zones of Influence (ZoI) for the cumulative assessment differ from the environmental aspect chapter for some aspects and clearly explain how the ZoI or study area(s) have been determined, based on the likely extent of impacts.	ZoIs have been defined in Table 3 of the **Volume A4, Annex 5.3: Offshore Cumulative Effects** which have been derived based upon the extent over which cumulative impacts are likely to occur. Cumulative effect screening ranges specific to each EIA receptor topic are presented in Table 6 of the **Volume A4, Annex 5.3: Offshore Cumulative Effects**.

Comment	How and where considered in the ES
Section 42 Consultation – Natural England September 2019	
Viking Link, Dogger Bank Creyke Beck A and B Export Cables as well as Hornsea Project Two Export Cables have been screened in for Benthic and Intertidal Ecology, however they have not been assessed in the corresponding chapter (**PEIR Volume 2 Chapter 2 Benthic and Intertidal Ecology**).	The long-list of cumulative schemes has been reviewed and the updated results of cumulative screening have been carried through to relevant ES chapters. The Applicant has ensured that all projects screened in for assessment within **Volume A4, Annex 5.3: Offshore Cumulative Effects** have been carried through for assessment within the relevant ES chapters.

12.4 Assessment Methodology

12.4.1 Introduction

12.4.1.1 This section summarises the approach to the assessment of cumulative and transboundary impacts for offshore elements for Hornsea Four. Further details on the methodologies are provided in **Volume A4, Annex 5.3: Offshore Cumulative Effects** and **Volume A4, Annex 5.7: Transboundary Screening Report**.

12.4.2 Cumulative Effects Assessment

Overview

12.4.2.1 Cumulative effects can be defined as effects upon a single receptor from Hornsea Four when considered alongside other proposed and reasonably foreseeable projects and developments. This includes all projects that result in a comparative effect that is not intrinsically considered as part of the existing environment and is not limited to offshore wind projects.

12.4.2.2 The assessment of cumulative effects arising as a result of Hornsea Four is a required part of an impact assessment under the Infrastructure Planning (Environmental Impact Assessment) Regulations (2017). As described in **paragraph 12.2.1.4**, PINS produced Advice Note 17: Cumulative Effect Assessment, to provide guidance on a staged process that can be used for CEAs for NSIPs. **Table 12.3** summarises the stages and activities involved in the CEA process as described in PINS Advice Note 17.

Table 12.3: Stages and activities involved in the CEA process (adapted from PINS Advice Note 17).

CEA stage	Activity
Stage 1 – Establish the project's ZoI and establish a long-list of other developments	A desk study should be undertaken to identify the ZoI for the development for the topics that are proposed to be scoped into the EIA. The ZoI analysis is documented (i.e. table of topics and ZoIs), with supporting Geographic Information System (GIS); The long list of other existing developments and/or approved developments is drawn up through a desk study of planning applications, development plan documents, relevant development frameworks and any other available and relevant sources to identify other existing developments and/or approved developments within the ZoI; and 'Other existing development and/or approved development' types that should be established for the CEA, with any assumptions or limitations in relation to the 'other existing development and/or approved development' data collected. It is recommended that a

CEA stage	Activity
	level of certainty (or tier), reflecting the availability of detail and information necessary for the assessment, is assigned to each development and recorded.
Stage 2 – Screening of long list: Identify a shortlist of other developments for the CEA	Inclusion/exclusion threshold criteria, against which the potential for 'other development to give rise to significant cumulative effects by virtue of overlaps in temporal scope, the scale and nature of the 'other developments' and/or receiving environment, or any other relevant factors is used to determine whether to include or exclude 'other existing development and/approved development from further assessment. From this assessment, a shortlist of 'other developments' to be included in the CEA is produced. It is noted that documented information on each of the 'other development' is likely to be high level at this stage, outlining the key issues to take forward. Advice Note 17 notes that the proposed inclusion/exclusion criteria should ideally be finalised prior to the request for a Scoping Opinion, and the project should consult with the relevant consultation bodies including the local planning authorities regarding the shortlist[11].
Stage 3 – Information gathering	All available information on the 'other existing development and/or approved development' within the shortlist generated at Stage 2 is collated to inform the CEA. The information captured should include but not be limited to: proposed design and location information; proposed programme of construction, operation and decommissioning; and environmental assessments that set out baseline data and effects arising from the 'other existing development and/or approved development'.
Stage 4 – Assessment	An assessment of the cumulative effects of the project with the 'other existing developments and/or approved developments' should be undertaken to an appropriate level of detail, commensurate with the information available at the time of assessment. An assessment should be provided for all Tier 1 and Tier 2 'other existing development and/or approved development', where possible. For 'other existing development and/or approved development' falling into Tier 3, as assessment should be undertaken where possible, although this may be qualitative and at a very high level.

Methodology

12.4.2.3 A screening process has identified a number of reasonably foreseeable projects and developments which may act cumulatively with Hornsea Four. The full list of such projects that have been identified in relation to the offshore environment are set out in **Volume A4, Annex 5.3: Offshore Cumulative Effects** and are presented in a series of maps within **Volume A4, Annex 5.4: Location of Offshore Cumulative Schemes**. This long-list, seaward of MHWS, has been produced based on the scale of other projects and the potential for them to produce cumulative effects with Hornsea Four, as well as ZoIs or cumulative search area extents as detailed in Table 3 of **Volume A4, Annex 5.3: Offshore Cumulative Effects**. Any projects or plans that went into planning post 30th May 2021 have not been considered for inclusion in the CEA.

12.4.2.4 Having developed the Hornsea Four long list, all projects, plans and activities have been screened based on the level of detailed information available and the potential for interaction with Hornsea Four, whether this interaction be temporal, spatial or potential. This screening has produced EIA topic-specific short-lists of projects to be considered further within the CEA as part of each ES chapter. It should be noted that this process may have screened a project in for one EIA topic, but screened it out for another.

[1] Note that Hornsea Four did not provide a long list for consideration at scoping for offshore cumulative issues, this was prepared for consultation at the PEIR stage and updated for ES and is included as Appendix A of **Volume A4, Annex 5.3: Offshore Cumulative Effects**.

12.4.2.5 In assessing the potential cumulative impacts for Hornsea Four, it is important to bear in mind that some projects, predominantly those 'proposed' or identified in development plans, may not actually be taken forward, or fully built out. There is therefore a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, those projects under construction are likely to contribute to cumulative impacts (providing effect or spatial pathways exist), whereas those proposals not yet approved are less likely to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors.

12.4.2.6 With this in mind, all projects and plans considered alongside Hornsea Four have been allocated into 'tiers' reflecting their current stage within the planning and development process. This allows the cumulative impact assessment to present several future development scenarios, each with a differing potential for being ultimately built out. This approach also allows appropriate weight to be given to each scenario (tier) when considering the potential cumulative impact. The proposed tier structure that is intended to ensure that there is a clear understanding of the level of confidence in the cumulative assessments provided in the Hornsea Four ES. An explanation of each tier is included in **Table 12.4**.

Table 12.4: Description of tiers of other developments considered for CEA (adapted from PINS Advice Note 17).

Tier 1	Project under construction.
	Permitted applications, whether under the Planning Act 2008 or other regimes, but not yet implemented.
	Submitted applications, whether under the Planning Act 2008 or other regimes, but not yet determined.
Tier 2	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has been submitted.
Tier 3	Projects on the Planning Inspectorate's Programme of Projects where a Scoping Report has not been submitted.
	Identified in the relevant Development Plan (and emerging Development Plans with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited.
	Identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals, where such development is reasonably likely to come forward.

12.4.2.7 Topic-specific cumulative effect screening ranges were then applied to the long list, to identify relevant short list plan/projects/activities to be taken forward to the topic-specific CEA presented in each ES chapter (summary short list tables are presented in each of the offshore ES topic chapters).

12.4.2.8 Following on from the production of the topic-specific short lists, EIA topics authors have undertaken an information gathering exercise in relation to all plans, projects and activities that have been screened-in for each topic. This information gathering has then been used to inform the CEA assessments presented within each EIA topic chapter.

12.4.3 Transboundary Impact Assessment

12.4.3.1 The Hornsea Four transboundary assessments within each topic-specific chapter have followed methodology set out in PINS Advice Note 12: Transboundary Impacts (2020). A transboundary screening process was carried out and was presented as Annex J of the Scoping Report (Orsted 2018) and confirmed that only certain offshore (marine) technical aspects could result in such effects, namely: fish and shellfish ecology; marine mammals; ornithology; commercial fisheries; shipping and navigation; and aviation and radar. Each of these technical assessment chapters includes a short section of such potential transboundary effects. The transboundary screening

report has been updated since Scoping and is presented in **Volume A4, Annex 5.7: Transboundary Screening Report** of the DCO Application.

12.5 Cumulative Impact Assessment Summary

12.5.1 Introduction

12.5.1.1 The sections below summarise the cumulative impacts identified for each offshore chapter in the ES. The tables below provide each cumulative impact assessed, a rationale of how cumulative impacts could occur, and the outcome of the assessment. It is important to note that the cumulative impact significance in the sections below relates to the residual significance, taking into account any mitigation that is applied (over and above commitments embedded in the assessment process). All mitigation measures and further detail around the CEA are included in each relevant technical chapter.

12.5.2 Marine Geology, Oceanography and Physical Processes

12.5.2.1 **Table 12.5** provides a summary of the CEA outcomes for marine geology, oceanography and physical processes. All plans and projects with the potential for cumulative impacts identified for marine geology, oceanography and physical processes are presented in **Volume A4, Annex 5.3: Offshore Cumulative Effects** and **Volume A4, Annex 5.4: Location of Offshore Cumulative Schemes**.

Table 12.5: Potential cumulative effects identified for marine geology, oceanography and physical processes.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Temporary increase in Suspended Sediment Concentrations (SSC).	Potential overlap in sediment plumes between spoil disposal at the Bridlington A disposal site (HU015), Scotland England Green Link 2 (SEGL2) cable installation, decommissioning activities related to the Johnston Wellhead Protection Structure (WHPS) and manifold / template, drill arisings from Tolmount production wells, sediment disturbance from the proposed Endurance Carbon Capture and Storage (CCS) site and associated development activity, and Hornsea Four cable trenching activities.	**Not significant**
Operation		
Potential changes to waves affecting coastal morphology	Potential for interaction of array scale blockage effects on wave and flows towards the coast from Hornsea Four with Hornsea Project One, Hornsea Project Two and Hornsea Project Three Offshore Wind Farms and the proposed Endurance CCS site.	**Not significant**

12.5.3 Benthic and Intertidal Ecology

12.5.3.1 **Table 12.6** provides a summary of the CEA outcomes for benthic and intertidal ecology. All plans and projects with the potential for cumulative impacts identified for benthic and intertidal

ecology are identified in Volume A4, Annex 5.3: Offshore Cumulative Effects and Volume A4, Annex 5.4 Location of Offshore Cumulative Schemes.

Table 12.6: Potential cumulative effects identified for benthic and intertidal ecology.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Temporary habitat disturbance	There is potential for cumulative temporary habitat disturbance as a result of construction activities associated with Hornsea Four and other projects. The additive impact has been assessed for projects that fall within a 10 km buffer of the Hornsea Four array area, and 14 km buffer around the offshore Export Cable Corridor (ECC) (representative of the maximum tidal excursion in the area). Tier 1 projects identified are: the operation and maintenance of several projects (Hornsea Project Two, the Viking Link interconnector cable, the Dana Petroleum Platypus pipeline, the Tolmount Platform), export cable laying for Dogger Bank A and B, and decommissioning activities associated with the Johnston WHPS and the Johnston Template/Manifold oil and gas infrastructure. No Tier 2 projects were identified. The operation and maintenance of the Endurance CCS project is considered as a Tier 3 project alongside the construction of the Scotland England Green Link 2 (SEGL2) cable.	**Slight**
Temporary increase in SSC and sediment deposition	There is potential for cumulative SSC and deposition as a result of construction activities associated with Hornsea Four and other projects. The additive impact has been assessed for projects that fall within a 10 km buffer of the Hornsea Four array area, and 14 km buffer around the offshore ECC (representative of the maximum tidal excursion in the area). Tier 1 projects identified are: disposal activities at Bridlington A disposal site, the operation and maintenance of several projects (Hornsea Project Two, the Viking Link interconnector cable, Hornsea Project Two export cables, the Dana Petroleum Platypus pipeline, the Tolmount Platform); export cable laying and maintenance activities associated with Dogger Bank A and B, and decommissioning activities associated with the Johnston WHPS and the Johnston Template/Manifold oil and gas infrastructure. No Tier 2 projects were identified. The operation and maintenance of the Endurance CCS project is considered as a Tier 3 project alongside the construction of the Scotland England Green Link 2 (SEGL2) cable.	**Slight**
Operation and Maintenance		
Direct disturbance to seabed from jack-up vessels and cable maintenance activities	There is potential for cumulative direct disturbance to seabed from jack-up vessels and cable maintenance activities associated with Hornsea Four and other projects. The additive impact has been assessed for projects that fall within 10 km buffer of the Hornsea Four array area and 14 km buffer around the offshore ECC (representative of the maximum tidal excursion in the area). Tier 1 projects identified are the operation and maintenance of several projects (Hornsea Project Two (export cables and array), the	**Not significant**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	Dogger Bank A and B export cables and Viking Link interconnector cable). No Tier 2 projects were identified. The operation and maintenance of the Endurance CCS project is considered as a Tier 3 project alongside the maintenance of the Scotland England Green Link 2 (SEGL2) cable.	
Long-term habitat loss/change from the presence of foundations, scour protection and cable protection	Long term habitat loss may result from the physical presence of foundations, scour protection and cable/pipeline protection, which are assumed to be in place for the lifetime of the relevant offshore wind, cable or pipeline projects and potentially beyond the lifetime of these projects. The additive impact has been assessed for projects that fall within 10 km buffer of the Hornsea Four array area and 14 km buffer around the offshore ECC (representative of the maximum tidal excursion in the area). Tier 1 projects identified are the operation and maintenance of several projects (Hornsea Project Two (export cables and array), the Dogger Bank A and B export cables, Viking Link interconnector cable, the Dana Petroleum pipeline and the Tolmount platform). No Tier 2 projects were identified. The operation and maintenance of the Endurance CCS project is considered as a Tier 3 project alongside the maintenance of the Scotland England Green Link 2 (SEGL2) cable.	**Slight**
Colonisation of the wind turbine generators (WTGs) and scour / cable protection may affect benthic ecology and biodiversity	There is potential for cumulative impacts from colonisation of the WTG foundations and scour / cable protection to affect benthic ecology and biodiversity. The additive impact has been assessed for projects that fall within 10 km buffer of the Hornsea Four array area and 14 km buffer around the offshore ECC (representative of the maximum tidal excursion in the area). Tier 1 projects identified are the operation and maintenance of several projects (Hornsea Project Two (export cables and array), the Dogger Bank A and B export cables, Viking Link interconnector cable, the Dana Petroleum pipeline and the Tolmount platform). No Tier 2 projects were identified. The operation and maintenance of the Endurance CCS project is considered as a Tier 3 project.	**Slight**
Changes to seabed habitats arising from effects on physical processes, including scour effects and changes in the sediment transport and wave regimes resulting in potential effects on benthic ecology	The cumulative presence of offshore structures associated with Hornsea Four and other projects in the region have the potential to introduce changes to the local hydrodynamic and wave regime, resulting in cumulative changes to the sediment transport pathways and associated effects on benthic ecology. The additive impact has been assessed within the representative SSC and deposition impact buffer for Hornsea Four (10 km buffer around the array area and 14 km around the ECC). The only projects identified for this tier are the operation and maintenance of several projects (Hornsea Project Two (export cables and array), the Dogger Bank A and B export cables, Viking Link interconnector cable, the Dana Petroleum pipeline and the Tolmount platform), and decommissioning activities associated with the Johnston WHPS and the Johnston Template/Manifold oil and gas infrastructure. No Tier 2 projects were identified. The operation	**Not significant**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	and maintenance of the Endurance CCS project is considered as a Tier 3 project.	

12.5.4 Fish and Shellfish

12.5.4.1 Table 12.7 provides a summary of the CEA outcomes for fish and shellfish. All plans and projects with the potential for cumulative impacts identified for fish and shellfish are identified in Volume A4, Annex 5.3: Offshore Cumulative Effects and Volume A4, Annex 5.4 Location of Offshore Cumulative Schemes.

Table 12.7: Potential cumulative effects identified for fish and shellfish.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Temporary localised increases in SSC and smothering	There is potential for cumulative increases in SSC and associated sediment deposition as a result of construction activities associated with Hornsea Four and other projects. The additive impact has been assessed for projects that fall within a 10 km buffer of the Hornsea Four array area, and 14 km buffer around the offshore ECC (representative of the maximum tidal excursion in the area). Tier 1 projects identified are: disposal activities at Bridlington A disposal site, the operation and maintenance of several projects (Hornsea Project Two, the Viking Link interconnector cable, Hornsea Project Two export cables, the Dana Petroleum Platypus pipeline, the Tolmount Platform); export cable laying and maintenance activities associated with Dogger Bank A and B, and decommissioning activities associated with the Johnston WHPS and the Johnston Template/Manifold oil and gas infrastructure. No Tier 2 projects were identified. The operation and maintenance of the Endurance CCS project is considered as a Tier 3 project alongside the construction of the Scotland England Green Link 2 (SEGL2) cable.	**Slight**
Mortality, injury, behavioural and auditory masking arising from noise and vibrations	There is potential for cumulative mortality, injury, behavioural changes and auditory masking from noise and vibration as a result of construction activities associated with Hornsea Four and other projects. The additive impact has been assessed for projects that fall within 100 km of Hornsea Four (representative of the maximum extent of impacts from noise). Tier 1 projects scoped in for this impact are the construction of Sofia, Hornsea Three, Dogger Bank A and B, and the decommissioning activities associated with the Johnston WHPS and Johnston template/manifold. Tier 2 projects identified are Dudgeon and Sheringham Shoal Extensions. The operation and maintenance of the Endurance CCS project is considered as a Tier 3 project.	**Slight**
Operation and Maintenance		
Temporary localised increases in SSC and smothering	There is potential for cumulative increases in SSC and associated sediment deposition associated with maintenance activities in Hornsea Four (cable remedial burial and cable repairs) and other operational projects. The additive impact has been assessed for projects that fall	**Slight**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	within a 10 km buffer of the Hornsea Four array area, and 14 km buffer around the offshore ECC (representative of the maximum tidal excursion in the area). Tier 1 projects identified are: disposal activities at Bridlington A disposal site, the operation and maintenance of several projects (Hornsea Project Two (array and export cables), the Viking Link interconnector cable, the Dana Petroleum Platypus pipeline, Dogger Bank A and B export cables and the Tolmount Platform), and decommissioning activities associated with the Johnston WHPS and the Johnston Template/Manifold oil and gas infrastructure. No Tier 2 projects were identified. The operation and maintenance of the Endurance CCS is considered as a Tier 3 project alongside the maintenance of the Scotland England Green Link 2 (SEGL2) cable.	
Long-term loss of habitat due to the presence of turbine foundations, scour protection and cable protection	Cumulative long-term habitat loss is predicted to occur as a result of the presence of Hornsea Four infrastructure. The additive impact has been assessed for projects that fall within a 10 km buffer of the array area and 14 km buffer around the offshore ECC. Tier 1 projects identified are the operation and maintenance of several projects (Hornsea Project Two (array and export cables), the Viking Link interconnector cable, the Dana Petroleum Platypus pipeline, Dogger Bank A and B export cables and the Tolmount Platform). No Tier 2 projects were identified. The operation and maintenance of the Endurance CCS project is considered as a Tier 3 project alongside the maintenance of the Scotland England Green Link 2 (SEGL2) cable.	**Slight**
Increased hard substrate and structural complexity as a result of the introduction of turbine foundations, scour protection and cable protection	The introduction of hard substrate into areas of predominantly soft sediments has the potential to alter fish community composition including potentially acting as fish aggregation devices, thereby resulting in localised redistribution of fish and shellfish populations within offshore wind farms. The additive impact has been assessed for projects that fall within a 10 km buffer of the array area and 14 km buffer around the offshore ECC. Tier 1 projects identified are the operation and maintenance of several projects (Hornsea Project Two (array and export cables), the Viking Link interconnector cable, the Dana Petroleum Platypus pipeline, Dogger Bank A and B export cables and the Tolmount Platform). No Tier 2 projects were identified. The operation and maintenance of the Endurance CCS project is considered as a Tier 3 project alongside the maintenance of the Scotland England Green Link 2 (SEGL2) cable.	**Neutral** (shellfish receptors) **Slight** (herring and sandeel)

12.5.5 Marine Mammals

12.5.5.1 Table 12.8 provides a summary of the CEA outcomes for marine mammals. All plans and projects with the potential for cumulative impacts identified for marine mammals are identified in Volume A4, Annex 5.3: Offshore Cumulative Effects and Volume A4, Annex 5.4 Location of Offshore Cumulative Schemes.

Table 12.8: Potential cumulative effects identified for marine mammals.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Underwater noise from Hornsea Four construction operations alongside other underwater noise generating activities (construction activities including vessel activity, piling operations, Unexploded Ordnance (UXO) clearance and seismic survey activity)	Maximum potential for cumulative effects from underwater noise associated with offshore wind farm construction (e.g. piling and unexploded ordnance clearance) and other noisy activities (e.g. seismic surveys) is considered within the relevant management unit/area for each species. This spatial scale was chosen as a result of the spatial extent of noise related impacts as well as the high mobility of marine mammal receptors. Only projects where the construction periods are expected to overlap with, or occurring the year immediately prior to or after, the construction activity at Hornsea Four have been included.	**Slight** to **Moderate** (harbour porpoise) **Slight** (bottlenose dolphin and grey seal)
Cumulative effect of increased disturbance risk from an increase in vessel activity across construction of Hornsea Four alongside other operations requiring an increase in vessel activity.	Maximum potential for cumulative effects from the increased risk of collision from an increase in vessel activity is considered within the relevant management unit/area for each species. This spatial scale was chosen as a result of the high mobility of marine mammal receptors.	**Slight**

12.5.5.2 In relation to the slight to moderate underwater noise impact predicted for harbour porpoise, it is important to note that the impact was deemed to be slight for projects with high confidence, and moderate for other projects with less confidence. While there is the potential for a moderate impact significance to occur for these lower confidence projects prior to the application of any mitigation measures, it is highly unlikely that these projects would all overlap temporally with Hornsea Four as assumed in the assessment. Additionally, the implementation of management measures at each project, through the Site Integrity Plans for the Southern North Sea Special Area of Conservation, means that the impact would be managed and considerably reduced and is therefore unlikely to be significant.

12.5.6 Offshore and Intertidal Ornithology

12.5.6.1 Table 12.9 provides a summary of the CEA outcomes for offshore and intertidal ornithology. All plans and projects with the potential for cumulative impacts identified for offshore intertidal ornithology are identified in Volume A4, Annex 5.3: Offshore Cumulative Effects and Volume A4, Annex 5.4 Location of Offshore Cumulative Schemes.

Table 12.9: Potential cumulative effects identified for offshore and intertidal ornithology.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Operation and Maintenance		
Cumulative effect of displacement on auk species (guillemot, razorbill and puffin) and gannet	Maximum potential for interactive effects from maintenance activities associated with and the operational effects of the offshore wind farm(s) considered within the UK North Sea and English Channel (where appropriate). This region was chosen as seabirds associated with Hornsea Four are expected to come from	**Slight** (guillemot, razorbill and puffin) **Not significant**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
	or move to other areas within this region, that are also subject to interaction with other projects within this region.	(gannet)
Cumulative effect of collision risk on seabirds (gannet, kittiwake, herring gull, lesser black-backed gull and great black-backed gull)		**Slight** (gannet, kittiwake and great black backed gull) **Not significant** (herring gull and lesser back backed gull)
Combined cumulative operational disturbance and collision risk for gannet		**Slight**
Cumulative effect of collision risk on migratory seabirds		**Not significant**

12.5.7 Commercial Fisheries

12.5.7.1 Table 12.10 provides a summary of the CEA outcomes for commercial fisheries. All plans and projects with the potential for cumulative impacts identified for commercial fisheries are identified in Volume A4, Annex 5.3: Offshore Cumulative Effects and Volume A4, Annex 5.4 Location of Offshore Cumulative Schemes.

Table 12.10: Potential cumulative effects identified for commercial fisheries.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Reduction in access to, or exclusion from established fishing grounds	There is potential for cumulative reduction in access to or exclusion from established fishing grounds as a result of construction activities associated with Hornsea Four and other projects. This additive impact has been assessed within the North Sea, which is considered to be representative of the fishing grounds exploited by the fleets active across Hornsea Four. Projects considered are aggregate extraction and disposal, cable and pipeline projects, offshore wind farms, oil and gas infrastructure, and designated Marine Protected Areas (MPAs).	*Tier 1* **Moderate** (mobile demersal trawling fleets) **Slight** (all other fleets) *Tier 3* **Moderate** (UK potting fleet) **Slight** (all other fleets)
Displacement leading to gear conflict and increased fishing pressure on established fishing grounds	The effect of displacement leading to gear conflict and increased fishing pressure is directly correlated to the previous impact of reduced access to fishing grounds (i.e. if there is no reduction in access, then there will be no displacement). Projects considered are aggregate extraction and disposal, cable and pipeline projects, offshore wind farms, oil and gas infrastructure, and designated MPAs.	**Moderate** (UK potting fleet) **Slight** (all other fleets)

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Operation and Maintenance		
Reduction in access to, or exclusion from established fishing grounds	The cumulative effect during operation and maintenance of projects on reduction in access to or exclusion from fishing grounds is expected to be lower than that presented during construction. Projects considered are aggregate extraction and disposal, cable and pipeline projects, offshore wind farms, oil and gas infrastructure, and designated MPAs.	**Moderate** (mobile demersal trawling fleets) **Slight** (all other fleets)
Displacement leading to gear conflict and increased fishing pressure on established fishing grounds	The effect of displacement leading to gear conflict and increased fishing pressure is directly correlated to the previous impact of reduced access to fishing grounds (i.e. if there is no reduction in access, then there will be no displacement). Projects considered are aggregate extraction and disposal, cable and pipeline projects, offshore wind farms, oil and gas infrastructure, and designated MPAs.	**Slight**

12.5.7.2 In relation to the Tier 1 moderate effects predicted for mobile demersal trawling fleets associated with the reduction in access to, or exclusion from established fishing grounds, the limited activity of demersal trawling fleets across Hornsea Four resulted in slight adverse effects to these metiers for Hornsea Four in isolation; the inclusion of MPAs into the cumulative assessment has led to this moderate adverse assessment for demersal trawling fleets. The effect of the MPAs is unmitigable by the Applicant and this impact would remain significant without the *de minimis* cumulative contribution from Hornsea Four.

12.5.7.3 With respect to the Tier 3 moderate effects predicted for the UK potting fleet in relation to the reduction in access to, or exclusion from established fishing grounds, The activity of the UK potting fleet across Hornsea Four resulted in moderate adverse effects during construction of Hornsea Four in isolation, which, with further mitigation, is reduced to slight adverse**.** The inclusion of these Tier 3 projects into the cumulative assessment has led to a **moderate adverse** cumulative effect for UK potting. This takes account of high uncertainty related to the impact to commercial fisheries and Tier 3 projects, which have not yet been assessed by the Endurance or Scotland England Green Link 2 (SEGL2) Cable projects. The Applicant is committed to ongoing communication and discussion with the Endurance and SEGL2 Cable project developers and the Applicant will seek to collaborate with these projects in order to develop a consistent approach in fisheries liaison, coexistence and mitigation.

12.5.7.4 In relation to the moderate effects predicted for the UK potting fleet associated with construction displacement effects, the inclusion of MPAs into the cumulative assessment led to the moderate adverse assessment for reduced access for demersal trawling fleets, which has then influenced the moderate adverse assessment for displacement of the UK potting fleet. The effect of the MPAs in reduced access and subsequent displacement is unmitigable by the project and this impact would remain significant without the *de minimis* cumulative contribution from Hornsea Four.

12.5.8 Shipping and Navigation

12.5.8.1 Table 12.11 provides a summary of the CEA outcomes for shipping and navigation. All plans and projects with the potential for cumulative impacts identified for shipping and navigation are identified in **Volume A4, Annex 5.3: Offshore Cumulative Effects** and **Volume A4, Annex 5.4 Location of Offshore Cumulative Schemes**.

Table 12.11: Potential cumulative effects identified for shipping and navigation.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Increased encounters and vessel to vessel collision risk	Construction activities associated with the presence of structures within the Hornsea Four array area, offshore ECC and High Voltage Alternating Current (HVAC) booster station search area as well as other offshore developments may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions.	**Slight** (Tier 1 projects) **Neutral** (Tier 2 projects)
Drifting vessel to structure allision risk	Pre-commissioned structures within the Hornsea Four array area as well as other offshore developments will create powered and drifting allision risk for all vessels.	**Slight**
Operation and Maintenance		
Increased encounters and vessel to vessel collision risk	Presence of structures associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area as well as other offshore developments may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions.	**Slight** (Tier 1 projects) **Neutral** (Tier 2 projects)
Drifting vessel to structure allision risk	Operational structures within the Hornsea Four array area as well as other offshore developments will create powered and drifting allision risk for all vessels.	**Slight**
Decommissioning		
Increased encounters and vessel to vessel collision risk	Decommissioning activities associated with the presence of structures within the Hornsea Four array area, offshore ECC and HVAC booster station search area as well as other offshore developments may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions.	**Slight** (Tier 1 projects) **Neutral** (Tier 2 projects)
Drifting vessel to structure allision risk	Decommissioning structures within the Hornsea Four array area as well as other offshore developments will create powered and drifting allision risk for all vessels.	**Not significant**

12.5.9 Aviation and Radar

12.5.9.1 Table 12.12 provides a summary of the CEA outcomes for aviation and radar. All plans and projects with the potential for cumulative impacts identified for aviation and radar are identified in **Volume A4, Annex 5.3: Offshore Cumulative Effects** and **Volume A4, Annex 5.4 Location of Offshore Cumulative Schemes**.

Table 12.12: Potential cumulative effects identified for aviation and radar.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction		
Creation of an aviation obstacle to low flying aircraft operating offshore	Inclusion of other developments will have the potential to create a cumulative aviation obstacle for other users in the same region. The additive impact has been assessed for projects that fall within 40 km of Hornsea Four which include Hornsea Project One and Hornsea Project Two.	**Slight**
Operation and Maintenance		
Wind turbines causing permanent interference on civil and military radar systems	There is potential for cumulative effect as a result of operational activities associated with Hornsea Four and other projects within 100 km of Hornsea Four, which is considered to be the maximum range where aviation and radar cumulative effect may occur due to performance characteristics. These projects include the following offshore wind farms: Westermost Rough, Humber Gateway, Triton Knoll, Dudgeon, Lincs, Teesside, Inner Dowsing, Race Bank, Sheringham Shoal, Lynn and the Dudgeon and Sheringham Shoal extension projects.	**Slight**
Creation of an aviation obstacle to low flying aircraft operating offshore	Inclusion of other developments will have the potential to create a cumulative aviation obstacle for other users in the same region. The additive impact has been assessed for projects that fall within 40 km of Hornsea Four which include Hornsea Project One and Hornsea Project Two.	**Slight**

12.5.10 Marine Archaeology

12.5.10.1 Table 12.13 presents a summary of the CEA outcomes for marine archaeology. All plans and projects with the potential for cumulative impacts identified for marine archaeology are identified in Volume A4, Annex 5.3: Offshore Cumulative Effects and Volume A4, Annex 5.4 Location of Offshore Cumulative Schemes.

Table 12.13: Potential cumulative effects identified for marine archaeology.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Construction and Operation and Maintenance		
Loss or accumulation of sediment	Cumulative sediment changes may result in the loss or accumulation of sediment, thereby altering or destabilising archaeological sites and contexts, including palaeoenvironmental information and exposing such material to natural, chemical or biological processes, and causing or accelerating loss of the same. Maximum additive sediment disturbance is calculated within a representative 50 km buffer of Hornsea Four as this area can be considered to represent the marine archaeology within the Southern North Sea.	**Not significant**

12.5.11 Seascape, Landscape and Visual Resources

12.5.11.1 Impacts on seascape, landscape and visual resources (SLVR) from infrastructure in the array area were scoped out based on PINS Scoping Opinion (PINS, 2018). Consultation in relation to impacts on SLVR from the HVAC booster stations was undertaken with relevant stakeholders (East Riding of Yorkshire Council (ERYC) and Natural England). It has been agreed with these consultees based on the distance of HVAC booster stations from receptors and refined lighting requirements for the HVAC Booster Stations (secured by the HVAC Booster Station Lighting Plan (**Document F2.17**)), that SLVR impacts arising from the HVAC booster stations can also be scoped out. As such, all SLVR impacts have been agreed to be scoped out and no CEA assessment is presented.

12.5.12 Infrastructure and Other Users

12.5.12.1 **Table 12.14** presents a summary of the CEA outcomes for infrastructure and other users. All plans and projects with the potential for cumulative impacts identified for infrastructure and other users are identified in **Volume A4, Annex 5.3: Offshore Cumulative Effects** and **Volume A4, Annex 5.4 Location of Offshore Cumulative Schemes**.

Table 12.14: Potential cumulative effects identified for infrastructure and other users.

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
Operation and Maintenance		
Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary loss of access to existing pipelines and wells for repairs and maintenance.	The proposed Endurance CCS site currently associated with the proposed Net Zero Teeside (NZT) and Zero Carbon Humber (ZCH) onshore projects and the Easington to Endurance CO_2 injection pipeline may result in conflicts with the repair and maintenance of existing oil and gas pipelines and wells within the Hornsea Four array area or the associated 1 km study area.	**Not significant**
Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells.	There is potential for an interaction between Hornsea Four and the proposed Endurance CCS site and associated pipeline. The operation of proposed Endurance CCS site and associated pipeline may result in anchor snagging or dropping on oil and gas assets within the Hornsea Four array area or the associated 1 km study area.	**Not significant**
Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of Hornsea Four infrastructure.	The re-routeing of vessel traffic introduces an allision risk with oil and gas platforms located in proximity to Hornsea Four. Projects considered are Hornsea Project One and Hornsea Project Two.	**Not significant**
Cumulative effect of interference with the performance of the Radar Early Warning System (REWS) located on oil and gas platforms.	The physical presence of wind turbines and associated offshore structures has the potential to interfere with the performance of the REWS. This system is sometimes used by oil and gas operators as an integral part of their anti-collision safety systems for their offshore platforms. Projects considered are Hornsea Project One and Hornsea Project Two.	**Not significant**
The presence of new wind turbines in previously open sea areas will deviate vessels which may cause a	Existing shipping lanes will be altered by the physical presence of Hornsea Four and other projects which may result in vessels being rerouted nearer the platforms	**Not significant**

Potential Impact	Rationale for Cumulative Impact	Cumulative Impact Significance
change in Closest Point of Approach (CPA) and Time to Closest Point to Approach (TCPA) alarms at oil and gas platforms equipped with REWS.	protected by the REWS. This may cause an increase in the CPA/TCPA alarm rates at these platforms. Projects considered are Hornsea Project One and Hornsea Project Two.	
Hornsea Four infrastructure and associated works may restrict or hamper helicopter access to oil and gas platforms.	The offshore project within 10 nm that will contribute to interference with helicopter access to oil and gas platforms near Hornsea Four is Hornsea Project Two. The cumulative increase in aviation obstacles from Hornsea Project Two may impact oil and gas related helicopter operations.	**Not significant**

12.6 Transboundary Impact Assessment Summary

12.6.1 Introduction

12.6.1.1 Transboundary effects are defined as those effects upon the receiving environment of other EEA states, whether occurring from Hornsea Four alone, or cumulatively with other projects in the wider area. A transboundary screening exercise was undertaken at Scoping and updated for the ES (**Volume A4, Annex 5.7: Transboundary Screening Report**) which identified that only certain offshore (marine) technical aspects could result in such effects, namely: fish and shellfish ecology; marine mammals; offshore and intertidal ornithology; commercial fisheries; shipping and navigation; and aviation and radar. Each of these technical assessment chapters includes a short section of such potential transboundary effects with a summary of the transboundary effects provided in the sections below.

12.6.2 Fish and Shellfish

12.6.2.1 A transboundary screening exercise was undertaken at Scoping and updated for the ES (**Volume A4, Annex 5.7: Transboundary Screening Report**) which identified that there was the potential for transboundary effects to occur in relation to fish and shellfish ecology. The potential transboundary impacts screened into the assessment for fish and shellfish ecology were:

- Direct effects as a result of underwater noise from piling operations during the installation of subsea infrastructure; and
- Indirect effects may occur in relation to fish and shellfish habitat or disturbance to habitat due to increased suspended sediment concentrations and deposition from the placement/removal of foundations and cables in or on the seabed.

12.6.2.2 Underwater noise levels expected to elicit behavioural responses in certain fish and shellfish, are predicted to extend to several 10s of kilometres beyond Hornsea Four and therefore have the potential to affect fish and shellfish habitats of the Netherlands, an EEA state (87 km from Hornsea Four) during the construction period. These impacts were predicted to be short term and intermittent, with recovery of fish and shellfish populations to affected areas following completion of all piling activities. Overall, the sensitivity of fish and shellfish receptors to this impact were assessed as low to high (herring) and the magnitude predicted to be minor adverse. The minor magnitude, and maximum sensitivity of high could result in either a slight or moderate effect, however taking into account the short-term and intermittent nature of the impact, and the distance to the nearest EEA state, the expected recovery of the fish and shellfish populations after piling, and the implementation of mitigation to reduce the impacts of underwater noise,

the significance of effect therefore is deemed a maximum of **slight**, which is not significant in EIA terms.

12.6.2.3 Effects of increases in SSC are predicted to occur up to 14 km from Hornsea Four and are therefore not predicted to extend into the waters of other EEA states. Effects on herring and sandeel from all impacts, including habitat loss and disturbance and increases in SSC, were predicted to be **not significant** in EIA terms.

12.6.3 Marine Mammals

12.6.3.1 A transboundary screening exercise was undertaken at Scoping and updated for the ES (**Volume A4, Annex 5.7: Transboundary Screening Report**) which identified that there was the potential for transboundary effects to occur in relation to marine mammals. The potential transboundary impacts screened into the assessment for marine mammals were:

- Underwater noise generated during construction and decommissioning, particularly piling during the installation of foundations; and
- Disturbance to prey (fish) species from loss of fish spawning and nursery habitat and suspended sediments and deposition.

12.6.3.2 Behavioural disturbance resulting from underwater noise during construction could occur over large ranges (tens of kilometres) and therefore there is the potential for transboundary effects to occur where subsea noise arising from Hornsea Four could extend into waters of other EEA states (such as the Netherlands whose marine border is located approximately 87 km from Hornsea Four). For Hornsea Four, these impacts were predicted to be short term and intermittent, with recovery of marine mammal populations to affected areas following completion of all piling activities. Overall, the sensitivity of marine mammal receptors to behavioural disturbance was assessed as **medium** to **low** and the magnitude predicted to be **negligible** to **minor** adverse. The effect was therefore considered to be a maximum of **slight**, which is not considered significant in EIA terms.

12.6.3.3 No significant effects of reduction in prey availability are predicted to extend into the waters of other EEA states (see **Section 12.6.2**). **Chapter 3: Fish and Shellfish Ecology** concluded no significant impacts on all fish species. Therefore, the impact of a reduction in prey ability will not lead to a significant effect.

12.6.4 Offshore and Intertidal Ornithology

12.6.4.1 Transboundary impacts upon ornithological receptors are possible due to the wide foraging and migratory ranges of typical bird species in the North Sea. In addition, a number of bird species that have been recorded during previous surveys include those that are listed as qualifying features of European Sites in other EEA States.

12.6.4.2 The key direct potential impacts and effects for ornithological receptors are predicted to arise during the operation and maintenance phase as a result of potential collisions (with rotating turbine blades which may result in direct mortality of individuals), disturbance and barrier effects (caused by the physical presence of structures which may displace birds or prevent transit of birds between foraging and breeding sites, or on migration, respectively).

12.6.4.3 Protected sites in countries beyond the UK were not considered to have connectivity with Hornsea Four significantly enough to be included in this assessment, though the impacts considered in **Chapter 5: Offshore and Intertidal Ornithology** do consider potential effects on

the UK North Sea and English Channel and biogeographic scales that includes birds from outside of the UK.

12.6.4.4 To inform this EIA, consideration has been given to the consultation responses received between the EIA Scoping Stage and the PEIR Stage. One response was received that raised a potential concern over transboundary impacts on ornithology receptors. This was provided by Rijkswaterstaat (RWS) in the Netherlands and noted that non-UK wind farms in the southern North Sea had not been included in the cumulative assessment. The response also noted that this would require an international cumulative approach, which has not been developed to date. Furthermore, owing to the different approaches to impact assessment adopted by the UK and EU Member States, the Applicant considers that it would be difficult to undertake this international cumulative approach quantitatively.

12.6.4.5 With regards to the potential for transboundary cumulative impacts, there is some limited potential for collisions and displacement at offshore wind farms outside UK territorial waters. However, the operational Offshore Wind Farms (OWFs) in Belgium, the Netherlands and Germany are comparatively small (collectively, these projects are of a similar size to no more than one to two of the more recent UK OWFs, such as East Anglia ONE).

12.6.4.6 Since the spatial scope for a transboundary assessment would be much larger than that considered for Hornsea Four alone or cumulatively with other UK projects, any assessment of potential impacts and effects would be against larger seabird population sizes accounting for a wider Biologically Defined Minimum Population Scale (BDMPS). Therefore, it is apparent that the scale of OWF developments within such a wider context would be relatively much smaller with respect to any potential impacts considered at the UK North Sea and English Channel scale. Therefore, the inclusion of non-UK offshore wind farms is considered very unlikely to alter the conclusions of the existing cumulative assessment, and highly likely to reduce estimated impacts at population levels if calculated at larger spatial scales.

12.6.5 Commercial Fisheries

12.6.5.1 A transboundary screening exercise was undertaken at Scoping and updated for the ES (**Volume A4, Annex 5.7: Transboundary Screening Report**) which identified that there was potential for transboundary effects in to occur in relation to commercial fisheries. The potential transboundary impacts screened into the assessment for commercial fisheries were:

- Effects on commercial fishing fleets as a result of impacts from Hornsea Four on commercial fish stocks in the waters of other EEA States; and
- Effects on commercial fishing fleets from all EEA countries as a result of constraints on foreign commercial fishing activities operating in Hornsea Four, including demersal trawling, beam trawling, demersal seining and other gears. These effects may include reduction in access to fishing grounds and potential displacement of fishing effort from Hornsea Four to alternative fishing grounds in other EEA States, which will have direct implications to that fishing ground.

12.6.5.2 Effects on biological resources could occur over a range of 10s of kilometres from Hornsea Four and could therefore interact with the following EEA states: the Netherlands. Based on the neutral to slight significance of disruption to commercial species during all phases of the project, it is expected that the impact on stocks in the Dutch Exclusive Economic Zone (EEZ) will be **slight**. Therefore, the potential transboundary impact of effects on commercial fish stocks in the waters of other EEA States on commercial fisheries is concluded to be not significant in EIA terms.

12.6.5.3 Effects on commercial fishing fleets could occur over a range of 100s of kilometres from Hornsea Four (i.e. affecting fleets from other states that operate in the vicinity of Hornsea Four) and could therefore interact with the following EEA states: the Netherlands, Germany, Belgium, Denmark, Norway, France and Ireland. Effects on these foreign commercial fishing fleets from EEA states, in terms of reduction in access to fishing grounds and displacement into alternative grounds including other EEZs, have therefore been intrinsically considered throughout the commercial fisheries EIA process and are consistent to those presented in the impact assessment and CEA (within **Chapter 6: Commercial Fisheries**).

12.6.6 Shipping and Navigation

12.6.6.1 It has been identified that transboundary issues could arise from Hornsea Four on commercial shipping routes transiting between the UK and other EEA ports. It is anticipated that the presence of structures associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area as well as other offshore developments may cause vessels to be deviated cumulatively. It is noted that navigational safety impacts associated with increased encounters and increased collision risk, direct consequence of the deviations, have been assessed to be of slight significance (Tier 1) or neutral significance (Tier 2) given the low significance and minor magnitude, with no effect from Tier 3 CEA developments.

12.6.6.2 Although the displacement will occur within a national spatial extent, consultation feedback from both Regular Operators and shipping representative bodies indicates that there is potential for commercial transboundary impacts given the direct consequence of deviation, increased distance and therefore increased journey time and fuel use. No transboundary navigation safety impacts were identified.

12.6.6.3 In summary, none of the deviated main routes have been identified as having a potentially significant impact placed upon them. This is because of a low sensitivity of the receptor incurred by a lack of vulnerability due to relatively small deviations (particularly when considered as a percentage increase on the total route length). It is noted that this lack of vulnerability is a result of the inclusion of the gap between Hornsea Four and Hornsea Project Two. The gap – which represents a 18% reduction in the size of the Hornsea Four array area assessed at PEIR and is excluded from the Hornsea Four Order Limits – limits the extent of some of the deviations, thus allowing operators to maintain scheduled timetables and make berthing slots/arrival times. This in turn ensures that there are no consequences on the customer base of such receptors which could have a potential impact on their business. This is particularly notable for Routes 1, 2, 3, 5 and 13 which include timetabled commercial ferries and therefore would incur a reasonably probable occurrence and moderate ranking for magnitude – however none of these routes require a deviation and so there is no effect.

12.6.6.4 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **moderate**. The effect could be either neutral or slight (which are both not significant in EIA terms), however given that a medium-term change in vessel routeing is required from vessel operators, even if the change is not substantial in nature the transboundary effect is considered to be of **slight** significance, which is not significant in EIA terms.

12.6.7 Aviation and Radar

12.6.7.1 There is the potential for transboundary impacts to arise from the presence of the wind turbines during the operation and maintenance phase disrupting civil and military radar coverage from The Netherlands. The probability of impact (due to radar detectability of the Hornsea Four wind

turbines) is extremely low due to the range of applicable Netherlands radar systems from the Hornsea Four array area and the low likelihood of detection of the Hornsea Four array by Netherlands radar systems.

12.6.7.2 The sensitivity of the receptor is considered to be **low** and the magnitude of the impact is deemed to be **negligible**.

12.6.7.3 Therefore, the potential transboundary effect of disruption of civil and military aviation radar coverage interference on aviation and radar is concluded to be neutral or slight (not significant). It is considered that the transboundary effect will be **neutral** (not significant) as Hornsea Four is likely to be outside of the effective range of Netherlands radar systems.

12.7 References

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