Hornsea Project Four: Environmental Statement (ES)

PINS Document Reference: A2.11
APFP Regulation: 5(2)(a)

Volume A2,
Chapter 11: Infrastructure and Other Users

Prepared	GoBe Consultants Ltd. September 2021
Checked	GoBe Consultants Ltd. September 2021
Accepted	David King, Orsted. September 2021
Approved	Julian Carolan, Orsted. September 2021

Doc. no. A2.11
Version B

Table of Contents

List of Tables

List of Figures

Annexes

Annex	Heading
A5.11.1	Offshore Installation Interfaces

Glossary

Term	Definition
Allision	The act of striking or collision of a moving vessel against a stationary object.
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity, key statistics including location, destination, length, speed and current status, e.g., under power. Most commercial vessels and European Union (EU) fishing vessels over 15 metres (m) length are required to carry AIS.
Commitment	A term used interchangeably with mitigation and enhancement measures. The purpose of Commitments is to reduce and/or eliminate Likely Significant Effects (LSEs), in EIA terms. Primary (Design) or Tertiary (Inherent) are both embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, Preliminary Environmental Information Report (PEIR) or Environmental Statement (ES)). Secondary commitments are incorporated to reduce LSE to environmentally acceptable levels following initial assessment i.e. so that residual effects are acceptable.
Cumulative effects	The combined effect of Hornsea Four in combination with the effects from 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 **Volume A1, Chapter 4: Project Description**. This envelope is used to define Hornsea Four for 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.
Export Cable Corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
Export cables	Cables that transfer power from the offshore substation(s) or the converter station(s) to shore.
Helicopter Main Route (HMR)	HMRs are routes typically and routinely flown by helicopters operating to and from offshore destinations and are promulgated for the purpose of signposting concentrations of helicopter traffic to other airspace users. HMR promulgation does not predicate the flow of helicopter traffic. Whilst HMRs have no airspace status and assume the background airspace classification within which they lie (in the case of the southern North Sea, Class G), they are used by the air navigation service provider and helicopter operators for flight planning and management purposes.

Term	Definition
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
High Voltage Direct Current (HVDC)	High voltage direct current is the bulk transmission of electricity by direct current (DC), whereby the flow of electric charge is in one direction.
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.
HVAC booster station(s)	Offshore HVAC booster station(s) are required in HVAC transmission systems only; they are not required in HVDC transmission systems. If required for Hornsea Four, they would be located entirely offshore.
Instrument Meteorological Conditions (IMC)	Weather conditions which would preclude flight by the Visual Flight Rules, i.e. conditions where the aircraft is in or close to cloud or flying in visibility less than a specified minimum.
Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency (MCA) which provide significant advice relating to the improvement of the safety of shipping and of life at sea, and to prevent or minimise pollution from shipping.
Maximum design scenario (MDS)	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment.
Mean High Water Spring (MHWS)	The height of MHWS is the average throughout the year (when the average maximum declination of the moon is 23.5°) of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
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, PEIR or ES).
National Policy Statement (NPS)	A document setting out national policy against which proposals for NSIPs will be assessed and decided upon.
Offshore accommodation platform(s)	Used to accommodate multiple Operations & Maintenance (O&M) staff for a number of weeks at a time and to allow spares and tools to be stored within the array area.
Offshore substation(s)	One or more offshore substations to convert the power to higher voltages and/or to HVDC and transmit this power to shore.
Orbis Energy Limited	Energy consultant that engaged in pre-application consultation with oil and gas stakeholders for the Applicant.
Orsted Hornsea Project Four Ltd	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Radar Cross Section (RCS)	RCS is the measure of a target's ability to reflect radar signals in the direction of the radar receiver. An object reflects a limited amount of radar energy back to the source. A larger RCS indicates that an object is more easily detected.
Receptor	A component of the natural or man-made environment that is affected by an impact, including people.
Scour protection	Protective materials avoid sediment being eroded away from the base of the offshore foundations as a result of the flow of water.
Sea room	The unfettered space needed to safely operate which has to include space for manoeuvring, space for anchors to clear pathways to stand by and drift off positions and space for additional associated vessels (e.g. tugs and/or anchor handlers).

Term	Definition
Safety Zone	A marine zone demarcated for the purposes of safety around a possibly hazardous installation or works/construction area under the Energy Act 2004 and The Electricity (Offshore Generating Stations) (Safety Zones) (Applications Procedures and Control of Access) Regulations 2007 (SI No 2007/1948). The Petroleum Act 1987 is the UK law which governs offshore oil and gas safety zones. Under this law there are two types of safety zone which can be created, Health and Safety Executive (HSE) Safety Zones for surface installations, and Statutory Instrument (S.I.) safety zones for subsea structures.
The Secretary of State for Business, Energy and Industrial Strategy (BEIS)	The ultimate decision maker with regards to the Hornsea Four application for Development Consent.
Visual Flight Rules (VFR)	The rules governing flight conducted visually i.e. with the crew maintaining separation from obstacles, terrain and other aircraft visually.
Wind turbine generator	All of the components of a wind turbine, including the tower, nacelle, and rotor.
Wind turbine foundation	The wind turbines are attached to the seabed with a foundation structure typically fabricated from steel or concrete.

Acronyms

Acronym	Definition
ACOP	Approved Codes of Practice
AfL	Agreement for Lease
AIS	Automatic Information System
ALARP	As Low As Reasonably Practicable
APOSC	Assessment Principles for Offshore Safety Cases
ARA	Airborne Radar Approach
BEIS	Department for Business, Energy and Industrial Strategy
CAA	Civil Aviation Authority
CAT	Commercial Air Transport
CAP	Civil Aviation Publication
CC	Central Complex
CCS	Carbon Capture Storage
CCUS	Carbon Capture Utilisation and Storage
CDA	Common Data Access
CEA	Cumulative Effect Assessment
CPA	Closest Point of Approach
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
DMRB	Design Manual Roads and Bridges
ECC	Export Cable Corridor
EEA	European Economic Area
EIA	Environmental Impact Assessment
EIEOMP	The East Inshore and East Offshore Marine Plans
ES	Environmental Statement
ESCA	European Subsea Cables Association
FDP	Field Development Plan

Acronym	Definition
GIS	Geographical Information System
HMR	Helicopter Main Route
HSE	Health and Safety Executive
HV	High Voltage
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IMC	Instrument Meteorological Conditions
LAT	Lowest Astronomical Tide
LOS	Line-of-Sight
LSE	Likely Significant Effect
MCA	Maritime and Coastal Agency
MDS	Maximum Design Scenario
Metocean	Meteorological Ocean
MHWS	Mean High Water Spring
MOD	Ministry of Defence
MPI	Multi-Purpose Interconnector
MPS	Marine Policy Statement
MSL	Mean Sea Level
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NRA	Navigational Risk Assessment
NtM	Notice to Mariners
NUI	Normally Unmanned Installations
OGA	Oil and Gas Authority
OGCI	Oil & Gas Climate Initiative
OREI	Offshore Renewable Energy Installations
PBN	Performance Based Navigation
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
PINS	Planning Inspectorate
RCS	Radar Cross Section
REWS	Radar Early Warning System
SAR	Search And Rescue
SECE	Safety and Environmental Critical Elements
SEZ	Structures Exclusion Zone
S.I.	Statutory Instrument
SIMOPS	Simultaneous Operations
SOLAS	Safety of Life at Sea
SoS	Secretary of State
TBC	To Be Confirmed
TCPA	Time to Closest Point to Approach
THLS	Trinity House Lighthouse Services
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
WHPS	Well Head Protection Structure

Acronym	Definition
WTG	Wind Turbine Generators

Units

Unit	Definition
dB	Decibels
°	Degrees
ft	Feet
GT	Gross tons
Hz	Hertz
m	Metre
m^2	Metre squared
Mtpa	Million tons per annum
nm	Nautical mile
kJ	Kilojoule
km	Kilometre
km^2	Kilometre squared

11.1 Introduction

11.1.1.1 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 (please see **Volume A1, Chapter 1: Introduction** for further details on the 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 (please see **Volume A1, Chapter 4: Project Description** for full details on the Project Design).

11.1.1.2 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.

11.1.1.3 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**.

11.1.1.4 This chapter of the ES presents the results of the EIA for the potential impacts of Hornsea Four on infrastructure and other users. The primary focus of this chapter considers the potential impacts of Hornsea Four during its construction, operation and maintenance, and decommissioning phases on infrastructure and other users. This chapter also summarises baseline information and assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**, related to existing offshore oil and gas installations.

11.1.2 Infrastructure and Other Users Assessment Strategy

11.1.2.1 This chapter provides a summary of the potential impacts on infrastructure and other users, with particular focus on existing offshore oil and gas installations in response to those issues raised during consultation with relevant operators. A detailed oil and gas assessment is provided in **Volume A5, Annex 11.1: Offshore Installation Interfaces** which has been supported by the following associated appendices:

- Helicopter Access Report (Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces**);

- Radar Early Warning Technical Report (Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces**);
- Allision Technical Report (Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces**);
- Premier Oil SIMOPS Workshop Report (Appendix D of **Volume A5, Annex 11.1: Offshore Installation Interfaces**); and
- Hornsea Four Oil and Gas Consultations Standalone Report (Appendix E of **Volume A5, Annex 11.1: Offshore Installation Interfaces**).

11.1.2.2 The assessment approach for oil and gas installations has been designed to reflect the recent experiences of offshore wind farm developments in the southern North Sea and the associated issues raised by oil and gas operators. The oil and gas assessment presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces** is based upon the experience gained from previous offshore wind farm DCO Applications and Examinations but is primarily informed by ongoing consultation with the relevant oil and gas operators. The Applicant has made considerable efforts to discuss and agree the approach to the assessment of the potential impacts on oil and gas interests with all relevant operators (see **Table 11.3** for further information).

11.1.2.3 The aim of this ES chapter is, therefore, primarily to provide a comprehensive baseline relating to infrastructure and other users (with particular focus on oil and gas assets and operations) in the vicinity of Hornsea Four, as informed by early consultation with the relevant operators (**Section 11.4**), to identify the potential impacts upon these receptors, to set out the conclusions of the oil and gas assessment, and to assess the potential impacts on other (non-oil and gas) infrastructure and other users. Further details on the potential impacts that are subject to consideration are set out under **Section 11.11** onwards, but in broad terms give consideration to the following:

- Aviation (helicopter access to oil and gas platforms and associated oil and gas vessels);
- Navigation (access to oil and gas vessels and infrastructure, deviations to oil and gas vessels, allision risk, interference with Radar Early Warning Systems (REWS)):
- Future Development (impacts on future seismic surveys, exploratory drilling and developments, where information is available in the public domain or has been provided by the oil and gas operators with a high degree of certainty); and
- Other matters (disruption to oil and gas communications, impacts of piling on oil and gas infrastructure, temporary impact upon access in discrete areas for repairs and maintenance of subsea and surface infrastructure, damage to subsea and surface infrastructure from vessel traffic, restriction of oil and gas decommissioning activities and impacts on Carbon Capture Utilisation and Storage (CCUS) developments).

11.1.2.4 An assessment of the impacts on oil and gas assets as a result of interactions between Hornsea Four and the surrounding offshore oil and gas installations was completed by EPConsult Energies (EPEn) and is detailed in **Volume A5, Annex 11.1: Offshore Installation Interfaces**. EPEn adopted a methodology familiar to the oil and gas industry and were supported by technical specialists, Anatec Limited (in relation to oil and gas helicopter operations, allision and vessel deviation/access to oil and gas assets) and Manchester Advanced Radar Services (in relation to REWS systems). Where appropriate, the assessment undertaken by EPEn has identified additional, potential risk mitigation

and controls to manage the potential impacts of Hornsea Four on each of the operators and assets in the vicinity of the Hornsea Four array, the offshore export cable corridor (ECC) and the High Voltage Alternating Current (HVAC) booster station search area.

11.2 Purpose

11.2.1.1 The primary purpose of the ES is to support the Development Consent Order (DCO) application for Hornsea Four under the Planning Act 2008 (the 2008 Act).

11.2.1.2 The ES has been finalised following completion of pre-application consultation (see **B1.1: Consultation Report** and **Table 11.1**) and will accompany the application to the Planning Inspectorate (PINS) for Development Consent.

11.2.1.3 This ES chapter:

- Summarises the existing environmental baseline established from desk studies and informed by consultation;
- Presents the potential effects on infrastructure and other users arising from Hornsea Four, based on the information gathered;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or mitigation measures which could avoid, prevent, reduce or offset the possible effects identified in the EIA process.

11.3 Policy Context

11.3.1 National Policy Statements

11.3.1.1 Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to infrastructure and other users, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1, Department for Energy and Climate Change (DECC) 2011a) and the NPS for Renewable Energy Infrastructure (EN-3, DECC 2011b).

11.3.1.2 Specifically, the guidance provided within the NPS EN-3 was considered. Paragraphs 2.6.179 to 2.6.181 include guidance on what matters are to be considered in the assessment, with regards to infrastructure and other users. NPS EN-3 also highlights a number of factors relating to the decision-making process and mitigation considerations (paragraphs 2.6.183 to 2.6.188), when applying for a DCO for an offshore wind farm. These are summarised in **Table 11.1** below.

11.3.1.3 NPS EN-3 advises that a pragmatic approach should be employed where a proposed offshore wind farm potentially affects other offshore activity. Where possible steps should be taken to minimise negative impacts and the wind farm should be designed with a view of avoiding or minimising disruption or economic loss. Mitigation measures may be possible to minimise negative impacts on other operations of the infrastructure and other users receptors and these are presented in **Table 11.13**.

Table 11.1: Summary of NPS EN-3 provisions and policy on decision making relevant to infrastructure and other users and where considered in this chapter.

Summary of NPS EN-3 provisions and policy	How and where considered in the ES
Paragraph 2.6.179 notes that *"applicants should undertake an assessment of the potential effect of the proposed development on existing or permitted offshore infrastructure or activities."*	**Section 11.11** considers the potential effects on existing or proposed offshore infrastructure (with the scope of the assessment focusing on offshore infrastructure and operations in line with the Secretary of State's (SoS) Scoping Opinion) and provided an assessment of their likely significance, considering each phase of the development process.
Paragraphs 2.6.180 – 2.6.181 note that *"applicants should engage with interested parties in the potentially affected offshore sector early in the development phase of the proposed offshore wind farm, with an aim to resolve as many issues as possible prior to the submission of an application. Such stakeholder engagement should continue throughout the life of the development."*	Consultation with potentially affected stakeholders has been carried out from the early stages of the project and throughout the pre-application consultation process. Details of the consultation are summarised in **Section 11.4**.
Paragraph 2.6.182 and 2.6.183 notes that *"there are statutory requirements concerning automatic establishment of navigational safety zones relating to offshore petroleum developments and that, where a proposed offshore wind farm potentially affects other offshore infrastructure or activity, a pragmatic approach should be employed; the Applicant should be expected to minimise negative impacts and reduce risks to as low as reasonably practicable."*	Hornsea Four has been sited to minimise disruption to other offshore infrastructure or activities, where possible. In cases where potential disruption has been identified, the Applicant has, in consultation with relevant operators and where appropriate and feasible, provided mitigation measures to reduce or negate impacts. This is discussed further within **Section 11.11**. Further information is provided in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**. Additionally, designed in mitigation and controls are set out in **Section 11.8.2**.
Paragraph 2.6.184 notes that *"applicants should ensure site selection and site design of the proposed offshore wind farm has been made with a view to avoiding or minimising disruption or economic loss or any adverse effect on safety to other offshore industries (applications that pose unacceptable risks to safety after mitigation measures have been considered should not be consented)."*	Hornsea Four has been sited to minimise disruption, as far as possible, to other offshore industries. In cases where potential disruption has been identified, the Applicant has, in consultation with relevant operators, and where appropriate and feasible, provided appropriate controls to minimise disruption or economic loss of any adverse effects on safety. Further information is provided in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**. Additionally, designed in mitigation and controls are set out in **Section 11.8.2**.
Paragraph 2.6.185 notes that *"where a proposed development is likely to affect the future viability or safety of an existing or approved/licensed offshore infrastructure or activity, these adverse effects should be given substantial weight in the decision-making process."*	The approach to developing the assessment presented in **Section 11.11** is set out in **Section 11.10**; with designed in mitigation and controls set out in **Section 11.8.2**. The assessment provided in **Section 11.11** presents the conclusions of a specific and detailed safety case assessment, where conclusions were identified as predominately 'broadly acceptable'. The assessment also demonstrates that there will be no significant effects on viability or safety associated with consultee assets following the implementation of mitigation.

Summary of NPS EN-3 provisions and policy	How and where considered in the ES
Paragraph 2.6.186 notes that *"where schemes have been carefully designed and the necessary consultation has been undertaken at an early stage, mitigation measures may be found that can negate or reduce effects on other offshore infrastructure or operations to a level sufficient to enable the Secretary of State to grant consent."*	Hornsea Four has been sited to minimise disruption, as far as possible, to other offshore industries. In cases where potential disruption has been identified, the Applicant has, in consultation with relevant operators, and where appropriate and feasible, provided appropriate controls to minimise disruption or economic loss of any adverse effects on safety. Further information is provided in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**. Additionally, designed in mitigation and controls are set out in **Section 11.8.2**.
Paragraph 2.6.187 notes in relation to mitigation that *"detailed discussions between the applicant and the relevant consultees should have progressed as far as reasonably possible prior to the submission of an application. As such, appropriate mitigation should be included in any application and ideally agreed between relevant parties."*	Hornsea Four has been sited to minimise disruption, as far as possible, to other offshore industries. In cases where potential disruption has been identified, the Applicant has, in consultation with relevant operators, and where appropriate and feasible, provided appropriate controls to minimise disruption or economic loss of any adverse effects on safety. Further information is provided in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**. Additionally, designed in mitigation and controls are set out in **Section 11.8.2**. Details of the consultation are summarised in **Section 11.4**, with further information on the project consultation process presented within **Volume A1, Chapter 6: Consultation**.
Paragraph 2.6.188 notes that *"in some circumstances, the Infrastructure Planning Commission [hereafter the Secretary of State (SoS)] may wish to consider the potential to use requirements involving arbitration as a means of resolving how adverse impacts on other commercial activities will be addressed."*	Hornsea Four has been sited to minimise disruption, as far as possible, to other offshore industries. In cases where potential disruption has been identified, the Applicant has, in consultation with relevant operators, and where appropriate and feasible, provided appropriate controls to minimise disruption or economic loss of any adverse effects on safety. Further information is provided in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**. Details of the consultation are summarised in **Section 11.4**.

11.3.2 Other Relevant Policies

11.3.2.1 The Marine Policy Statement (MPS) notes that a secure, sustainable and affordable supply of energy is of central importance to the economic and social wellbeing of the UK. This contribution includes the oil and gas sector, which supply a major part of current energy needs, and a growing contribution from renewable energy and from other forms of low carbon energy supply in response to the challenges of tackling climate change and energy security (MPS 2011).

11.3.2.2 The infrastructure and other users' assessment has also given consideration to the specific policies set out in the East Inshore and East Offshore Marine Plans (EIEOMP) (Department for Environment, Food and Rural Affairs (DEFRA) 2014). Key provisions are set out in **Table 11.2** along with details as to how these have been assessed within the assessment.

Table 11.2: EIEOMP polices of relevance.

Policy	Key provisions	How and where considered in the ES
Oil and Gas Policy OG1	*"Proposals within areas with existing oil and gas production should not be authorised except where compatibility with oil and gas production and infrastructure can be satisfactorily demonstrated"*	This is considered in the assessment of effect on the oil and gas production in **Section 11.11**. Consultation with oil and gas operators is included in **Section 11.4.**
Carbon Capture and Storage Policy (CCS1)	*" Within defined areas of potential carbon dioxide storage proposals should demonstrate in order of preference:* *a) That they will not prevent carbon storage;* *b) How, if there are adverse impacts on carbon dioxide storage, they will minimise them;* *c) How if the adverse impacts cannot be minimised, they will be mitigated; and* d) *The case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts."*	The potential effect of Hornsea Four on Carbon Capture and Storage (CCS) is assessed in **Section 11.11**.
Cabling Policy (CAB1)	*"Preference should be given to proposals for cable installation where the method of installation is burial. Where burial is not achievable, decisions should take account of protection measures for the cable that may be proposed by the applicant."*	As detailed in **Section 11.9**, Hornsea Four cables will be buried below the seabed wherever possible. Cable protection will be required at cable crossings, as well as areas where cable burial is not possible. As detailed in **Table 11.13** crossing and proximity agreements with known existing pipeline and cable operators will be sought (Co107). This will ensure access for cable or pipeline repair and maintenance, and as such has not been considered further in the ES assessment.

11.3.3 Policy and Guidance related to infrastructure and other users

11.3.3.1 In addition to the NPSs and Marine Plans, there is a variety of other policy and guidance documents which are relevant to the consideration of impacts on infrastructure and other users, including subsea cables, CCS and the oil and gas industry. The following list provides the relevant policies and guidance, including those detailed in **Volume A5, Annex 11.1: Offshore Installation Interfaces**, which has been given further consideration in completing the infrastructure and other users assessment for the ES:

- Assessment Principles for Offshore Safety Cases [APOSC];

- Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015 and associated guidance document L154;
- Offshore Installations and Wells (Design and Construction etc.) Regulations 1996;
- Pipeline Safety Regulations 1996, in particular Regulations 5-17, 18-24, Schedules 2-5 and associated Guidance Document L82;
- Provision and Use of Work Equipment Regulations 1998, in particular Regulations 4, 5 and 12;
- Maritime and Coastal Agency (MCA) - Methodology for assessing the marine navigational safety & emergency response risks of offshore renewable energy installations (OREI), April 2021;
- European Subsea Cables Association (ESCA) (2016). ESCA Guideline No.6 The Proximity of Offshore Renewable Energy Installations & Submarine Cable Infrastructure in UK Waters;
- HM Government (2017). The Clean Growth Strategy Leading the way to a low carbon future.
- Offshore Installations (prevention of Fire and Explosion, and Emergency Response) Regulations 1995) and associated Approved Codes of Practice (ACOP) and Guidance Document L65;
- The Diving at Work Regulations 1997; and
- Safety of Life at Sea (SOLAS) Chapter IX, 'Management for the Safe Operation of Ships' 1998. The ISM Code provides an international standard for the safe management and operation of ships and for pollution prevention.

11.4 Consultation

11.4.1.1 Consultation is a key part of the DCO pre-application process. Consultation regarding the potential impacts of Hornsea Four on infrastructure and other users with relevant stakeholders has been conducted through the EIA scoping process (Orsted 2018), through the formal Section 42 and Section 47 consultation process, informed by the production of the PEIR, and through informal consultation meetings with relevant stakeholders and operators. An overview of the project consultation process is presented within **Volume A1, Chapter 6: Consultation**.

11.4.1.2 Specifically, Orbis Energy Limited (hereafter Orbis) were engaged by the Applicant to undertake pre-PEIR informal consultation with relevant oil and gas operators to identify, amongst other things, the current and proposed infrastructure and activities in the vicinity of Hornsea Four. It should be noted that this informal consultation was undertaken using the broader Hornsea Four AfL (846 km^2) (i.e. a larger project development area than is now being considered in this ES (Hornsea Four array area = 468 km^2)).

11.4.1.3 The informal consultation completed by Orbis was conducted in two phases:

- An initial questionnaire was sent to relevant oil and gas operators in order to gather relevant information concerning assets, current activities, proposed activities, access requirements and aviation requirement; and
- Following analysis of the responses to the questionnaires, initial consultation meetings were undertaken with relevant oil and gas operators.

11.4.1.4 Since the production of the PEIR and completion of the formal, statutory pre-application consultations, further extensive consultation has been undertaken by the Applicant regarding infrastructure and other users, with direct liaison with relevant oil and gas, subsea cable and CCS operators and developers.

11.4.1.5 A summary of the key issues raised during all stages of Hornsea Four consultation, specific to infrastructure and other users is outlined below in **Table 11.3**, together with how the issues raised have been considered in the production of this ES.

Table 11.3: Consultation responses and engagement with relevant stakeholders and operators for infrastructure and other users.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
Harbour Energy (formerly Premier Oil & Chrysaor) Chrysaor (previously Conoco-Phillips)	Meetings, workshops, calls, letters and email exchanges held between December 2018 and the point of application. Meetings, calls, questionnaire response and email exchanges held between December 2018 and May 2020 until merger of Premier Oil and Chrysaor into Harbour Energy.	• Navigation hazards workshop. • Meeting regarding Tolmount plans. • Call to discuss Section 42 response. • Meeting regarding Johnston and Tolmount. • SIMOPs workshop regarding Johnston. • Letter to Premier setting out Hornsea Four position. • Premier requested helicopter report. • Premier email regarding marine issues. • Call to discuss Johnston access, 32nd round licences and Tolmount. • Orsted provided update on DCO submission date. • Orsted provided map of interface between Hornsea Four and Premier 32nd round licences. • Meeting to discuss High Voltage (HV) cables. • Premier requested further information regarding HV cables, helicopter access and 32nd round licences • Helicopter workshop • Orsted provided HV cable info • Premier provide details regarding helicopters and crossings • Orsted provided helicopter report and platform data • Email advising of change to DCO submission date • Update call regarding technical matters • Email informing of Hornsea Four offshore geophysical survey • Engagement regarding geophysical survey	Harbour Energy (formerly Premier Oil) assets are considered in the baseline in **Section 11.7.1**. With the suggested embedded mitigation detailed in **Section 11.8.2**, the Applicant will ensure access for pipeline repair and maintenance as such this potential issue is not considered further. This is discussed in **Section 11.8**. The Applicant will discuss the coexistence of Hornsea Four with Johnston subsea infrastructure and the potential plans for decommissioning and how this might best be achieved with Harbour Energy. Potential impact of piling on oil and gas assets are considered in **Section 11.11.4**. Potential impact of Hornsea Four infrastructure during construction and operation on drilling activities is described in **Section 11.11.6**. The potential impacts on vessel and helicopter access are described in **Section 0** and **11.11.10** respectively.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		• Harbour query regarding DCO timing • Harbour technical update • Update meeting regarding Johnston and Tolmount	Potential impact of Hornsea Four infrastructure during construction and operation on seismic survey and drilling activities are described in Section 11.11.6 and Section.11.11.11. The cumulative effects assessment is considered in Section 11.12.2. With the embedded mitigation detailed in Section 11.8.2, the Applicant will ensure appropriate agreements are put in place for crossings and ensure access for pipeline repair and maintenance as such this potential issue is not considered further. This is discussed in Section 11.8.
Gassco	Meetings, workshops, calls, letters and email exchanges held between December 2018 and the point of application.	• Call to discuss Section 42 response • Letter of No Objection completed • Email advising of change to DCO submission date • Email informing of Hornsea Four offshore geophysical survey • Call to discuss geophysical survey	Gassco assets and planned activity are considered in the baseline detailed in Section 11.7.1. With the embedded mitigation detailed in Section 11.8.2, the Applicant will ensure access for pipeline repair and maintenance as such this potential issue is not considered further. This is discussed in Section 11.8.
Shell U.K. Limited (Shell)	Meetings, workshops, calls, letters and email exchanges held between January 2019 and the point of application.	• Call to discuss Section 42 response • Call to discuss potential of shipping structures exclusion zone (SEZ) • Confirmed adoption of SEZ • General agreement of contents of Side Agreement • Shell awaiting comments from SEAL owners • Email advising of change to DCO submission date • Email informing of Hornsea Four offshore geophysical survey • Feedback from SEAL owners	Shell's assets are considered in the baseline detailed in Section 11.7.1. With the embedded mitigation detailed in Section 11.8.2, the Applicant will ensure access for pipeline repair and maintenance as such this potential issue is not considered further. This is discussed in Section 11.8.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		• Orsted sent Execution copy of side agreement. Delay due to change in owner (merger of Premier and Chrysaor)	
Perenco UK Limited (Perenco)	Meetings, workshops, calls, letters and email exchanges held between February 2019 and the point of application.	• Initial Consultation meeting in Norwich • Navigation Hazards Workshop • Helicopter workshop to discuss assessments and methodology for understanding risks and mitigations. • Helicopter report meeting • Call to discuss communication links • Allision risk workshop (with Perenco and Alpha) • Hazard workshop for shipping SEZ • Call to discuss helicopter matters • Meeting with Perenco and helicopter operator • Orsted seeking consent regarding use of Allision Report information • Orsted querying regarding Automatic Information System (AIS) and REWS tracker • Orsted provided Helicopter Report • Orsted introducing new Commercial Manager • Orsted suggested workshop dates and requested details of Perenco's other concerns • Email informing of Hornsea Four geophysical survey • Hornsea Four workshop to discuss aviation, microwave link, pipeline crossings, allision • Email requesting Perenco feedback on minutes and a further meeting on specific area of concern • Perenco responded they would chase up internally and requested additional Radar Cross Section (RCS) report • Orsted provided RCS report	Perenco's assets are considered in the baseline in **Section 11.7.1**. The potential impacts on vessel and helicopter access are described in **Section 0** and **11.11.10** respectively. Helicopter access requirements of Perenco are detailed in **Section 11.7.1** with potential impacts on aviation receptors detailed in **Section 11.11.10**. Further information of aviation impact is detailed in **Chapter 8: Aviation and Radar.** The potential impacts on vessel access, main route deviations, impacts on Closest Point of Approach (CPA) and Time to Closest Point to Approach (TCPA) alarms are described in **Section 0**. With the embedded mitigation detailed in **Section 11.8.2**, the Applicant will ensure access for pipeline repair and maintenance as such this potential issue is not considered further. This is discussed in **Section 11.8**. The potential impacts of interference to microwave link communication are described in **Section 11.11.12**. The Applicant is regularly engaging with Perenco to ensure the issues are addressed appropriately.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
RockRose (formerly Speedwell)	Meetings, workshops, calls, letters and email exchanges held between March 2019 and the point of application.	• Initial consultation meeting. • Confirmed sale from Speedwell to RockRose • Introductory call with RockRose • Call to discuss potential routing of pipelines • Orsted advised of revised DCO submission date • Email advising of change to DCO submission date • Email informing of Hornsea Four offshore geophysical survey • RockRose informed of relinquishment of the licence	RockRose (formerly Speedwell) assets are considered in the baseline in Section 11.7.1.
Dana Petroleum	Meetings, workshops, calls, letters and email exchanges held between March 2019 and the point of application.	• Email from Dana regarding access requirements, aviation queries and future activities • Consultation meeting • Call to update on PEIR and Section 42 from Orsted and project updates from Dana. Also discussed commercial matters • Call regarding Dana future activities • Dana returned signed Letter of No Objection • Dana confirmed the Platypus crossing could be referenced in the DCO submission • Email to Dana regarding 32nd licensing round • Workshop to share updates • Joint Dana/ Premier meeting regarding 32nd licensing round • Orsted advising Dana of revised DCO submission date • Dana informed they are withdrawing from the Platypus licence • Call to update on Platypus and other projects • Email informing of Hornsea Four offshore geophysical survey • Dana provided additional 32nd licence round information • Orsted provided updated map of Hornsea Four/ Dana overlap/proximity	Dana Petroleum assets are considered in the baseline in Section 11.7.1. With the embedded mitigation detailed in Section 11.8.2, the Applicant will ensure access for pipeline repair and maintenance as such this potential issue is not considered further. This is discussed in Section 11.8. Potential impact of piling on oil and gas assets are considered in Section 11.11.4.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
Alpha Petroleum	Meetings, workshops, calls, letters and email exchanges held between April 2019 and the point of application.	• Initial Consultation Workshop • Hazard workshop with Alpha in attendance • Alpha provided platform information to Orsted • Aviation workshop • Helicopter workshop with Perenco and Alpha • Allision workshop with Perenco and Alpha • Hazard workshop regarding SEZ with Alpha in attendance • Letter to Alpha regarding technical and commercial matters • Alpha response regarding helicopter, allision and commercial matters • Orsted requested permission to include data in allision report for DCO application • Orsted advised of revised DCO submission date • Alpha agreed for key points to be included in DCO application • Allision workshop, also discussed helicopter, pipeline and microwave link • Orsted provided Allision, Helicopter Report and platform data • Commercial Manager introductory meeting and Alpha update • Email informing of Hornsea Four offshore geophysical survey • Alpha technical and commercial update meeting • Call to discuss DCO process and commercial considerations • Allision report and Letter of Comfort draft sent to Alpha • Call to discuss Letter of Comfort and commercial matters • Signed Letter of No Objection received	Alpha Petroleum's assets are considered in the baseline in Section 11.7.1. With the embedded mitigation detailed in Section 11.8.2, the Applicant will ensure access for pipeline repair and maintenance as such this potential issue is not considered further. This is discussed in Section 11.8. Potential impacts arising from aviation access to oil and gas platforms and vessels are described in Section 11.11.10.
NEO Energy (formerly Spirit Energy)	Meetings, workshops, calls, letters and email exchanges held between	• Meeting regarding helicopter matters • Data provided by Orsted • Call regarding REWS and helicopter matters • SEZ workshop with NEO in attendance	NEO Energy (formerly Spirit Energy)'s assets are considered in the baseline in Section 11.7.1. Helicopter access requirements of NEO Energy (formerly Spirit

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
	May 2019 and the point of application.	• Call regarding allision and helicopter matters • Orsted provided update on DCO submission date • Email seeking consent to include wording regarding NEO in DCO application • Helicopter and Allision workshop • Provided Helicopter report to NEO • Email advising of change to DCO submission date • NEO provided helicopter Briefing note • Email informing of Hornsea Four offshore geophysical survey • Email from NEO covering helicopter technical matters • Call to discuss helicopter matters • Call to discuss DCO application and commercial considerations • NEO email regarding Babbage/Hornsea Four maps • Providing final technical reports to NEO and further maps as requested	Energy) are detailed in Section 11.7.1 with potential impacts on aviation receptors detailed in Section 11.11.10. The potential impacts on vessel access, main route deviations, impacts on Closest Point of Approach (CPA) and Time to Closest Point to Approach (TCPA) alarms are described in Section 0. With the embedded mitigation detailed in Section 11.8.2, the Applicant will ensure access for pipeline repair and maintenance as such this potential issue is not considered further. This is discussed in Section 11.8. Potential impact of Hornsea Four infrastructure during construction and operation on seismic survey and drilling activities are described in Section 11.11.6 and Section 11.11.11
Northern Endurance Partnership (NEP)	Meetings, workshops, calls, letters and email exchanges held between October 2019 and the point of application.	The Applicant has engaged in extensive informal consultation with BP and National Grid Electricity Transmission (NGET), representing the Northern Endurance Partnership (NEP), Net Zero Teesside (NZT) and Zero Carbon Humber (ZCH), in relation to the development of the Endurance CCS Site. Discussions relating to co-existence between Hornsea Four and the development of a Carbon Capture and Storage project, which uses the Endurance aquifer as a CO_2 store, have been ongoing since 2013, with over 20 meetings and workshops held between April 2019 to September 2021. Discussions regarding the use of overlapping seabed and the technical considerations for infrastructure, monitoring, pipeline crossing, brine release, and access requirements remain ongoing. Due to the commercial	Endurance CCS CO_2 store is considered in the baseline in Section 11.7.1. The potential impacts on the site are described in Section 11.11.3, Section 11.11.7 and Section 11.11.13.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		sensitivity of these discussions, the specifics of these discussions remain confidential. Informal consultation to date on co-existence has consisted of phone calls, emails, face-to-face meetings and workshops. Key points from all of the consultation to date has been captured on a central database which is not being shared in this report due to the confidential nature of discussions.	
National Grid Viking Link	Meetings, workshops, calls, letters and email exchanges held between March 2019 and the point of application	• Email seeking engagement • Meeting with Viking Link • Email notifying of potential SEZ • PEIR Shapefile provided • NGET seeking more detail/information • Email regarding dates for Hazard Workshop • Provided information from Hazard Workshop • Provided update regarding SEZ adoption • Follow up call regarding SEZ and updated Red Line Boundary • Follow up email confirming change of Red Line Boundary • NGET shared headline issue regarding Gap • Orsted advising of extension to DCO submission • NGET agreeable to Allision workshop • Workshop regarding Allision and Anchorage • Orsted advised of revised DCO date • Orsted seeking Viking Cable Burial Risk Assessment • Comprehensive technical note shared	Viking Link's assets are considered in the baseline in **Section 11.7.1**. With the embedded mitigation detailed in **Section 11.8.2**, the Applicant will ensure access for cable repair and maintenance as such this potential issue is not considered further. This is discussed in **Section 11.8.** A safety case undertaken for the gap between Hornsea Four and Hornsea Project Two (see Section 19.3 of **Volume A5, Annex 7.1: Navigational Risk Assessment**)
Dogger Bank	Meetings, workshops, calls, letters and email exchanges held between March 2019 and the point of application.	• Initial consultation meeting to discuss Hornsea Four and Dogger Bank interactions. • Meeting to discuss Onshore and Offshore Crossings • Orsted advising of revised submission date	Dogger Bank A and B Wind Farm's assets are considered in the baseline in **Section 11.7.1.** With the embedded mitigation detailed in **Section 11.8.2**, the Applicant will ensure access for cable repair and maintenance as such this potential issue is not considered further. This is discussed in **Section 11.8**.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
NGET Scotland England Green Link 2 (NGET SEGL2)	Meetings, workshops, calls, letters and email exchanges held between August 2020 and the point of application.	• Introductory meeting • Orsted update regarding DCO submission date • Regular update meeting • Orsted providing Notice to Mariners • Orsted requesting Survey Vessel information • Orsted requesting a shapefile of Scotland England Green Link 2 (SEGL2) High Voltage Direct Current (HVDC) route • Joint project update meeting • NGET provided extract of project description • Joint project update meeting, onshore route provided • Joint Project update call to discuss fisheries	SEGL2's asset and planned activity are considered in the baseline detailed in Section 11.7.1. With the embedded mitigation detailed in Section 11.8.2, the Applicant will ensure access for cable repair and maintenance as such this potential issue is not considered further. This is discussed in Section 11.8.
NGET Continental Link	Meetings, workshops, calls, letters and email exchanges held between September 2020 and the point of application.	• Introductory meeting • NGET letter seeking to explore collaboration • Collaboration Meeting • Joint project update meeting • Orsted Development Project Director Call with Continental Link regarding collaboration • Continental Link providing collaboration ideas • Joint collaboration meeting with respective directors supporting	Continental Link's asset and planned activity are considered in the baseline detailed in Section 11.7.1. With the embedded mitigation detailed in Section 11.8.2, the Applicant will ensure access for cable repair and maintenance as such this potential issue is not considered further. This is discussed in Section 11.8.
Bridge Petroleum	Meetings, workshops, calls, letters and email exchanges held between January 2019 and the point of application.	• Plans for future development in the area • Access and aviation queries • Email advising of change to DCO submission date • Email informing of Hornsea Four offshore geophysical survey • Call to discuss Bridge's plans and commercial arrangements • Email of consenting timeline and commercial considerations • Orsted provided shapefiles of Hornsea Four array	Bridge Petroleum assets and planned activity are considered in the baseline detailed in Section 11.7.1.
Painted Wolf Resources (formerly Actis Oil & Gas)	Meeting and email exchanges held between	• Introduction meeting • Call regarding agreements • Information regarding 32nd Licencing round	Painted Wolf Resources assets are not considered in this ES.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
	December 2018 and the point of application.	• Orsted issued draft Letter of No Objection • Email advising of change to DCO submission date • Call to discuss commercial considerations • Signed Letter of No Objection	
Deltic Energy (formerly Cluff Natural Resources)	Email exchanges held between January 2019 and the point of application.	• Confirmation of no objection to the scheme • Letter of No Objection signed	Deltic Energy's licence blocks are a considerable distance from Hornsea Four and are not operational. Deltic Energy assets not considered in this ES.
Cornerstone Oil & Gas	Meeting and email exchanges held between October 2020 and the point of application.	• Intro meeting following 32nd licence round award • Call to discuss Letter of No Objection • Email advising of change to DCO submission date • Signed Letter of No Objection received	Cornerstone Oil & Gas assets not considered in this ES.

11.5 Study Area

11.5.1.1 The infrastructure and other users study area for Hornsea Four includes the Hornsea Four array area, the offshore ECC and the HVAC booster station search area. The study areas consist of several buffers depending upon the potential impact and/or receptor being considered. It should be noted that the study areas defined in this Chapter are linked to those described in **Volume A5, Annex 11.1: Offshore Installation Interfaces**, however the nomenclature has changed from Tier 1, 2 and 3 to Study Area 1, 2 and 3. **Figure 11.1** below provides an overview of the corresponding **Volume A5, Annex 11.1: Offshore Installation Interfaces** and the associated appendices. Information as to how the receptors have been assessed is provided in the bullet point list below. The cumulative effects assessment (CEA) study area is based on the extent of the Order Limits plus any relevant safety zones and additional safety distances (see **Volume A4, Annex 5.3 Offshore Cumulative Effects**). The following study areas defined below, have been applied and are shown in **Figure 11.2**:

- Study Area 1: Other users: Encompasses the Order Limits for Hornsea Four array area, ECC and HVAC booster station search area as detailed in **Volume A5, Annex 11.1: Offshore Installation Interfaces**. However, in this chapter a 1 km buffer has been included around the Hornsea Four array area and ECC Order Limits which allows for the identification of infrastructure and other users receptors which may have a physical overlap with Hornsea Four. The buffer is based upon 500 m safety zones which are typically implemented around, for example, active CCUS and oil and gas infrastructure and a potential 500 m around Hornsea Four infrastructure under construction and during certain periods of maintenance. This Study Area has

been used to identify subsea cables, oil and gas licence blocks, subsea infrastructure, survey activity and offshore platforms;

- Study Area 2: Aviation and Vessel Access: A consultation zone with a radius of 9 nm (16.67 km) exists around offshore helicopter destinations (e.g. oil and gas installations) as suggested by the Civil Aviation Authority (CAA) (CAA 2016). This consultation zone does not represent an area within which the development of Hornsea Four cannot occur but rather is intended as a trigger for consultation with offshore helicopter operators, the operators of existing installations and the holders of oil and gas exploration and development licences to help to ensure safe offshore helicopter operations. A 10 nm (18.52 km) buffer has been applied around Hornsea Four array area and the HVAC booster station area of search, to inform consultation in relation to the safety of helicopter operations. This buffer is not applicable to the ECC where infrastructure with the potential to affect the safety of helicopter operations (i.e. wind turbine generators (WTG)) will not be installed. Moreover, as stated in **Chapter 8: Aviation and Radar**, stationary offshore infrastructure associated with Hornsea Four including accommodation platforms and substations (e.g. HVAC booster stations) do not pose any issue to radar systems as radar processing techniques remove stationary objects from the radar display; and
- Study Area 3: An area which is beyond the 10 nm of Study Area 2 (which surrounds the array area and the HVAC booster station search area) as detailed in the **Volume A5, Annex 11.1: Offshore Installation Interfaces**. Within this study area of beyond 10 nm is the 30 km maximum range of the REWS located on oil and gas platforms and CPA alarms as provided within Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report). The impact of offshore wind farms on REWS may arise from a number of factors such as high radar returns from the turbines and associated offshore structures, increased number of detections and false alarm/track generation.

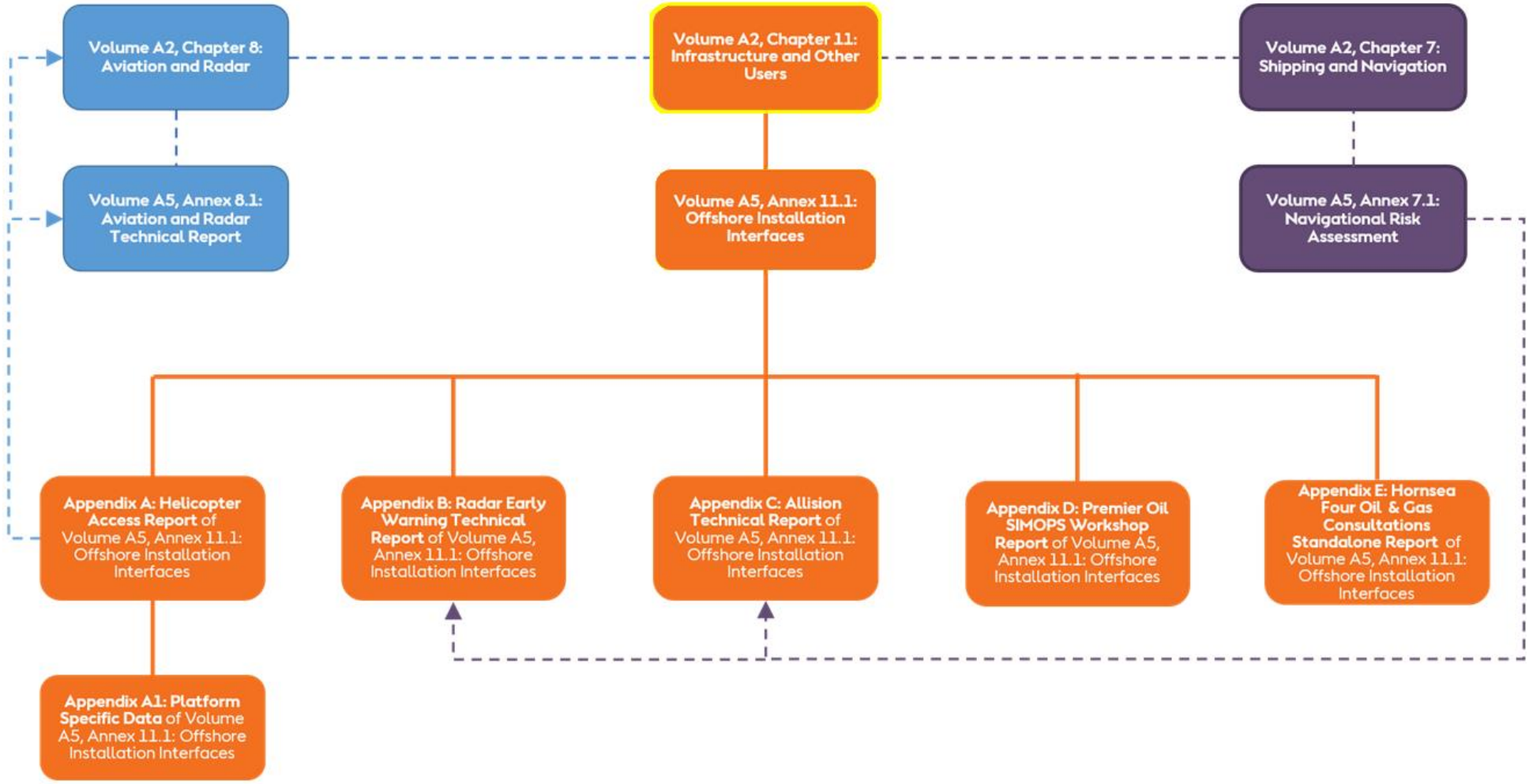
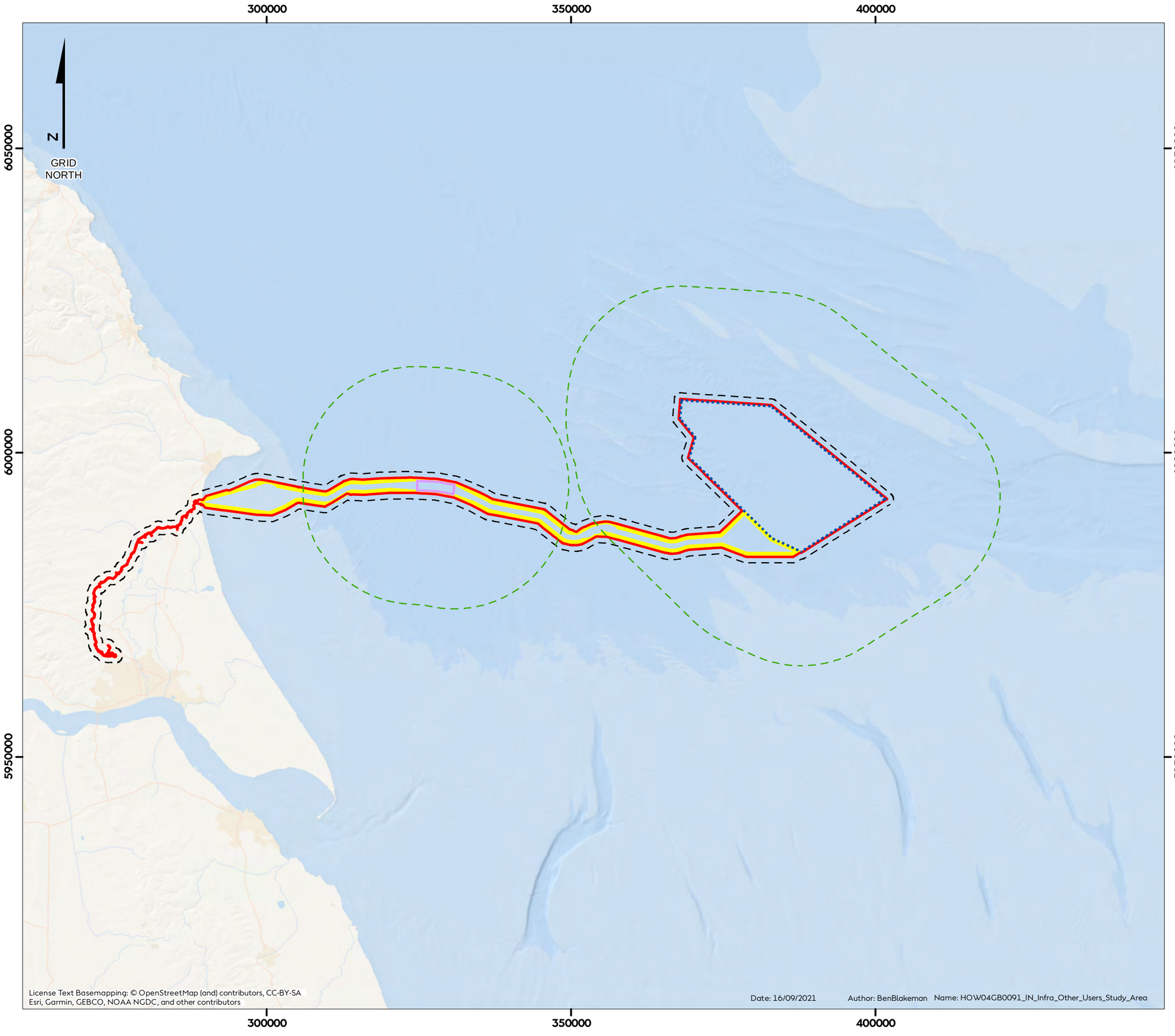


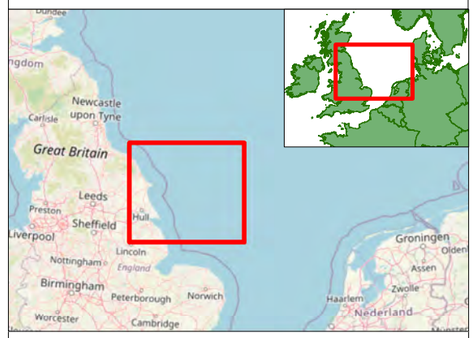
Figure 11.1: Overview of the Infrastructure and Other Users Chapter and Associated Reports.

Hornsea Four

Figure 11.2

Location of Hornsea Four infrastructure and other users study areas





Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:600,000

0 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
....	First Issue	17/06/2019
A	Updated following PEIR consultation, for DCO	16/09/2021

Infrastructure and Other Users Study Area
Document no: HOW04GB0091
Created by: BPHB
Checked by: KJ
Approved by: LK

GoBe

Ørsted

11.6 Methodology to inform the baseline

11.6.1 Desktop Study

11.6.1.1 Information on oil and gas activity within the Hornsea Four study areas (defined in Figure 11.2) was collected through a detailed desktop review of existing studies and datasets, as detailed in Table 11.4 and supplemented by information provided by oil and gas operators during the formal and informal consultation process summarised in Table 11.3.

Table 11.4: Key sources of infrastructure and other users data.

Source	Summary	Coverage of Hornsea Four Development Area
OGA Data/Common Data Access (CDA)	Publicly available Geographical Information System (GIS) data, details on the oil and gas licencing rounds and UK oil and gas activity.	Full coverage of the Hornsea Four infrastructure and other users study areas, as illustrated in Figure 11.2.
Consultation with oil and gas, CCUS and subsea cable operators	Consultation with relevant oil and gas, CCUS and subsea cable operators provided information on the operators' current and proposed activity.	Full coverage of the Hornsea Order infrastructure and other users study areas, as illustrated in Figure 11.2
The Crown Estate (TCE) Charts Offshore Wind Lease Agreement Areas	Other offshore wind farms	Full coverage of the Hornsea Four array area and ECC Order Limits and the 1 km buffer of Study Area 1.
SeaZone Solutions Ltd TCE Wind Farm Export Cable Routes Seabed Agreement OceanWise Marine Themes Kingfisher Information Service – Cable Awareness (KIS-ORCA) Electrics, Telecommunications Cables in the North Sea (EMODnet)	Offshore cables and pipelines (including proposed cables such as the Viking Link and SEGL2 Interconnectors)	Full coverage of the Hornsea Four array area and ECC Order Limits and the 1 km buffer of Study Area 1.
TCE, EIEOMP and OGA	CCUS (including the proposed Endurance CCS)	Full coverage of the Hornsea Four array area and ECC Order Limits and the 1 km buffer of Study Area 1.

11.7 Baseline Environment

11.7.1 Existing Baseline

Offshore licence blocks

11.7.1.1 Licences for the exploration and extraction of oil and gas on the United Kingdom Continental Shelf (UKCS) have been offered since 1964 and are granted by the OGA. These licences are granted for identified geographical United Kingdom Hydrographic Office (UKHO) areas (blocks and sub-blocks) in consecutive rounds, with the most recent being the 32nd Offshore Licensing Round (blocks offered September 2020), with 113

offshore licence areas over 260 blocks or part-blocks awarded to 65 companies. The OGA have also announced a suspension to new licensing rounds in what would have been the 2020/2021 period (OGA 2020c).

11.7.1.2 The main type of offshore licence is the Innovative Licence (OGA 2019b). This is a new licence introduced by the OGA for the 29th licence round which replaces the traditional Seaward Production Licence. The Innovative Licence may cover the whole, or part of a specified block or a group of blocks and grants exclusive rights to the holders '*to search and bore for, and extract, petroleum*' (including gas) in the area covered by the licence. The initial term is variable, runs for a maximum of nine years, and is subdivided into three phases:

- Phase A (optional) is a period for carrying out geotechnical studies and geophysical data reprocessing;
- Phase B (optional) is a period for undertaking seismic surveys and acquiring other geophysical data; and
- Phase C (mandatory) is for drilling.

11.7.1.3 There is a mandatory requirement to relinquish 50% of the licence block after the initial term. The second term is for field development and lasts four years and the third term is for production, The traditional licence terms still apply to licences gained prior to the 29th Licence Round for which the initial term is four years, which can then be renewed for a further four years with a third term for production. Exclusive rights may also include retained rights within an existing licenced acreage. Other licences available for applicants include Production Licences and Exploration Licences. A Production Licence, which except in special circumstances, runs for three successive terms and covers both exploration and production. An Exploration Licence grants rights to explore only, not to produce; and is non-exclusive. This licence is useful for seismic contractors who wish to gather data to sell rather than to exploit geological resource, and to Production Licence holders who wish to explore beyond the areas where they hold or require exclusive rights.

11.7.1.4 **Table 11.5** and **Table 11.6** summarises the licence blocks located within, or within 1 km, of the Hornsea Four array area and offshore ECC, see **Figure 11.3**. There are currently four licenced blocks coinciding with the Hornsea Four array area and associated 1 km buffer, operated by Bridge Petroleum, (Harbour Energy (formerly Premier Oil[1]) and Perenco. There are seven unlicensed blocks coinciding with the Hornsea Four array area.

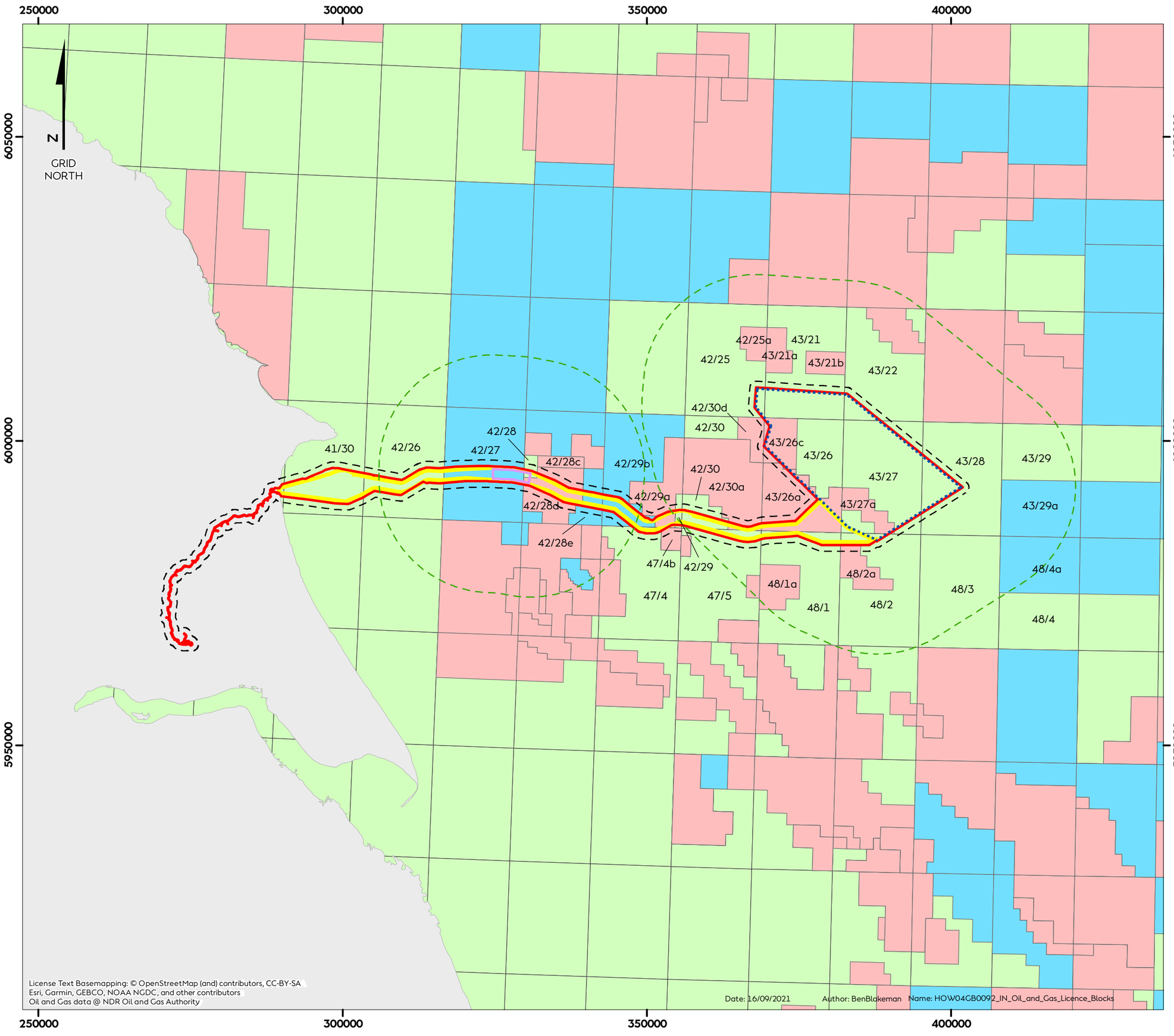
11.7.1.5 There are currently nine licenced blocks coinciding with the Hornsea Four offshore ECC and HVAC booster station search area and the associated 1 km buffer, operated by Dana Petroleum, Perenco, Harbour Energy and NEO Energy. There are currently nine unlicensed blocks within the Hornsea Four ECC and HVAC booster station search area and associated 1 km buffer.

[1] At the end of March 2021, Premier Oil had merged with Chrysaor to become Harbour Energy plc (Harbour Energy 2021).

Hornsea Four

Figure 11.3

Oil and gas licence blocks
in the vicinity of Hornsea Four



- Order Limits
- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Study Area 1: Area with Potential Interfaces with Other Users (1km)
- Study Area 2: Aviation and Vessel Access (10nm)
- Oil and Gas Licenced Blocks
- Oil and Gas Unlicenced Blocks
- 32nd Round Provisional Award Blocks

Coordinate system: ETRS 1989 UTM Zone 31N
Scale@A3: 1:600,000

0 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
---	First Issue	17/06/2019
A	Updated following PEIR consultation, for DCO	16/09/2021

Oil and gas licence blocks
in the vicinity of Hornsea Four
Document no: HOW04GB0092
Created by: BPHB
Checked by: AdB
Approved by: LK

GoBe
Ørsted

Table 11.5: Current licenced blocks coinciding with the Hornsea Four array area and associated 1 km buffer.

Block	Licence	Type	Licence End Date	Operator
42/30d	P2426	Production	30/09/2044 (Anticipated)*	Bridge Petroleum (administrator)
43/26a	P380	Production	N/A – will continue indefinitely	Harbour Energy/Perenco
43/26c	P2426	Production	30/09/2044 (Anticipated)*	Bridge Petroleum (administrator)
43/27a	P686	Production	19/07/2025 (Anticipated)	Harbour Energy

* note that the initial term end date is 30/09/2023.

Table 11.6: Current licenced blocks coinciding with the Hornsea Four ECC and HVAC booster station search area and associated 1 km buffer.

Block	Licence	Type	Licence End Date	Operator
42/27[2]	P2563	Exploration	30/11/2046 (Anticipated)*	Dana Petroleum
42/28d	P1330	Production	21/12/2031 (Anticipated)	Harbour Energy
42/28e[2]	P2564	Exploration	30/11/2046 (Anticipated)*	Harbour Energy (administrator)
42/29a	P1	Production	N/A – will continue indefinitely	Perenco/Dana Petroleum
42/29b[2]	P2564	Exploration	30/11/2046 (Anticipated)*	Harbour Energy (administrator)
42/30a	P1	Production	N/A – will continue indefinitely	Perenco
43/26a	P380	Production	N/A – will continue indefinitely	Harbour Energy /Perenco
47/4b	P302	Production	N/A – will continue indefinitely	Perenco
48/2a	P456	Production	N/A – will continue indefinitely	NEO Energy

* note that the initial term end date is 30/11/2024.

11.7.1.6 Other licence blocks which are located outside the 1 km buffer surrounding the Hornsea Four array area, ECC and HVAC booster station search area (and are therefore not detailed in **Table 11.5** or **Table 11.6)** but have been considered in **Section 11.11** include, Alpha Petroleum's licence blocks 42/25a, 43/21a and 43/22a which are located north of the Hornsea Four array area; Perenco's licence blocks 42/28a and 42/28b which are located north-east of the HVAC booster station search area and licence block 43/24a which is associated with the Trent platform and located north-east of the Hornsea Four array area; and Harbour Energy's licence block 42/28c which was awarded as part of the 32nd Offshore Licensing Round is located east of the HVAC booster station search area.

Hydrocarbon Fields

11.7.1.7 Areas with hydrocarbon potential have been extensively explored, with many fields brought into production in the southern North Sea. There is a consensus view that the great majority of large fields in shelf depth waters (<200 m) have already been

[2] 32nd OGA Licencing Round provisionally awarded licence blocks (https://www.ogauthority.co.uk/media/6673/32nd-round-winner-by-administrator.pdf). The licence for Block 42/27a lapsed in 2019, however in September 2020 Dana Petroleum were provisionally awarded Block 42/27.

discovered in the 1960s and 70s. (DECC 2011c; DECC 2016). However, with technological advances in seismic processing and drilling techniques there is still the potential for new discoveries. Owing to the geology of the southern North Sea, the hydrocarbon fields in the vicinity of Hornsea Four are gas or gas condensate fields rather than oil fields.

11.7.1.8 Figure 11.4 below presents the known gas fields that are within proximity to Hornsea Four and the associated 1 km buffer. There are two gas fields which clip with the Hornsea Four array area and associated 1 km buffer, operated by Harbour Energy and Perenco (Table 11.7).

Table 11.7: Gas fields located within the Hornsea Four array area and associated 1 km buffer.

Field Name	Resource	Status	Discovery Date	Discovery Well	Production Date	Operator	Licence
Ravenspurn	Gas	Producing	04/1983	42/30-2	10/1990	Perenco	P380 - P001
Johnston	Gas	Producing	04/1998	43/27-1	10/1994	Harbour Energy	P686 - P380

11.7.1.9 A total of five known gas fields clip the offshore ECC and associated 1 km buffer and are operated by NEO Energy, Perenco and Harbour Energy (Table 11.8).

Table 11.8: Hydrocarbon fields located within the Hornsea Four ECC and HVAC booster station search area and associated 1 km buffer.

Field Name	Resource	Status	Discovery Date	Discovery Well	Production Date	Operator	Licence
Babbage	Gas	Producing	12/1988	48/02-2	08/2010	NEO Energy	P456
Ravenspurn	Gas	Producing	04/1983	42/30-2	10/1990	Perenco	P380 - P001
Cleeton	Gas	Producing	04/1983	42/29-2	10/1988		P105 - P001
Neptune	Gas	Producing	11/1985	47/05a-4	12/1999		P302 - P001
Tolmount[3]	Gas	Pre-production	09/2011	42/28d-12	N/A (predicted Q4 2021[4])	Harbour Energy	P380

11.7.1.10 Tolmount is a recently developed gas field which is considered one of the largest undeveloped gas field discoveries in the North Sea (OGA 2018a) and its development is considered critical to maximising economic recovery in the UKCS. In 2020, a surface platform was constructed and is located approximately 3.98 km south-east of Hornsea Four HVAC booster station search area. First production from the gas field was expected in Q2 2021 (OGA 2018a). However, following a delay in first gas production at the site

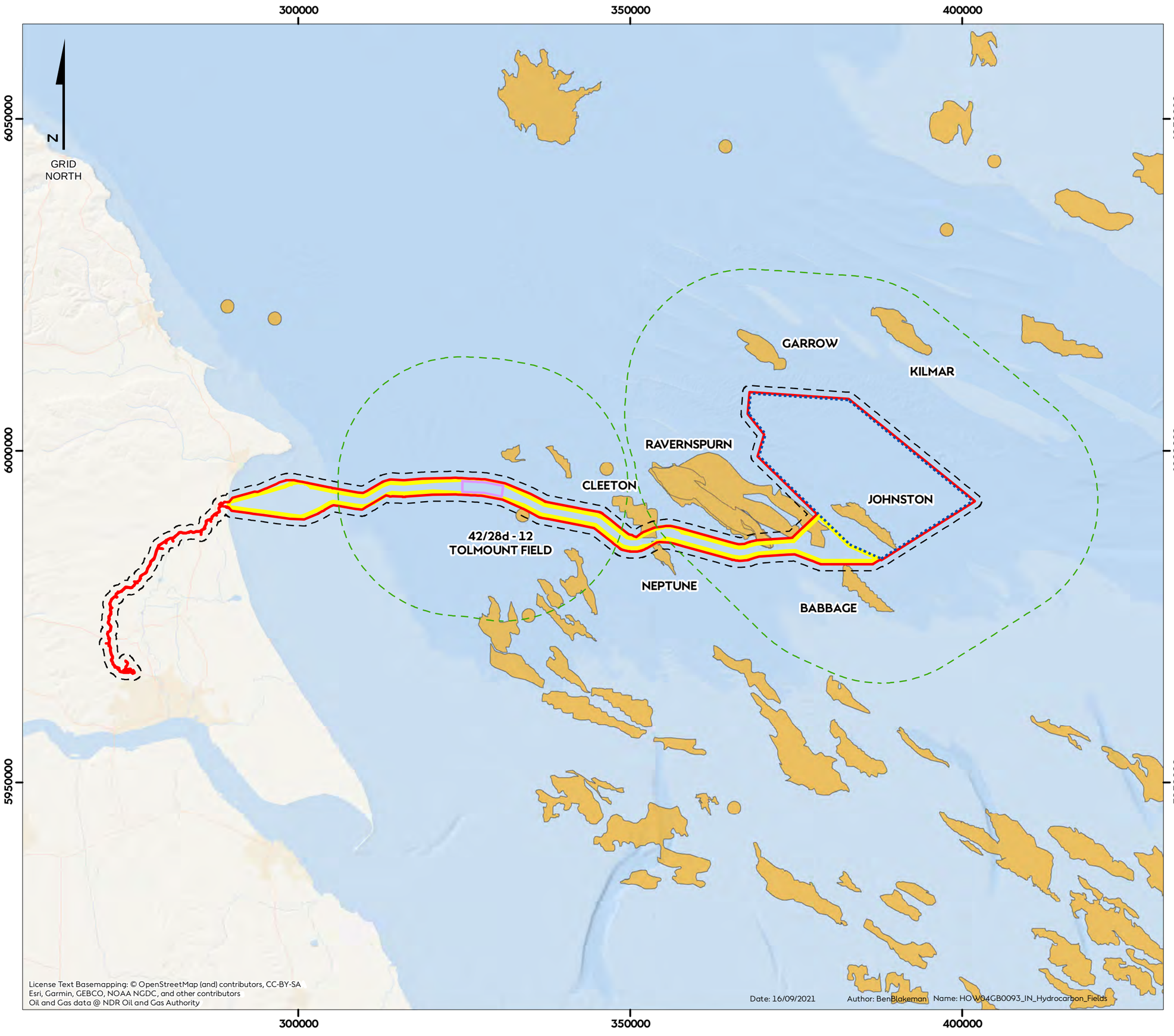
[3] The development of this field was discussed during pre-application consultation with oil and gas operators.
[4] First gas production at the Tolmount field has been delayed until end of 2021, following the detection of electrical systems issues associated with the platform (Offshore Engineering 2021).

the production date has been rescheduled for year-end (Offshore Engineering 2021). Further information concerning drilling activity at the Tolmount Field is detailed below in **Table 11.10**.

Hornsea Four

Figure 11.4

Hydrocarbon fields in the vicinity of Hornsea Four



- Order Limits
- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Study Area 1: Area with Potential Interfaces with Other Users (1km)
- Study Area 2: Aviation and Vessel Access (10nm)
- Hydrocarbon Fields

Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:550,000

0 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
....	First Issue	17/06/2019
A	Updated following PEIR consultation, for DCO	16/09/2021

Hydrocarbon fields
in the vicinity of Hornsea Four
Document no: HOW04GB0093
Created by: BPHB
Checked by: LS
Approved by: LK

GoBe

Ørsted

Survey Activity

11.7.1.11 Seismic survey operations may be carried out by the oil and gas industry to identify sub-surface geological structures that might hold reserves of oil and gas. The technique involves releasing pulses of acoustic energy along designated survey lines with the energy penetrating the sub-surface rocks and being reflected to the surface where it can be detected by acoustic transducers and relayed to a recording vessel.

11.7.1.12 To date there are no known geophysical surveys planned to occur during the construction phase of Hornsea Four.

11.7.1.13 Although no applications for seismic or geophysical survey by the oil and gas industry are currently registered, it was made clear during consultation with the oil and gas operators that future surveys may be required. For example, Gassco identified that ongoing multi-beam echo-sounder surveys will be required in relation to maintenance of the Langeled pipeline.

11.7.1.14 It is recognised that further surveys may be planned during the development of Hornsea Four and consultation with relevant licence block holders would need to be ongoing to identify potential seismic survey activity. If such activity will be required in the future it will be adequately planned and analysed in line with regulatory requirements, good engineering practice and the safe operability regime existing on the UKCS.

Surface Structures

11.7.1.15 Oil and gas related surface structures include permanent infrastructure such as manned and unmanned production platforms, as well as temporary structure such as drilling rigs and vessels. Gas platforms are protected by a 500 m safety zone.

11.7.1.16 The current gas platforms are summarised below in **Table 11.9** and shown in **Figure 11.5**. There are no platforms located within the Hornsea Four array area or within 1 km of the Hornsea Four array area. The Ravenspurn North Central Complex (CC) platforms are the closest surface platforms to the Hornsea Four array area located approximately 3 km (1.65 nm) from the western boundary. There are also no platforms located within the Hornsea Four offshore ECC or the HVAC booster station search area. There are, however, two platforms (Ravenspurn North CCW and Ravenspurn North CC) which are within 1 km of the ECC for Hornsea Four.

11.7.1.17 There are a total of twelve permanent platforms within the 10 nm (18.52 km) helicopter access buffer study area surrounding the Hornsea Four array boundary. These platforms are listed in **Table 11.9** below.

11.7.1.18 Details on those platforms which are equipped with REWS were provided following consultation with relevant oil and gas operators and are provided within Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report). The Technical Report identified that the following platforms have REWS installed within 30 km of Hornsea Four array area: Ravenspurn North CC, Ravenspurn South B and Cleeton CC (all operated by Perenco). However, Cleeton CC platform was not assessed as part of the Technical Report due to its distance away from

the Hornsea Four array area. The Technical Report also identified that the Babbage platform (operated by NEO Energy) and the Kilmar and Garrow NUIs (operated by Alpha Petroleum) which are close to the Hornsea Four array area, are currently not monitored by REWS. Further detail is provided below in **paragraph 11.7.1.39** *et seq*.

Table 11.9: Oil and gas platforms located within 10 nm (18.52 km) the of Hornsea Four array, and within 1 km of the ECC, and HVAC booster station search area.

Platform Name	Operator	Status	Distance to the Hornsea Four array boundary	Distance to the Hornsea Four ECC boundary	Distance to the Hornsea Four HVAC booster station
Babbage	NEO Energy	Active	4.31 km (2.33 nm)	2.50 km (1.35 nm)	53.72 km (29.00 nm)
Kilmar NUI	Alpha Petroleum	Active	12.65 km (6.83 nm)	30.01 km (16.20 nm)	64.45 km (34.80 nm)
Garrow NUI		Active	6.96 km (3.76 nm)	27.17 km (14.67 nm)	43.64 km (23.56 nm)
Ravenspurn North CC	Perenco	Active	3.05 km (1.65 nm)	0.92 km (0.50 nm)	44.94 km (24.26 nm)
Ravenspurn North CCW		Active	2.95 km (1.59 nm)	0.89 km (0.48 nm)	45.02 km (24.31 nm)
Ravenspurn North ST2		Active	4.16 km (2.25 nm)	5.15 km (2.78 nm)	40.29 km (21.75 nm)
Ravenspurn North ST3		Active	7.95 km (4.29 nm)	7.19 km (3.88 nm)	32.39 km (17.49 nm)
Ravenspurn South A		Active	9.25 km (4.99 nm)	3.19 km (1.72 nm)	36.13 km (19.51 nm)
Ravenspurn South B		Active	9.69 km (5.23 nm)	5.52 km (2.98 nm)	31.47 km (16.99 nm)
Ravenspurn South C		Active	11.95 km (6.45 nm)	6.52 km (3.52 nm)	26.53 km (14.33 nm)
Minerva		Active	32.87 km (17.75 nm)	8.12 km (4.38 nm)	16.69 km (9.01 nm)
Tolmount	Harbour Energy	Pre-production	35.36 km (19.09 nm)	1.46 km (0.78 nm)	3.98 km (2.15 nm)

11.7.1.19 During the pre-application consultation process, various operators have provided information on planned field development works which are at varying stages of the consent process. These are summarised in **Table 11.10**.

Table 11.10: Proposed future field developments near Hornsea Four.

Operator	Status	Location	Consultation
Dana Petroleum	Awarded Block 42/27 in the 32nd OGA Licencing Round.	Block 42/27 (overlaps with the ECC)	In September 2020 Dana Petroleum were awarded Block 42/27 as part of the 32nd OGA Licensing Round.
To be confirmed (TBC)[5] (formerly Dana Petroleum)	Field Development Plan (FDP) and ES to be updated.	Block 48/1a which is located approximately 4.1 km from the easterly end of the ECC	Platypus Project which is expected to involve development drilling, pipeline installation and the installation of a small NUI. .
Bridge Petroleum	Development Concept Phase	The exact drilling location is unknown at present, although it is expected to be located within Block 42/30d which is 7 km north-east of Ravenspurn North, overlapping the array area.	Plan to drill up to three wells within the known field (Kumatage) and reservoir. The field has an estimated life of seven years. They are currently in the Development Concept Phase and no concrete plans or timelines have been put in place as of yet. The production concept will either take the form of a subsea wellhead or a NUI. A platform is expected to be the chosen outcome (either mooring or hybrid), likely located in Block 42/30d. It should be noted that the initial term end date is 20/09/2023 (see Table 11.5).
Harbour Energy	Platform constructed.	Block 42/28d, located within the ECC.	Construction of the Tolmount Main platform was completed in October 2020, with first gas due to be delivered in Q4 of 2021[6] and will therefore be operational during Hornsea Four construction and operation and maintenance phase. Three upcoming wells (Tolmount East Appraisal Well, Tolmount Far East Well and Tolmount Main - South Infill Well) are also likely to be developed.
RockRose Energy	Drafted an FDP for submission to OGA.	Block 43/21b, is 2.8 km (1.5 nm) to the north of the array area.	Previous owner Speedwell Energy indicated the possible development of a platform.
	In planning	Potentially travelling across the Hornsea Four array area.	During consultation RockRose Energy noted the potential for a pipeline (across Hornsea Four array area), umbilical and wellheads, which will connect to the Ravenspurn North platform. RockRose Energy indicated first gas would potentially be produced in 2023.
Alpha Petroleum	In planning	Potentially travelling across the	During consultation Alpha Petroleum indicated the potential for a proposed pipeline between Kilmar NUI

[5] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.
[6] First gas production at the Tolmount field has been delayed until end of 2021, following the detection of electrical systems issues associated with the platform (Offshore Engineering 2021).

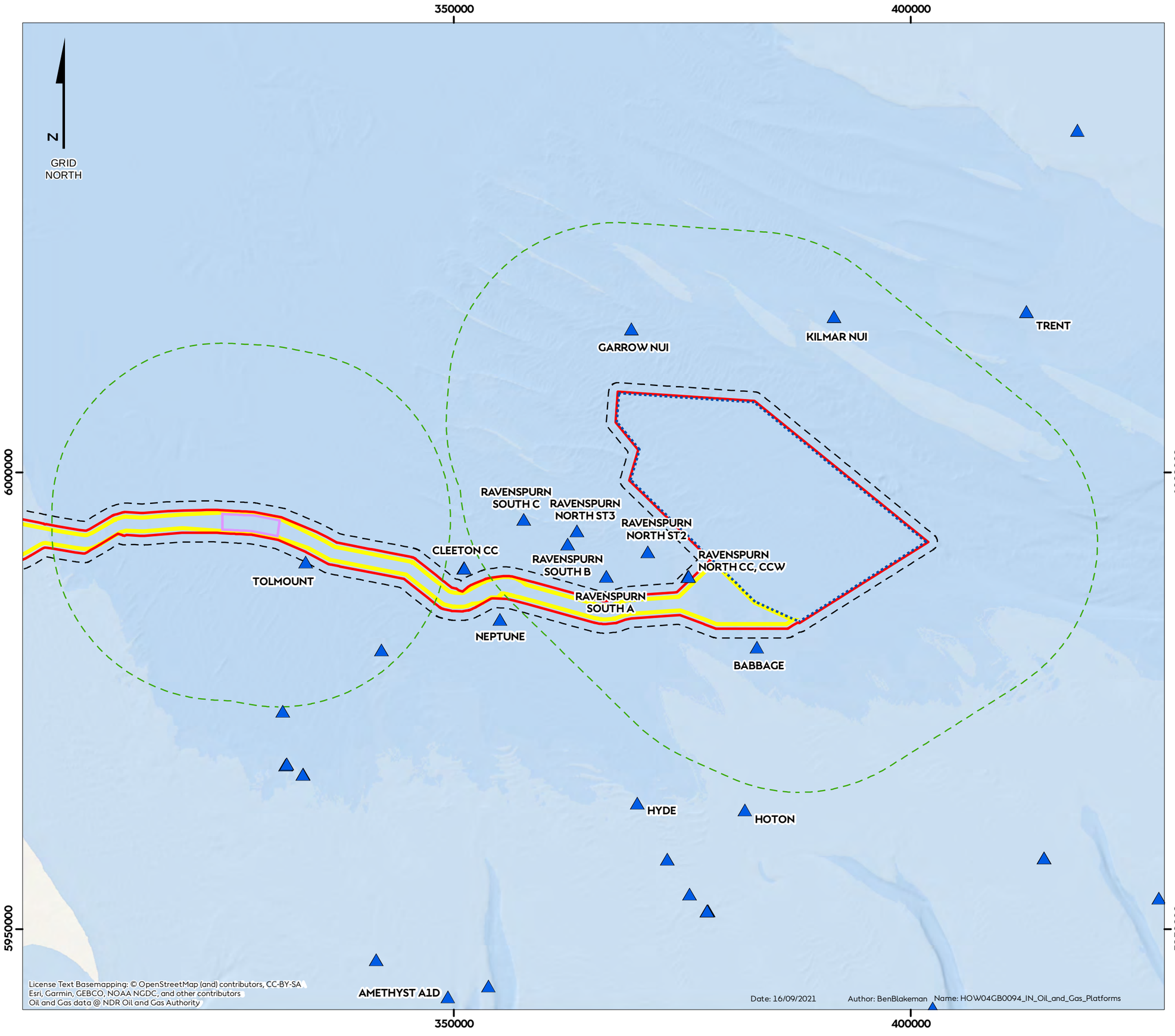
Operator	Status	Location	Consultation
		Hornsea Four array area.	and the Ravenspurn North Hub, passing through the Hornsea Four array area.

11.7.1.20 In addition, several of the operators consulted have indicated that a number of platforms and associated infrastructure within the southern North Sea are scheduled to be decommissioned in the near future. Alpha Petroleum, the owner of Garrow and Kilmar NUIs, expect decommissioning activities at these two platforms to occur in 2024.

Hornsea Four

Figure 11.5

Oil and gas platforms located in the vicinity of Hornsea Four



- Order Limits
- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Study Area 1: Area with Potential Interfaces with Other Users (1km)
- Study Area 2: Aviation and Vessel Access (10nm)
- Oil and Gas Platform

Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:400,000

0 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
....	First Issue	17/06/2019
A	Updated following PEIR consultation, for DCO	16/09/2021

Oil and Gas Platforms
in the vicinity of Hornsea Four
Document no: HOW04GB0094
Created by: BPHB
Checked by: LS
Approved by: LK

GoBe Ørsted

Subsea Structures

11.7.1.21 Subsea structures (excluding wells, see below in **paragraph 11.7.1.25** *et seq.* for further details) include:

- Protective structures – These structures can be fully enclosed structures which provide a suspended subsea wellhead protection from dropped objects and to help deflect towed fishing gear;
- Manifolds – A subsea manifold is a large metal piece of equipment, made up of pipes and valves and designed to transfer oil/gas from wellheads into a pipeline;
- Wellheads – When a well is drilled the structure placed on the seabed is called a wellhead. There may be a single wellhead, though often there may be several units grouped together to form a block. Attached to the top of the wellhead are the control units called subsea trees; and
- Trees and valves – Subsea trees are structures attached to the top of subsea wells to control the flow of oil/gas from a well. When attached to a subsea well the combined structures can extend to 7 m above the seabed in height.

11.7.1.22 These subsea structures (excluding wells) are usually protected by a 500 m exclusion zone as applied for and implemented by the operator. Subsea structures are shown in **Figure 11.6**.

11.7.1.23 There is one active manifold and an active wellhead located within the Johnston Gas Field (operated by Harbour Energy) connected to the Ravenspurn North CCW platform (part of the Ravenspurn North CC), which are within the Hornsea Four array area. Harbour Energy are expected to decommission their subsea Johnston infrastructure; although there are currently no confirmed timescales, Harbour Energy have noted cessation of production is likely to occur early 2020s, with decommissioning at some point in the future, not necessarily immediately after cessation of production.

11.7.1.24 There are no active subsea structures within the Hornsea Four ECC. However, there is one active subsea protection structure within 1 km of ECC, which is now operated by Perenco who took over the former BP assets. There is also a single wellhead within 1 km of the ECC associated with the Tolmount Field, operated by Harbour Energy, which is currently not in use.

Wells

11.7.1.25 Wells can be classified into four categories as follows:

- Completed wells – when a well is completed it is ready for production (or injection).
- Drilling wells – wells in the process of being drilled. These are temporary in nature, with drilling lasting several months. These could be one of the following:
  - **Exploration well:** drilled as part of an exploration programme for information gathering purposes, to determine the presence of oil/gas;
  - **Appraisal well**: drilled as part of an appraisal drilling programme which is carried out to determine the physical extent of reserves and the likely production rate of a field;

  - **Development well:** drilled within a proven production field or area of an oil or gas reservoir, to the depth of a stratigraphic horizon known to be productive; or
  - **Production well**: intended to produce gas from an already appraised field or reserve.
- Plugged and abandoned wells – where a well has become non-productive or non-viable. The standard requirement when a well is to be plugged and abandoned is to remove the well head and cut and remove the casings 10 ft below the seabed (Oil and Gas UK 2015). The well is plugged with cement plugs and salvage of all recoverable equipment undertaken.
- Suspended wells – after initial drilling, a well may be temporarily suspended if an operator intends to carry out further operations at a later date. In this event the well head may be left protruding a metre or two above the seabed and a guide base is left on the seabed to facilitate re-entry.

11.7.1.26 The completion status of wells, as defined by the OGA Well Operations Notification System (OGA 2018b) is described below:

- A constructed well or wellbore that is neither operational nor fully abandoned is assigned one of four, temporary physical (mechanical) status classifications:
  - **Completed (Shut-in**): A completed wellbore that is shut in either at the tree valves or subsurface safety valve. Normally this status will only be applied if the wellbore is intended to be shut in for 90 days or more;
  - **Plugged**: A wellbore that has been plugged with a plug rather than an abandonment barrier;
  - **AB1**: The reservoir has been permanently isolated. The wellbore below the barrier is no longer accessible; and
  - **AB2:** All intermediate zones with flow potential have been permanently isolated. The wellbore below the barrier is no longer accessible.
- A development well is categorised as "inactive" when the field permanently ceases production;
- A development well, with no further use, and not connected to an installation is categorised as "inactive";
- An exploration or appraisal well, without an active rig working on it and after any well test is completed is categorised as "inactive";
- A well that has had an abandonment notice served by OGA is categorised as "inactive"; and
- AB3 - A fully abandoned well means the well origin at the surface has been removed and the well origin will never be used again.

11.7.1.27 Completed and drilling wells typically have a 500 m safety zone (Step Change in Safety 2017). Suspended, and plugged and abandoned wells do not have safety zones and therefore not considered further within this ES.

11.7.1.28 There are 19 wells located within a 1 km buffer the Hornsea Four array area of which:

- Five are categorised as AB1;
- Eight are categorised as AB3;
- Two are completed and operating; and

- Four are categorised as completed (shut in).

11.7.1.29 There are 32 wells located within a 1 km buffer of the offshore ECC of which:

- Three are categorised as AB1;
- One is categorised as AB2;
- Thirteen are categorised as AB3;
- Eight are completed and operating; and
- Seven are categorised as completed (shut in).

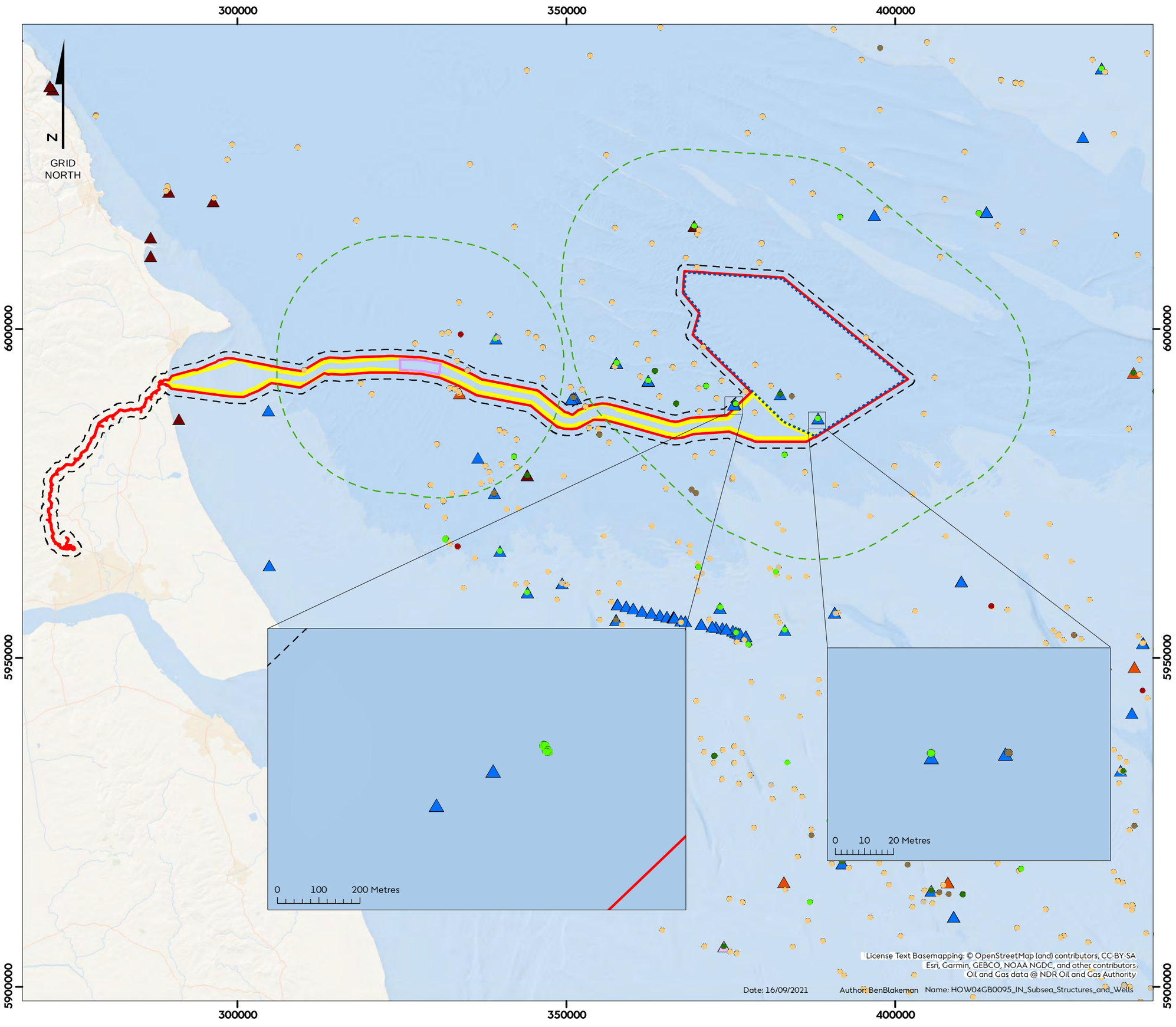
11.7.1.30 As detailed in **paragraph 11.7.1.19**, during the pre-application consultation, certain oil and gas operators indicated that they had future plans to drill further wells within or in the vicinity of Hornsea Four or to re-enter old wells in some licence blocks. An example of this includes the recent applications submitted by Harbour Energy to drill further wells within the Tolmount Field, specifically within Licence Block 42/28d (Department for Business, Energy and Industrial Strategy (BEIS) 2020). The likely key known developments that were noted in oil and gas consultation are detailed above in **Table 11.10**.

11.7.1.31 As noted in **paragraph 11.7.1.23** cessation of production is likely to occur for subsea infrastructure within the Johnston Field in the 2020s, with decommissioning at some point in the future, not necessarily immediately after cessation of production. In 2019, Premier Oil carried out well abandonment operations on the discovery well 43/27-1 (AB1 well status).

Hornsea Four

Figure 11.6

Subsea structures and wells in the vicinity of Hornsea Four



- Order Limits
- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Study Area 1: Area with Potential Interfaces with Other Users (1km)
- Study Area 2: Aviation and Vessel Access (10nm)

Well Status

- AB1
- AB2
- AB3
- Completed Operating
- Completed Shut In
- Drilling
- Plugged

Subsea Structure Status

- Active
- Precommission
- Not In Use
- Removed

Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:550,000

0 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
....	First Issue	17/06/2019
A	Updated following PEIR consultation, for DCO	16/09/2021

Subsea structures and wells
in the vicinity of Hornsea Four
Document no: HOW04GB0095
Created by: BPHB
Checked by: LS
Approved by: LK

GoBe

Ørsted

Pipelines

11.7.1.32 There are seven oil and gas associated pipelines located within the Hornsea Four array area and the associated 1 km buffer area, five of these pipelines are linked to wells within the Johnston Gas Field. There are eleven oil and gas pipelines which cross the offshore ECC and the associated 1 km buffer area, including the Langeled pipeline which intersects the HVAC booster station search area and the pipelines associated with the Johnston Gas Field. The active and planned pipelines that intersect the Hornsea Four array area and the offshore ECC are listed in **Table 11.11** and shown in **Figure 11.7** below.

11.7.1.33 Alpha Petroleum's proposed Kilmar to Ravenspurn North CC pipeline will likely cross the Hornsea Four array area, However, as the required details are not currently available the pipeline has not been assessed in **Volume A5, Annex 11.1: Offshore Installation Interfaces** and therefore is not considered further in this ES.

Table 11.11 Pipelines crossing and located within the associated 1 km buffer area of the Hornsea Four array area, the HVAC Booster Station search area and offshore ECC.

Pipeline	Fluid Type	Status	Operator
Hornsea Four Array Area			
Johnston Umbilical	Chemical	Active	Harbour Energy
Johnston Export	Gas	Active	
Johnston Methanol	Methanol	Active	
JFE Umbilical	Chemical	Active	
JFE Production	Gas	Active	
Shearwater to Bacton (SEAL)	Gas	Active	Shell
HVAC Booster Station			
Langeled Pipeline	Gas	Active	Gassco
Offshore ECC			
Johnston Umbilical	Chemical	Active	Harbour Energy
Johnston Export	Gas	Active	
Johnston Methanol	Methanol	Active	
Ravenspurn North Export Line	Gas	Active	Perenco
Minerva to Cleeton Gas Export	Gas	Active	
Cleeton to Minerva Umbilical	Chemical	Active	
Minerva to Cleeton Piggy	Chemical	Active	
Neptune to Cleeton Pipeline	Gas	Active	
Cleeton CP to Dimlington	Gas	Active	
Platypus Pipeline	Gas	In planning	TBC[7] (formerly Dana Petroleum)

11.7.1.34 Pipelines are usually protected by a 500 m exclusion zone. Where Hornsea Four export, array and interconnector cables will need to cross an active pipeline, it is intended that commercial crossing agreements will be entered into with the pipeline operator. This is

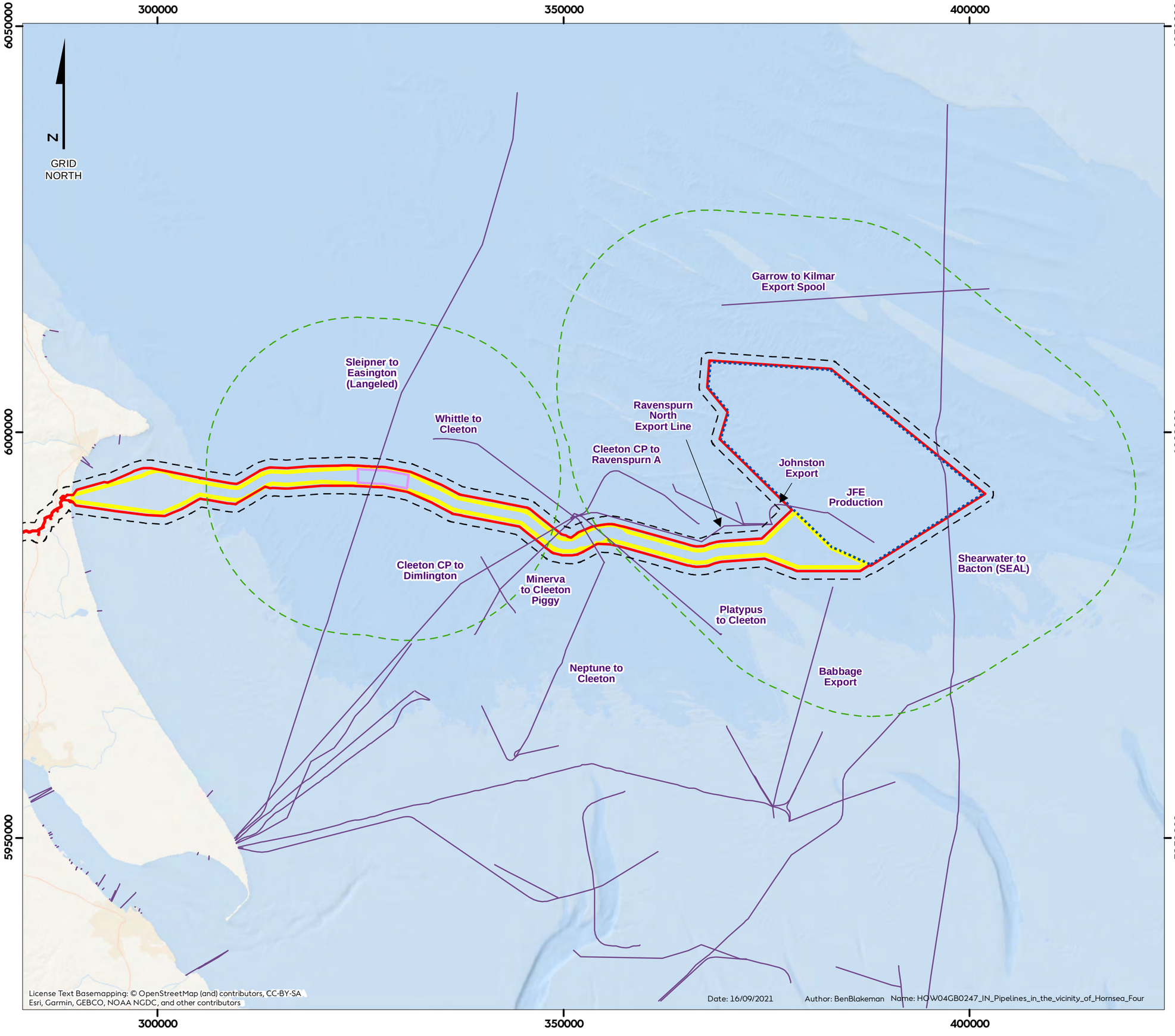
[7] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

a formal arrangement that establishes the responsibilities and obligations of both parties and to allow operations to be managed safely. Where the Hornsea Four cables are located within 500 m of an active pipeline, it is intended that a commercial proximity agreement will be entered into with the pipeline operator. This, in the same way as the crossing agreement, establishes the responsibilities and obligations of both parties and to allow operations to be managed safely.

Hornsea Four

Figure 11.7

Oil and gas pipelines in the vicinity of Hornsea Four



- Order Limits
- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Study Area 1: Area with Potential Interfaces with Other Users (1km)
- Study Area 2: Aviation and Vessel Access (10nm)
- Existing Pipelines

Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:450,000

0 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
....	First Issue	16/09/2021

Pipelines in the vicinity of Hornsea Four
Document no: HOW04GB0247
Created by: BPHB
Checked by: KJ
Approved by: LK

GoBe Ørsted

Oil and Gas Operations: Shipping and Navigation

11.7.1.35 A variety of vessels are required to service or support oil and gas operations. They can include:

- Offshore support vessels such as platform supply vessels bringing supplies and equipment and removing waste;
- Larger specialist vessels such as drilling rigs, crane barges and accommodation facilities which may be stationed adjacent to platforms or over subsea wells/infrastructure in order to drill, re-enter or abandon wells, undertake construction or decommissioning activity and provide accommodation for personnel undertaking significant construction, maintenance or decommissioning campaigns; and
- Supporting vessels such as tugs and anchor handlers, emergency response and recovery vessels, survey vessels etc.

11.7.1.36 Vessel visits may be planned (e.g. in order to change crews or carry out pre-planned work) or may be unplanned (i.e. arranged at short notice in order to respond to a problem/emergency).

11.7.1.37 Vessels do not have specified routes and do not always originate directly from shore. Routes can be via other platforms first. Nonetheless, the most commonly used vessel routes (as defined by AIS data) including use by oil and gas vessels, are described in **Chapter 7: Shipping and Navigation**.

11.7.1.38 A study on oil and gas support vessels within the Hornsea Four array area was conducted as part of Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report). This report identified the majority of baseline activity for oil and gas support vessels, in relation to surface platforms, were observed outside of the Hornsea Four array area, with the greatest activity associated with Ravenspurn assets (Ravenspurn North (CC, ST2 and ST3) and Ravenspurn South (A, B and C)), Babbage, Garrow NUI and Kilmar NUI (see Figure 6.6 in Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report)).

Oil and Gas Platforms: Radar Early Warning Systems

11.7.1.39 Early warning systems are used to prevent vessel allision with an offshore oil and gas platform, including REWS. This system utilises radar mounted on the platform to monitor and track vessels navigating within the detection area and provide allision warning when vessels are in breach of defined CPA and TCPA parameters. When they reach a certain threshold, an alarm is triggered to alert the vessel operator when a proximity violation or allision threat is detected. This value is set in accordance with the platform operator's own performance standards and typically consists of an amber alert and a red alarm indicating when vessel intervention or emergency procedure are required. The REWS radar does not work in isolation, but together with other radar and AIS data provides a field wide collision risk management system which protects the whole field. AIS is therefore a very useful source of vessel information and location data that can complement the radar data when temporary losses are experienced. The REWS on one platform (and sometimes combined with the REWS on another platform) therefore protects a range of platforms. Typically, a 30 km (16 nm) detection range is assumed to

be the minimum requirement for REWS to detect and track smaller vessels (100 m2 RCS). However, this may vary depending on factors such as weather conditions.

11.7.1.40 The locations of REWS on oil and gas platforms were confirmed during consultation with oil and gas operators and within Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report). This report identified two platforms within close proximity to Hornsea Four with REWS installed, Ravenspurn North CC and Ravenspurn South B (both operated by Perenco). These two REWS installations, along with Perenco's Cleeton CC platform, provide radar coverage and protection for several nearby Perenco assets in the region (i.e. Ravenspurn North ST2, Ravenspurn North ST3, Ravenspurn South A, Ravenspurn South C, Neptune, Hoton, Hyde, Trent and Amethyst A1D).

11.7.1.41 Other oil and gas platforms located within close proximity to the Hornsea Four array area are:

- Babbage platform (operated by NEO Energy); and
- Garrow NUI and Kilmar NUI platforms (both operated by Alpha Petroleum).

11.7.1.42 These three platforms were not assessed further in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report) as consultation with the respective operators indicated that REWS is not installed to monitor these platforms.

Oil and Gas Operations: Aviation

11.7.1.43 The majority of the manned and unmanned platforms will be accessed, in part, using helicopters, particularly for crew transfers. The safety of helicopters approaching platforms is governed by operating procedures which can be affected by the presence of wind turbines. Therefore, Hornsea Four has the potential to affect the helicopter operations at a number of the adjacent platforms, with Ravenspurn North and Babbage likely to be the key platforms in this regard given that they are located closest to the Hornsea Four array area.

11.7.1.44 In addition, helicopters may follow Helicopter Main Routes (HMRs) when transiting to or between platforms. Further information on HMRs is provided in **Chapter 8: Aviation and Radar** with a detailed assessment of the potential to impact helicopter operations to helideck operated oil and gas platforms is provided in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report).

11.7.1.45 Any platforms further than 10 nm (and subsequently outside the 9 nm consultation zone (as specified in CAP 764)) from Hornsea Four array area were disregarded from the assessment undertaken within Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report) as they would not be affected by the installation of Hornsea Four.

Subsea Cables

11.7.1.46 Existing and proposed subsea cables (electricity interconnectors and telecommunications cables) are shown in **Figure 11.8**. There are no cables located within

Hornsea Four array areas or its associated 1 km buffer. However, there is one interconnector cable currently under construction, Viking Link, which is jointly operated by the National Grid and Energinet and crosses an area of sea between Hornsea Four and Hornsea Project Two Offshore Wind Farm (hereafter Hornsea Project Two) array area Order Limits. There are also a further two planned interconnector cables located near to the Hornsea Four array area and ECC, these are the SEGL2 Interconnector and Continental Link Multi-Purpose Interconnector (MPI), with both operated by NGET.

11.7.1.47 The Viking Link interconnector is a 1400 MW HVDC electricity link, approximately 760 km long, linked between Bicker Fen in Lincolnshire and the substation at Revsing in southern Jutland, Denmark. Construction of the Viking Link commenced in 2020, with the cable set to become operational in 2023.

11.7.1.48 There are two offshore wind farm export cables Dogger Bank A (previously Dogger Bank Creyke Beck A) and Dogger Bank B (previously Dogger Bank Creyke Beck B), jointly operated by SSE Renewables and Equinor, which overlap with Hornsea Four offshore ECC, 9 km west of the HVAC booster station search area. Both export cables are scheduled for construction between 2021 and 2024 and will make landfall north of Ulrome. Although, Hornsea Project One and Hornsea Project Two are the closest offshore wind farms to Hornsea Four, both Hornsea Project One and Hornsea Project Two lie beyond the 1 km buffer of Study Area 1 and the export cables associated with both offshore wind farms do not interact with Hornsea Four's array area, HVAC booster station search area or the ECC.

11.7.1.49 The survey work for SEGL2 is underway and planning applications are expected to be submitted in early 2022, with construction proposed for 2025 and operation 2030. The cable is approximately 440 km proposed to connect between Peterhead, Scotland to Drax, England, with a capacity of 1500 MW. The proposed SEGL2 clips the Hornsea Four ECC as it travels to landfall (see **Figure 11.8**).

11.7.1.50 The Continental Link MPI is currently at Scoping stage and will have a capacity of 1800 MW and connected between Creyke Beck, UK and Norway. The subsea HVDC cable will be over 600 km long with the MPI providing connection for offshore wind farms to the interconnector transmission capacity (NGET 2021.)

11.7.1.51 Where the Hornsea Four export cables need to cross an active cable, it is intended that commercial crossing agreements will be entered into with the cable operator. This is a formal arrangement that establishes the responsibilities and obligations of both parties and to allow operations to be managed safely.

Carbon Capture, Utilisation and Storage (CCUS)

11.7.1.52 CCUS is the separation and underground sequestration of carbon dioxide (CO_2) arising from onshore fossil fuel and biomass power stations and industrial facilities. CCUS is regarded as a potential abatement technology for limiting the impact of climate change. The CO_2 is transported via pipelines to deep underground areas mostly offshore, such as depleted oil and gas reservoirs (DECC 2010). CCUS is a new technology and has not yet been demonstrated on a commercial scale in the UK. The proposed Endurance saline deposit reservoir overlaps in part with the Northern part of the Hornsea Four array area (see **Figure 11.8**).

11.7.1.53 Endurance is an underground "saline aquifer" storage reservoir which was the identified CO_2 store associated with the 2009 Don Valley Carbon Capture and Storage (CCS) project, before focussing support on the 2012 White Rose CCS project. The White Rose CCS was promoted by Capture Power Limited and National Grid Carbon Limited, to accept carbon produced by a proposed 448MW coal fired power station at the existing Drax site in North Yorkshire. The PINS website recorded an application for a DCO for the power station project as having been refused by the Secretary of State in 2016, together with an application for the connecting pipeline to the offshore CO_2 storage site which is noted as having been refused in 2017.

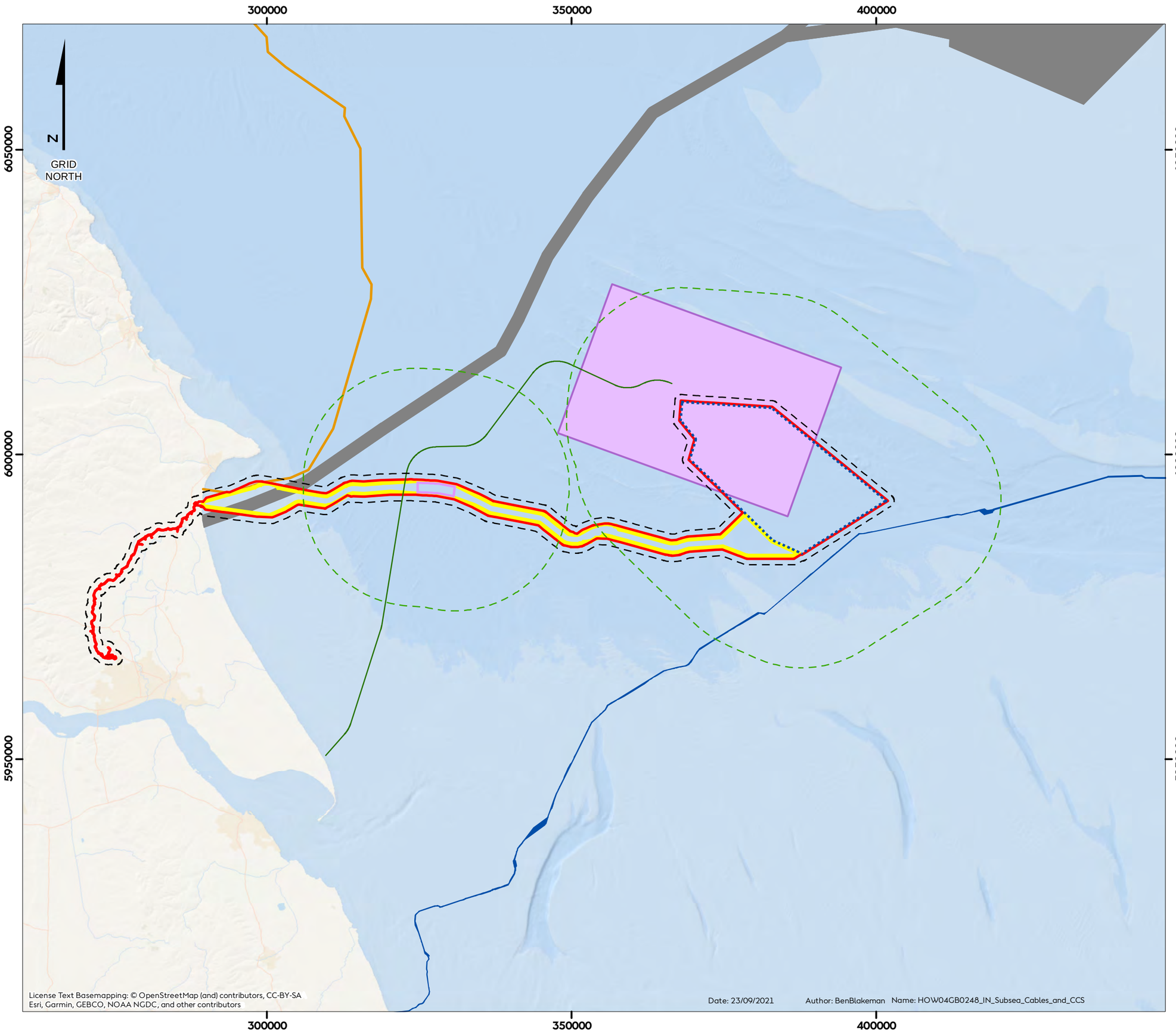
11.7.1.54 There are currently two planned CCS projects that propose to make use of the Endurance reservoir, the proposed NZT and ZCH. In October 2020, it was announced that BP, Eni, Equinor, Shell and Total had formed the NEP, with the purpose of developing the infrastructure within the Endurance site to serve these projects. There is limited publicly available information available on the project proposed within the Endurance CCS site due to the pre-planning status of the projects. However, the NEP provided information to the Applicant on the proposed Endurance CCS site, with area of potential overlap shown in **Figure 11.8**. The Endurance CCS site may result in the Hornsea Four offshore ECC crossing the CO_2 injection pipeline (Easington to Endurance) (see **Figure 11.8**).The project intends to gather and store CO_2 generated from the Teesside and Humber industrial clusters with injection rates progressively ramping up from an initial 4 Mtpa (million tons per annum) starting in the mid-2020s up to 15 Mtpa over time.

11.7.1.55 There are currently no other known proposed CCS developments or natural gas storage sites within the Hornsea Four array area or the offshore ECC.

Hornsea Four

Figure 11.8

Subsea cables and CCS in the vicinity of Hornsea Four



- Order Limits
- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Study Area 1: Area with Potential Interfaces with Other Users (1km)
- Study Area 2: Aviation and Vessel Access (10nm)
- Viking Link Cable
- Scotland England Green Link 2 (SEGL2)
- Dogger Bank A and B Export Cables
- Carbon Capture Storage Endurance AfL Site
- Endurance CCS Pipeline

Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:600,000

0 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
....	First Issue	23/09/2021

Subsea cables and CCS in the vicinity of Hornsea Four
Document no: HOW04GB0248
Created by: BPHB
Checked by: KJ
Approved by: LK

GoBe

Ørsted

11.7.2 Current Baseline

11.7.2.1 The current baseline description above provides an accurate reflection of the current state of the existing environment. The earliest possible date for the start of construction of Hornsea Four is January 2024, with an expected operational life of 35 years, and therefore, there exists the potential for the baseline to evolve between the time of assessment and point of impact. Changes to the baseline in relation to infrastructure and other users can occur over the long-term (considered in **Section 11.7.3**) or short to medium-term. The current baseline described above gives an accurate portrayal of the existing environment based on the most recently available data at the time of writing, and the baseline at the point of impact is expected to be broadly similar to this in most respects. However, it is considered reasonably foreseeable that the baseline will evolve between the time of assessment and the point of impact in terms of the construction and potentially decommissioning, of various oil and gas assets (platform and pipeline) as identified in **Volume A4, Annex 5.3: Offshore Cumulative Effects**.

11.7.3 Evolution of Baseline

11.7.3.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 requires that "an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge" is included within the ES (EIA Regulations, Schedule 4, Paragraph 3). From point of assessment, over the course of the development and operational lifetime of Hornsea Four (operational lifetime anticipated to be 35 years), long-term trends mean that the condition of the baseline environment is expected to evolve. This section provides a qualitative description of the evolution of the baseline environment, on the assumption that Hornsea Four is not constructed, using available information and scientific knowledge of infrastructure and other users.

11.7.3.2 An assessment of the future baseline conditions has been carried out (in the event of no development) and is described within this section, using the available information. The baseline environment is not static and will exhibit change over time, with or without Hornsea Four in place, due to the development of new offshore assets and the end of production decommissioning of offshore infrastructure.

11.7.3.3 The future baseline scenario for offshore subsea cables and CCS is subject to gradual change as new projects/sites are identified and/or developed. The future baseline scenario for oil and gas activities and associated development (including platforms, wells and pipelines) is considered to be subject to the greatest degree of change, which will depend upon currently unknown outcomes of, for example, acquisitions, exploration and development, repurposing of infrastructure for other uses, and decommissioning.

11.7.3.4 In 2016, the OGA Annual Report reported a continued decline in oil and gas production in the UKCS (continuing a gradual decline seen since the year 2000). While this decline is predicted to continue, they report a range of possible outcomes because the future rate of production is dependent on many different and unknown factors, including the level of investment and the success of further exploration.

11.7.3.5 In the 2019 Oil and Gas UK Business Outlook Report (Oil and Gas UK 2019b), it is noted that gas production (which is the resource exploited in the vicinity of Hornsea Four) has decreased around 3% compared to 2017 as a result of lower-than-expected performance within key gas hubs and the lack of new gas fields being explored. However, it was anticipated that there could be increases in both oil and gas production during the year. However, the 2020 edition of the Business Outlook Report (Oil and Gas UK 2020), noted a further 3.9% decrease in gas production, with an overall reduction of 22% in the last decade.

11.7.3.6 In 2018, only 102 wells were drilled in the UKCS; 85 of which were development wells. A further eight wells were drilled for exploration along with eight appraisal wells. Oil and Gas UK (2020) confirmed 141 wells were drilled in 2019, a 38% increase in comparison to 2018. The oil and gas forecast for 2020 predicts a decrease in all drilling activity, due to Covid-19, noting it is likely that drilling activities which are not firm commitments with contracts in place will be delayed or cancelled. Oil and Gas UK (2021) confirmed this prediction with 71 wells (including seven exploration, two appraisal and 62 development) drilled in 2020, which is half the number drilled in 2019, as companies cancelled or deferred activities, with around a third of well decommissioning plans deferred. However, an increase in both drilling and decommissioning of wells is anticipated in 2021 (Oil and Gas UK 2021).

11.7.3.7 In the North Sea, many older fields and assets are being decommissioned or will be decommissioned in the coming years. For example, 230 fields in UK waters are expected to undergo decommissioning activity over the next decade, with over 6,000 km of pipelines slated for decommissioning by 2028 (Oil and Gas UK 2019a). Moreover, in the North Sea, 2,624 wells are expected to be decommissioned, with over 1.2 million tonnes of topsides forecast to be removed over the next decade (Oil and Gas UK 2019a).

11.7.3.8 As these older fields and associated infrastructure are decommissioned, helicopter use in the vicinity will reduce. However, future offshore renewable energy leasing rounds are likely to increase helicopter activity in the support of offshore wind farm developments. It is therefore considered a reasonable assumption that helicopter numbers will remain relatively constant, but the provider may gradually shift from servicing one offshore industry (oil and gas) to another (wind). On the other hand, the potential use of new marine technology such as using marine service and accommodation vessels equipped with walk-to-work systems is also offering an alternative to helicopters for the oil and gas industry (and future offshore wind developments).

11.7.3.9 As such, the baseline in the Hornsea Four study area described in **Section 11.7.1** is a 'snapshot' of the present oil and gas associated infrastructure, CCS activity and subsea cable developments which are gradually and continuously changing. Any changes that may occur by the time Hornsea Four is constructed and during the lifetime of Hornsea Four (i.e. construction, operation and maintenance and decommissioning) should be considered in the context of an evolving baseline, with continuous construction and decommissioning of oil and gas developments and other assets within the southern North Sea.

11.7.4 Data Limitations

11.7.4.1 The data sources used in this chapter are detailed in **Table 11.4** above. The data used are the most up to date publicly available information supported by information provided by relevant operators during consultation as detailed in **Section 11.4**. For example, Perenco REWS data was acquired through consultation for Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report). Operators and owners of CCS and subsea cable projects within the study areas also provided additional information through consultation.

11.7.4.2 Consultation with relevant stakeholders and operators has provided the most up-to-date information. Where consultation has not been undertaken further or has been limited due to operators identifying a lack of interaction between Hornsea Four and their assets, or due to commercial sensitivities, desk-based information has been used which will require confirmation through further consultation with relevant operators.

11.7.4.3 It is considered that the data employed is of a robust nature and sufficient for the purposes of describing the baseline of infrastructure and other users, including oil and gas activity, in the vicinity of Hornsea Four.

11.8 Project Basis for Assessment

11.8.1 Impact register and impacts not considered in detail in this ES

11.8.1.1 Upon consideration of the baseline environment, the project description outlined in **Volume A1, Chapter 4: Project Description**, the Hornsea Four Commitments detailed within **Volume A4, Annex 5.2: Commitments Register** and in response to formal Section 42 and Section 47 consultation informed by the production of the PEIR, several impacts are "not considered in detail in the ES". All impacts assessed within the PEIR for infrastructure and other users have been further considered in the ES, with no impacts falling into the category "not considered in detail in the ES". **Table 11.12** details impacts that were agreed to be scoped out during the Scoping phase (Orsted 2018). Further detail is provided in **Volume A4, Annex 5.1: Impacts Register**.

11.8.1.2 In July 2019, Highways England issued an update to the Design Manual for Roads and Bridges (DMRB) significance matrix (see **Volume A1, Chapter 5: Environmental Impact Assessment Methodology**). Impacts resulting in effects on infrastructure and other users that were formerly assessed within the category medium sensitivity and minor magnitude, as Minor (Not Significant), under the new guidance are now within the significance range of Slight or Moderate and, therefore, require professional judgement. Following a review of the relevant potential impacts it was considered that the changes do not alter the overall significance of the effects assessed at Scoping and in the PEIR (see **Volume A4, Annex 5.1: Impacts Register**).

11.8.1.3 Note that the Scoping Opinion provided by the SoS confirmed that the potential impacts on the following receptors should be scoped out of any further consideration in the EIA process (PINS 2018):

- Offshore telecommunications cables;
- Other offshore wind farms;

- Existing and proposed cables and pipelines;
- Ministry of Defence (MOD) Practice and Exercise Areas (PEXAs);
- Natural gas storage;
- Disposal sites; and
- Aggregate extraction.

11.8.1.4 A consideration of CCS was included in the Scoping process, however, following agreement with PINS to scope out these assets, it was not included in the PEIR. Nevertheless, following stakeholder consultation, consideration of the potential impact on the proposed Endurance CCS project has been included in this ES. However, it should be noted that there is currently limited publicly available information on the CCS projects associated with the Endurance CCS site.

Table 11.12: Infrastructure and other users impact register.

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
Impacts on aggregate extraction or resource areas (Construction, Operation and Maintenance and Decommissioning) (IOU-AP-1)	No likely significant effect	Scoped Out	Scoped out based on PINS Scoping Opinion (PINS Scoping Opinion, November 2018, ID: 4.12.1). Given that there are no licensed aggregate dredging sites within 30+ km of the Hornsea Four array area or offshore ECC, impacts on aggregate dredging activity will be scoped out of any further consideration in the EIA process.
Impacts on marine disposal sites (Construction, Operation and Maintenance and Decommissioning) (IOU-AP-2)	No likely significant effect	Scoped Out	Scoped out based on PINS Scoping Opinion (PINS Scoping Opinion, November 2018, ID: 4.12.2). As there are no active, licensed sites within or within 2 km of the Hornsea Four array area (excluding the adjacent Hornsea Project One and Hornsea Project Two sites) or offshore ECC, and significant effects are unlikely to occur at any phase of the project development on licensed disposal sites the receptor will be scoped out of any further consideration in the EIA process.
Temporary loss of access to existing or proposed pipelines or cables for repair or maintenance (Construction, Operation and Maintenance and Decommissioning) (IOU-AP-4)	No likely significant effect	Scoped Out	Scoped out based on PINS Scoping Opinion (PINS Scoping Opinion, November 2018, ID: 4.12.4 & 4.12.5). The operators of active pipelines and cables are deemed to be of medium vulnerability, medium recoverability and high value. The suggested embedded mitigation, including crossing and proximity agreements with known existing pipeline and cables operators, will ensure access for cable or pipeline repair and maintenance, and as such does not need to be considered any further in the assessment.
Displacement of recreational craft and recreational fishing vessels resulting in a loss of recreational resource (Construction, Operation and Maintenance and Decommissioning) (IOU-AP-5)	No likely significant effect	Scoped Out	A consideration of marine recreational activity was not included within the Scoping process. However, consideration of impacts were considered at PEIR, although the Applicant considered that there will be no significant impacts and therefore scoped out further consideration of impacts on marine recreational receptors at PEIR. No objection came forward from consultees in Section 42 responses. Due to the relatively limited recreational activity in the nearshore and offshore areas in

			the vicinity of Hornsea Four and the temporal and spatial nature of the works proposed in the ECC, no likely significant effects are expected to occur on marine recreational users and this potential impact will be scoped out of any further consideration in the EIA process.

Notes:
Grey – Potential impact is scoped out at EIA Scoping and both PINS and Hornsea Four agree.
Red – Potential impact is scoped out in the ES with justification provided.

11.8.1.5 Please note that the term "scoped out" relates to the Likely Significant Effect (LSE) in EIA terms and not "scoped out" of the EIA process per se. All impacts "scoped out" of LSE are assessed for magnitude, sensitivity of the receiving receptor and conclude an EIA significance in the Impacts Register (see **Volume A4, Annex 5.1**). This approach is aligned with the Hornsea Four Proportionate approach to EIA (see **Volume A1, Chapter 5: EIA Methodology**).

11.8.2 Commitments

11.8.2.1 Hornsea Four has adopted commitments (primary design principles inherent as part of Hornsea Four, installation techniques and engineering designs/modifications) as part of their pre-application phase, to eliminate and/or reduce the LSE arising from a number of impacts. These are outlined in **Volume A4, Annex 5.2: Commitments Register**. Further commitments (adoption of best practice guidance), referred to as tertiary commitments are embedded as an inherent aspect of the EIA process. Secondary commitments are incorporated to reduce LSE on offshore infrastructure and other users to acceptable levels following initial assessment i.e. so that residual effects are reduced to acceptable levels.

11.8.2.2 The commitments adopted by Hornsea Four that are relevant to reducing interface risks to infrastructure and other users including oil and gas receptors are presented in **Table 11.13**. These commitments in themselves are a mix of standard offshore practices that Hornsea Four will adhere to and specific risk reduction measures, that reduce interface risks between oil and gas operators, the operators of other relevant infrastructure assets and Hornsea Four.

Table 11.13: Relevant infrastructure and other users commitments.

Commitment ID	Measure proposed	How the measure will be secured
Co2	Primary: A range of sensitive historical, cultural and ecological conservation areas (including statutory and non-statutory designations) have been directly avoided by the permanent Hornsea Four footprint, at the point of Development Consent Order Submission (DCO). These include, but are not restricted to: Listed Buildings (564 sites); Scheduled Monuments (30 sites); Registered Parks and Gardens (Thwaite Hall and Risby Hall); Onshore Conservation Areas (18 sites); Onshore National Site Network (one site); Offshore National Site	DCO Works Plan – Onshore (**Volume D1, Annex 4.2: Works Plan – Onshore**); and DCO Works Plan – Offshore (**Volume D1, Annex 4.1: Works Plan – Offshore**)

Commitment ID	Measure proposed	How the measure will be secured
	Network (three sites); Offshore Marine Conservation Zones (two sites); Sites of Special Scientific Interest (two sites); Local Nature Reserves (none have been identified); Local Wildlife sites (33 sites); Yorkshire Wildlife Trust Reserves (none have been identified); Royal Society for the Protection of Birds (RSPB) Reserves (none have been identified); Heritage Coast; National Trust land; Ancient Woodland (10 sites and known Tree Preservation Orders (TPOs)); non-designated built heritage assets (334 sites); and historic landfill (none have been identified). Where possible, unprotected areas of woodland, mature and protected trees (i.e. veteran trees) have and will also be avoided.	
Co57	Tertiary: Where offshore export cables must cross third party infrastructure, such as existing cables and pipelines, both the third-party asset and the installed cables will be protected.	DCO Schedule 11, Part 2 - Condition 13(1)(h); and DCO Schedule 12, Part 2 - Condition 13(1)(h) (Cable specification and installation plan)
Co81	Tertiary: Where scour protection is required, MGN (or latest relevant available guidance) will be adhered to with respect to changes greater than 5% to the under keel clearance in consultation with MCA.	DCO Schedule 11, Part 2 - Condition 15; and DCO Schedule 12, Part 2 - Condition 15 (Offshore Safety Management)
Co89	Tertiary: Advance warning and accurate location details of construction, maintenance and decommissioning operations, associated Safety Zones and advisory passing distances will be given via Notice to Mariners (NtM) and Kingfisher Bulletins.	DCO Schedule 11, Part 2 - Condition 7; and DCO Schedule 12, Part 2 - Condition 7 (Notifications and inspections)
Co93	Tertiary: Aids to navigation (marking and lighting) will be deployed in accordance with the latest relevant available standard industry guidance and as advised by Trinity House, MCA CAA and MoD as appropriate. This will include a buoyed construction area around the array area and the HVAC booster station in consultation with Trinity House.	DCO Schedule 11, Part 2 - Condition 8; and DCO Schedule 12, Part 2 - Condition 8 (Aids to navigation) DCO Schedule 11, Part 2 - Condition 13(1)(j); and DCO Schedule 12, Part 2 - Condition 13(1)(j) (Aid to navigation management plan)
Co94	Tertiary: The UKHO will be notified of both the commencement (within two weeks), progress and completion of offshore construction works (within two weeks) to allow marking of all installed infrastructure on nautical charts.	DCO Schedule 11, Part 2 - Condition 7(10) and DCO Schedule 12, Part 2 - Condition 7(10) (Notifications and inspections)
Co96	Tertiary: The project commits to agree layout principles with the MMO, in consultation with the MCA and Trinity House.	DCO Schedule 11, Part 2 - Condition 13(1)(a) and DCO Schedule 12, Part 2 - Condition 13(1)(a)

Commitment ID	Measure proposed	How the measure will be secured
		(Pre-construction plans and documentation)
Co98	Tertiary: Monitoring and annual reporting of vessel traffic for the duration of the construction period.	DCO Schedule 11, Part 2 - Condition 18(2)(b) and DCO Schedule 12, Part 2 - Condition 18(2)(b) (Construction Monitoring)
Co99	Tertiary: Hornsea Four will ensure compliance with MGN 654 where appropriate.	DCO Schedule 11, Part 2 - Condition 15; and DCO Schedule 12, Part 2 - Condition 15 (Offshore safety management)
Co102	Tertiary: The Defence Infrastructure Organisation and the CAA will be informed of the locations, heights and lighting status of the wind turbines, including estimated and actual dates of construction and the maximum height of any construction equipment to be used, prior to the start of construction, to allow inclusion on Aviation Charts.	DCO Schedule 11, Part 2 - Condition 10; and DCO Schedule 12, Part 2 - Condition 10 (Aviation Safety)
Co107	Tertiary: Crossing and proximity agreements with known existing pipeline and cable operators will be sought.	Secured by commercial agreements with pipeline and cable operators.
Co139	Secondary: Safety zones of up to 500 m will be applied during construction, maintenance and decommissioning phases. Where defined by risk assessment, guard vessels will also be used to ensure adherence with Safety Zones or advisory passing distances to mitigate impacts which pose a risk to surface navigation during construction, maintenance and decommissioning phases.	Application for safety zones to be made post consent under 'The Electricity (Offshore Generating Stations) (Safety Zones) (Applications Procedures and Control of Access) Regulations 2007 (SI No 2007/1948)'. Safety zones required are also detailed within **Volume A1, Chapter 4: Project Description**.
Co181	Tertiary: An Offshore Decommissioning Plan will be developed prior to decommissioning.	DCO Schedule 11, Part 1(6); and DCO Schedule 12, Part 1(6) (General Provisions)
Co201	Primary: Gravity Base Structure (GBS) foundations (WTG type) will be utilised at a maximum of 110 of the 180 WTG foundation locations. The location of GBS foundations, if used for WTG, will be confirmed through a construction method statement which will include details of foundation installation methodology.	DCO Schedule 11, Part 2 - Condition 13(1(c) (Construction Method Statement)

11.9 Maximum Design Scenario (MDS)

11.9.1.1 This section describes the MDS parameters on which the infrastructure and other users' assessment has been based. These are the parameters which are judged to give rise to the maximum levels of assessment undertaken, as set out in **Volume A1, Chapter 4: Project Description**. Should Hornsea Four be constructed using different parameters

within the design envelope, then impacts would not be any greater than those set out in this ES using the MDS presented in **Table 11.14**:.

Table 11.14: MDS for impacts on infrastructure and other users.

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
Construction			
CCS Impacts			
Hornsea Four construction activity, infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS site and associated development activity and infrastructure (IOU-C-1).	Primary: Co201 Secondary: Co139 Tertiary: Co57 Co81 Co89 Co93 Co94 Co107	**Total temporary reduction** **WTG and platforms within the Array Area** • Seabed preparation for 110 GBS (WTG type) foundations for WTGs = 411,321 m^2; • Seabed preparation for 70 suction caisson jacket (WTG type) foundations for WTGs = 198,870 m^2; • Seabed preparation for offshore substations (OSS) within the array (three large OSS on GBS (large OSS) foundations and six small OSS on suction caisson jacket (small OSS) = 156,594 m^2; • Seabed preparation for one accommodation platform on a suction caisson jacket (small OSS) foundation = 12,321 m^2. **Offshore cables within the Array Area** • Boulder and sandwave clearance for array cables (600 km length, 40 m width) = 24,000,000 m^2; • Burial of array cables (600 km length, 15 m width) = 9,000,000 m^2; • Boulder and sandwave clearance for interconnector cables (90 km length, 40 m width) = 3,600,000 m^2; and • Burial of interconnector cables (90 km length, 15 m width) = 1,350,000 m^2. **Offshore platforms within the ECC** • Seabed preparation for three HVAC booster stations on suction caisson jacket (small OSS) foundations = 36,963 m^2. **Offshore Cables within the ECC** • Boulder and sandwave clearance for export cables (654 km length, 40 m width) = 26,160,000 m^2; • Burial of export cables (654 km length, 15 m width) = 9,810,000 m^2; and • Cable jointing (four joints per cables, six cables and 3,500 m^2 per joint) = 84,000 m^2. **Safety Zones and Passing Distances:**	Parameters that create the greatest reduction in available sea room and are most likely to give rise to potential interactions with CCS activities in terms of area affected and duration.

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
		• 500 m exclusion zones around construction activities = 790,000 m^2 per structure under construction at any one time; • 50 m exclusion zones around incomplete structures = 7,854 m^2 per partially constructed structure at any one time; and • Roaming 500 m safe passing distance for mobile installation vessels, which may, in exceptional circumstances, be increased to 1,000 m dependant on the nature of the installation works. **Construction Duration:** A single phase of offshore construction over an approximately 3-year period, including: • Foundation installation = 12 months; • Turbine installation = 24 months • Platform installation = two months per platform; and • Cable installation = 24 months. **<u>Total permanent reduction</u>** **WTG and platforms within the Array Area** • Turbine footprint with scour protection, based on 110 GBS (WTG-type) foundations = 504,540 m^2; • Turbine footprint with scour protection, based on 70 suction caisson jacket (WTG type) foundations = 296,881 m^2; • Total seabed area for OSS in the array (three large OSS on GBS (large OSS) foundations and six small OSS on GBS (Box-type) foundations, including associated scour protection = 371,250 m^2; and • Total seabed area for one offshore accommodation platform within the array on a small OSS foundation (GBS (Box-type)), including associated scour protection = 30,625 m^2. **Offshore cables within Array Area** • Cable protection for array cables = 624,000 m^2; • Cable protection for interconnector cables = 94,000 m^2; and • Pre- and post-lay rock berm area for 32 cables crossings within the array area = 204,000 m^2. **Offshore platforms within ECC**	

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
		• Total seabed area for three HVAC booster stations on small OSS GBS (Box-type) foundations, including associated scour protection = 91,875 m^2. **Offshore cables within ECC** • Cable protection for export cables = 792,000 m^2; • Pre- and post-lay rock berm area for 54 cable crossings within the offshore ECC = 344,000 m^2. **Duration:** Offshore construction phase approximately three years.	
Oil and Gas Operational Impacts			
Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-C-2).	Primary: Co201 Secondary: Co139 Tertiary: Co81 Co89 Co94 Co96 Co98 Co102 Co107	As per MDS for "Hornsea Four construction activity, infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS site and associated development activity and infrastructure" (IOU-C-1).	Parameters that create the greatest disruption in available sea room and the greatest disruption to vessel access in terms of area affected and duration.
The piling of Hornsea Four wind turbine and substation foundations will generate vibration that may cause damage to existing pipelines and wells (IOU-C-3).	Secondary: Co139 Tertiary: Co107	**Array Area (spatial MDS):** • Up to 180 monopile WTG foundations (15 m diameter) with two foundations installed concurrently; • Up to six small OSS (15 m diameter monopiles); • Up to three large OSS (15 m diameter monopiles); • One offshore accommodation platform (15 m diameter monopiles); • Maximum hammer energy 5,000 kJ; and • 216 piling days (single vessel) or 106 piling days (two vessels). **Array Area (temporal MDS):**	Parameters that equate to the largest number of piling activities and for the greatest duration. It is important to note that three HVDC converter substations in the array area are mutually exclusive with three HVAC booster stations along the ECC in a single transmission system. As

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
		• Up to 180 WTGs on piled jacket (WTG-type) foundations (three 4 m diameter pin piles per jacket) – 540 pin piles; • Up to six OSS on piled jacket (small OSS) foundations (six legs per jacket and four 3.5 m pin piles per leg) – 144 pin piles; • Up to three OSS on piled jacket (large OSS) foundations (eight legs per jacket and two piles per leg) – 48 pin piles; • One offshore accommodation platform on a piled jacket (small OSS) foundation (six legs and four 3.5 m pin piles per leg – 24 pin piles; • Total of 756 pin piles in the array; • Maximum hammer energy 3,000 kJ; and • 270 piling days (single vessel) or 135 days (two vessels). **HVAC Booster Area of Search (spatial MDS):** • Up to three HVAC booster stations on 15 m diameter monopile foundations; • Maximum hammer energy 5,000 kJ; and • 1.2 days per monopile. **HVAC Booster Area of Search (temporal MDS):** • Up to three HVAC booster stations on piled jacket (small OSS) foundations (six legs per jacket and four 3.5 m diameter pin piles per leg) – 72 pin piles; • Maximum hammer energy 3,000 kJ; and • 1.5 days per jacket foundation.	secured by **C1.1 Draft DCO including Draft DML**, a maximum of ten OSS and platforms will be constructed within the Hornsea Four Order Limits, however in order to assess the MDS for both the array and the ECC, the presence of the maximum numbers of OSS and platforms in each area has been considered (ten and three, respectively). As a result, the outcome of the assessment is therefore inherently precautionary.
Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells. (IOU-C-4).	Secondary: Co139 Tertiary: Co107	**Construction Timeline:** • Construction over approximately three years. **Buoyed Construction Areas:** • Maximum extent of the Hornsea Four array area including 500 m construction safety zones and 50 m pre-commissioning safety zones; and • 500 m construction safety zones deployed around the HVAC booster stations. **Construction Vessels:** • Up to eight construction vessels within a given 5 km^2 area with approximately three or four 5 km^2 areas at any one time; • Up to 77 for the WTG foundations engaged at any given time with up to 2,880 return trips;	Parameters that create the greatest reduction in available sea room and are most likely to give rise to potential interactions with existing pipelines, and wells

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
		• Up to 38 for the WTGs engaged at any given time with up to 900 return trips; • Up to 18 for substation and accommodation platform foundations engaged at any given time with up to 180 return trips; • Up to 18 for substation and accommodation platform installation engaged at any given time with up to 270 return trips; • Up to 18 for the inter-array and interconnector cables engaged at any one time with up to 1,488 return trips; and • Up to 24 for the export cables engaged at any given time with up to 408 return trips.	
Oil and Gas Operations: Shipping and Navigational Impacts			
Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of Hornsea Four infrastructure (IOU-C-5).	Secondary: Co139 Tertiary: Co81 Co89 Co93	**The presence of the installed Hornsea Four infrastructure:** • Construction of up to 180 WTGs utilising the entire array area (468 km^2); • Up to ten offshore platforms within the array area (up to six small OSS, up to three large OSS and a single accommodation platform); and • Up to three HVAC booster stations within the HVAC booster station search area. **Safety zones:** • 500 m safety zones around infrastructure under construction; and • 50 m safety zones around incomplete structures.	Parameters that create the greatest reduction in available sea room and are most likely to give rise to deviation of shipping from existing routes. It is important to note that three HVDC converter substations in the array area are mutually exclusive with three HVAC booster stations along the ECC in a single transmission system. As secured by **C1.1 Draft DCO including Draft DML**, a maximum of ten OSS and platforms will be constructed within the Hornsea Four Order Limits, however in order to assess the MDS for both the array and the ECC, the presence of the maximum numbers of OSS and platforms in each area has been considered (ten and three, respectively). As a result, the outcome of the

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
			assessment is therefore inherently precautionary.
Proximity to Hornsea four infrastructure and associated works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-C-6).	Secondary: Co139 Tertiary: Co81 Co89 Co93 Co94	**The presence of the installed Hornsea Four infrastructure within the Array Area:** • Construction of up to 180 WTGs utilising the entire array area (468 km^2); and • Up to ten offshore platforms within the array area (up to six small OSS, up to three large OSS and a single accommodation platform). **The WTG dimensions are as follows:** • 42.43 m minimum height of lowest blade tip above Lowest Astronomical Tide (LAT); • 370 m maximum blade tip height above LAT; • 305 m maximum rotor blade diameter; and • Minimum turbine spacing of 810 m. **Offshore platforms within the Array Area** • A single accommodation platform with max height 64 m above LAT; • Six small platforms with a height of 90 m; and • Three large offshore platforms with height of 100 m LAT. **Offshore platforms within the ECC** • Three HVAC substations with a height of 100 m LAT; and • Minimum spacing of 100 m. **Safety zones:** • 500 m safety zones around infrastructure under construction; and • 50 m safety zones around incomplete structures.	Parameters that create the greatest disruption to vessel access in terms of area affected and duration. It is important to note that three HVDC converter substations in the array area are mutually exclusive with three HVAC booster stations along the ECC in a single transmission system. As secured by **C1.1 Draft DCO including Draft DML**, a maximum of ten OSS and platforms will be constructed within the Hornsea Four Order Limits, however in order to assess the MDS for both the array and the ECC, the presence of the maximum numbers of OSS and platforms in each area has been considered (ten and three, respectively). As a result, the outcome of the assessment is therefore inherently precautionary.

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
Wind turbines and associated works may result in deviations to routine support vessel routeing to oil and gas platforms (IOU-C-7).	Secondary: Co139 Tertiary: Co81 Co89 Co93 Co94	As per MDS for "Proximity to Hornsea Four infrastructure and associated works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-C-6)."	As MDS justification provided above for IOU-C-7.
Oil and Gas Operations: Future Development Impacts			
Hornsea Four infrastructure, safety zones, advisory safety distances and piling may restrict or cause acoustic interference with potential seismic survey activity (IOU-C-8).	Secondary: Co139 Tertiary: Co57 Co89 Co93 Co94 Co96 Co98 Co102 Co107	As per the MDS for "The piling of Hornsea Four wind turbine and substation foundations will generate vibration that may cause damage to existing pipelines and wells (IOU-C-3)."	Parameters that create the greatest disruption to future seismic survey activities in terms of area affected and duration (see **paragraph 11.1.2.3**).
Drilling and the installation/ decommissioning of oil and gas infrastructure has the potential to be restricted by the presence of Hornsea Four infrastructure, safety zones and advisory safety distances (IOU-C-9).	Secondary: Co139 Tertiary: Co57 Co81 Co89 Co94 Co96 Co98 Co102 Co107	As per MDS for "Hornsea Four construction activity, infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS site and associated development activity and infrastructure (IOU-C-1)."	Parameters that create the greatest disruption to oil and gas drilling and installation activities, including oil and gas decommissioning in terms of area affected and duration (see **paragraph 11.1.2.3**).
Operation and Maintenance			

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
CCS Impacts			
Hornsea Four infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS Site and associated infrastructure (IOU-O-10).	Primary: Co201 Secondary: Co139 Tertiary: Co57 Co81 Co89 Co93 Co94 Co107	**Total permanent reduction:** **WTGs and platforms within the Array Area** • Total seabed area for 110 GBS (WTG-type) foundations = 504,540 m^2; • Total seabed area for 70 suction caisson jacket (WTG type) foundations = 296,881 m^2; • Minimum turbine spacing of 810 m; • Total seabed area for OSS in the array (three large OSS on GBS (large OSS) foundations and six small OSS on GBS (Box-type) foundations, including associated scour protection = 371,250 m^2; and • Total seabed area for one offshore accommodation platform within the array on a small OSS foundation (GBS (Box-type), including associated scour protection = 30,625 m^2. **Offshore cables within Array Area** • Cable protection for array cables = 624,000 m^2; • Cable protection for interconnector cables = 94,000 m^2; and • Pre- and post-lay rock berm area for 32 cables crossings within the array area = 204,000 m^2. **Offshore platforms within the ECC** • HVAC booster station foundations footprint and scour protection, based on three small OSS foundations (GBS (Box-type)) = 91,875 m^2; and • Minimum spacing of 100 m. **Offshore cables within the ECC** • Cable protection for export cables = 792,000 m^2; • Pre- and post-lay rock berm area for 54 cable crossings within the offshore ECC = 344,000 m^2. **Temporary reduction from maintenance activities:** **WTG Activities** • Component replacement = 378,000 m^2; • Access ladder replacement = 378,000 m^2; • Foundation anode replacement = 378,000 m^2; and • J-Tube repair/ replacement = 108,000 m^2. **Offshore substation and accommodation platform activities within the Array Area**	Parameters that create the greatest reduction in available sea room and are most likely to give rise to potential interactions with CCS activities in terms of area affected and duration.

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
		• Offshore substation component replacement = 6,00 m^2; • Access ladder replacement = 21,000 m^2; • Foundation anode replacement = 21,000 m^2; and • J-Tube repair/ replacement = 6,000 m^2. **Array cable activities** • Remedial burial of array cables (42 km total length reburied) = 4,200,000 m^2; • Array cable repairs = 363,736 m^2; • Cable protection replacement = 156,000 m^2; • Ten array cable repair events over lifetime; and • Duration of each cable repair event: approximately three months. **Interconnector cable activities** • Remedial burial of interconnector cables (7 km total length reburied) = 700,000 m^2; • Interconnector cable repairs = 20,028 m^2; • Cable protection replacement = 23,500 m^2; • Three interconnector cable repair events over lifetime; and • Duration of each cable repair event approximately three months. **ECC Activities** • Remedial burial of export cables (14 km total length reburied) = 1,400,000 m^2; • Export cable repairs = 153,548 m^2; • Cable protection replacement = 198,000 m^2; and • Duration of each cable repair event: approximately three months. **HVAC booster station activities** • Offshore substation component replacement = 1,800 m^2; • Access ladder replacement = 6,300 m^2; • Foundation anode replacement = 6,300 m^2; and • J-Tube repair/ replacement = 1,800 m^2. **Safety Zones:** • 500 m safety zones around manned offshore platforms; and	

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
		• Temporary 500 m safety zones around turbines and offshore platforms undergoing major maintenance. **Duration:** Operational design life of 35 years.	
Oil and Gas Operational Impacts			
Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon loss of access to existing pipelines and wells for repairs and maintenance (IOU-O-11)	Secondary: Co139 Tertiary: Co57 Co81 Co89 Co94 Co96 Co98 Co102	As per MDS for "Hornsea Four infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS Site and associated infrastructure (IOU-O-10)."	Parameters that create the greatest reduction in available sea room and the greatest disruption to vessel access in terms of area affected and duration.
Anchor snagging or anchor dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells (IOU-O-12)	Secondary: Co139 Tertiary: Co107	**The presence of installed Hornsea Four infrastructure** • 180 WTGs utilising the entire array area (468 km^2); • 10 offshore platforms within the array area (up to six small OSS, three large OSS and one accommodation platform); • Three HVAC booster stations within the HVAC booster station area of search. **Total of 1,433 return vessel trips per year:** • 124 jack-up vessel return trips; • 1,205 crew vessels return trips; and • 104 supply vessel return trips. **Safety zones:** • 500 m safety zone around manned offshore platforms; and • Temporary 500 m safety zones around turbines and offshore platforms undergoing major maintenance. **Duration:** • Anticipated design life for Hornsea Four of 35 years.	Parameters that create the greatest reduction in available sea room and are most likely to give rise to potential interactions with existing pipelines and wells. It is important to note that three HVDC converter substations in the array area are mutually exclusive with three HVAC booster stations along the ECC in a single transmission system. As secured by C1.1 Draft DCO including Draft DML, a maximum of ten OSS and platforms will be constructed within the Hornsea Four Order Limits, however in

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
			order to assess the MDS for both the array and the ECC, the presence of the maximum numbers of OSS and platforms in each area has been considered (ten and three, respectively). As a result, the outcome of the assessment is therefore inherently precautionary.
Oil and Gas Operations: Shipping and Navigational Impacts			
Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of Hornsea Four infrastructure (IOU-O-13).	Secondary: Co139 Tertiary: Co81 Co89 Co93	**Installed Hornsea Four infrastructure** • WTGs and offshore platforms utilising the entire array area (468 km^2); and • Three HVAC booster stations within the HVAC booster station area of search. **Safety zones:** • 500 m safety zone around manned offshore platforms; and • Temporary 500 m safety zones around turbines and offshore platforms undergoing major maintenance. **Duration:** • Anticipated design life 35 years.	Parameters that create the greatest reduction in available sea room and are most likely to give rise to deviation of shipping from existing routes. It is important to note that three HVDC converter substations in the array area are mutually exclusive with three HVAC booster stations along the ECC in a single transmission system. As secured by **C1.1 Draft DCO including Draft DML**, a maximum of ten OSS and platforms will be constructed within the Hornsea Four Order Limits, however in order to assess the MDS for both the array and the ECC, the presence of the maximum numbers of OSS and platforms in each area has been considered (ten and three, respectively). As a

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
			result, the outcome of the assessment is therefore inherently precautionary.
Proximity to Hornsea Four infrastructure and associated works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-O-14).	Secondary: Co139 Tertiary: Co81 Co89 C093	As per MDS for "Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of Hornsea Four infrastructure (IOU-O-13)."	Parameters that create the greatest disruption to vessel access in terms of area affected and duration.
Wind turbines and associated works may result in deviations to routine support vessel routeing to oil and gas platforms (IOU-O-15).	Secondary: Co139 Tertiary: Co89 Co93 Co94	As per MDS for "Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of Hornsea Four infrastructure (IOU-O-13)."	As MDS justification provided above for IOU-O-16.
The presence of new wind turbines in previously open sea areas may cause interference with the performance of the REWS located on oil and gas platforms (IOU-O-16).	Tertiary: Co89 Co93	**The presence of the installed Hornsea Four infrastructure within the Array Area:** • Up to 180 WTGs utilising the entire array area (468 km^2); and • Up to 10 offshore platforms within the array area (up to six small OSS, three large OSS and one accommodation platform). **The wind turbine dimensions are as follows:** • 42.43 m minimum height of lowest blade tip above LAT; • 370 m maximum blade tip height above LAT; and • 305 m maximum rotor blade diameter. **Duration:** • Anticipated design life 35 years.	Parameters that create the greatest reduction in available sea room and are most likely to give rise to deviation of shipping from existing routes.

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
The presence of new wind turbines in previously open sea areas will deviate vessels which may cause a change in CPA and TCPA alarms on oil and gas platforms equipped with REWS (IOU-O-17).	Tertiary: Co89 Co93	As per MDS for "The presence of new wind turbines in previously open sea areas may cause interference with the performance of the REWS located on oil and gas platforms (IOU-O-16)."	Parameters that create the greatest number of turbines with the greatest RCS.
Oil and Gas Operations: Aviation Impacts			
Hornsea Four infrastructure and associated works may restrict or hamper helicopter access to oil and gas platforms (IOU-O-18).	Tertiary: Co99	**The presence of the installed Hornsea Four infrastructure within the Array Area:** • Up to 180 WTGs utilising the entire array area (468 km^2) • Up to 10 offshore platforms within the array area (up to six small OSS, three large OSS and one accommodation platform) **The wind turbine dimensions are as follows:** • 42.43 m minimum height of lowest blade tip above LAT • 370 m maximum blade tip height above LAT • 305 m maximum rotor blade diameter • Minimum turbine spacing of 810 m **Offshore platforms within the Array Area** • A single accommodation platform with max height 64 m above LAT; • Six small platforms with a height of 90 m; and • Three large offshore platforms with height of 100 m LAT **Duration:** • Anticipated design life of 35 years	The maximum number of wind turbines and other structures within the array area affecting the operation of helicopters approaching or departing from oil and gas platforms. It is important to note that three HVDC converter substations in the array area are mutually exclusive with three HVAC booster stations along the ECC in a single transmission system. As secured by **C1.1 Draft DCO including Draft DML**, a maximum of ten OSS and platforms will be constructed within the Hornsea Four Order Limits, however in order to assess the MDS for both the array and the ECC, the presence of the maximum numbers of OSS and platforms in

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
			each area has been considered (ten and three, respectively). As a result, the outcome of the assessment is therefore inherently precautionary.
Hornsea Four infrastructure and associated works may restrict or hamper helicopter access to oil and gas vessels (IOU-O-19).	Tertiary: Co99	**The presence of the installed Hornsea Four infrastructure within the Array Area:** • Up to 180 WTGs utilising the entire array area (468 km^2); • Up to 10 offshore platforms within the array area (up to six small OSS, three large OSS and one accommodation platform) **The wind turbine dimensions are as follows:** • 42.43 m minimum height of lowest blade tip above LAT • 370 m maximum blade tip height above LAT • 305 m maximum rotor blade diameter • Minimum turbine spacing of 810 m. **Offshore platforms within the Array Area** • A single accommodation platform with max height 64 m above LAT; • Six small platforms with a height of 90 m; and • Three large offshore platforms with height of 100 m LAT **The presence of the installed HVAC Booster Stations:** • Three HVAC substations with height of 100 m LAT • Minimum spacing of 100 m. **Duration:** Anticipated design life of 35 years	As above in relation to helicopter access to oil and gas vessels.
Oil and Gas Operations: Future Development Impacts			
Hornsea Four infrastructure, safety zones and advisory safety distances may restrict or cause interference with	Secondary: Co139 Tertiary: Co57 Co89	As per MDS for "Hornsea Four infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS Site and associated infrastructure (IOU-O-10)".	Parameters that create the greatest disruption to future seismic survey activities in terms of area affected and duration (see **paragraph 11.1.2.3**).

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
potential seismic survey activity (IOU-O-20).			
Drilling and the installation/ decommissioning of oil and gas infrastructure has the potential to be restricted by the presence of Hornsea Four infrastructure, safety zones and advisory safety distances (IOU-O-21).	Secondary: Co139 Tertiary: Co57 Co81 Co89	As per MDS for "Hornsea Four infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS Site and associated infrastructure (IOU-O-10)".	Parameters that create the greatest disruption to oil and gas drilling and installation activities in terms of area affected and duration (see **paragraph 11.1.2.3**).
Oil and Gas Operations: General Impacts			
Impact of physical presence of wind turbines in Hornsea Four array area on microwave links (IOU-O-22).	Tertiary: Co89 Co93	As per MDS for "The presence of new wind turbines in previously open sea areas may cause interference with the performance of the REWS located on oil and gas platforms (IOU-O-16)."	Parameters that create the greatest number of turbines with the greatest RCS.
Decommissioning			
CCS Impacts			
Hornsea Four decommissioning activity, infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS Site and associated development activity	Secondary: Co139 Tertiary: Co57 Co81 Co89 Co93 Co94 Co107	In the absence of detailed methodologies and schedules, decommissioning works and associated implications for access to existing Endurance CCS assets for repairs and maintenance are considered analogous with those assessed for the construction phase. • Decommissioning of up to 180 WTGs; • Decommissioning of up to ten offshore platforms within the array area (six small OSS, three large OSS and a single accommodation platform); • Decommissioning of six export cables; and • Removal of cables utilising the entire offshore ECC. **Safety zones:**	Parameters that create the CCS activities in terms of area affected and duration.

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
and infrastructure (IOU-D-23).	Co181	• 500 m safety zone around infrastructure being decommissioned **Duration:** Decommissioning period of three years.	
Oil and Gas Operational Impacts			
Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon of access to existing pipelines and wells for repairs and maintenance (IOU-D-24).	Secondary: Co139 Tertiary: Co89 Co94 Co96 Co98 Co102 Co107 CO181	In the absence of detailed methodologies and schedules, decommissioning works and associated implications for access to existing oil and gas assets for repairs and maintenance are considered analogous with those assessed for the construction phase. • Decommissioning of up to 180 WTGs; • Decommissioning of up to ten offshore platforms within the array area (six small OSS, three large OSS and a single accommodation platform); • Decommissioning of three HVAC booster stations; • Decommissioning of six export cables; and • Removal of cables utilising the entire offshore ECC. **Safety zones:** • 500 m safety zone around infrastructure being decommissioned **Duration:** Decommissioning period of three years	Parameters that create the greatest reduction in available sea room and the greatest disruption to vessel access in terms of area affected and duration.
Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells (IOU-D-25).	Secondary: Co139 Tertiary: Co107 Co181	As per MDS for "Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-D-24)."	Parameters that create the greatest reduction in available sea room and are most likely to give rise to potential interactions with existing pipelines and wells.
Oil and Gas Operations: Shipping and Navigational Impacts			
Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of	Secondary: Co139 Tertiary: Co81 Co89	As per MDS for "Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-D-24)."	Parameters that create the greatest reduction in available sea room and are most likely to give rise to deviation of shipping from existing routes.

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
partially decommissioned Hornsea Four infrastructure (IOU-D-26).	Co93 Co181		
Proximity to Hornsea Four infrastructure partially decommissioned and associated decommissioning works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-D-27).	Secondary: Co139 Tertiary: Co89 Co181	As per MDS for "Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-D-24)."	Parameters that create the greatest disruption to vessel access in terms of area affected and duration.
Wind turbine decommissioning and associated works may result in deviations to routine support vessel routeing to oil and gas platforms (IOU-D-28).	Secondary: Co139 Tertiary: Co81 Co89 Co93 Co181	As per MDS for "Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-D-24)."	As MDS justification provided above for IOU-D-24.
Oil and Gas Operations: Future Development Impacts			
Hornsea Four infrastructure, safety zones and advisory safety distances may	Secondary: Co139 Tertiary: Co89	As per MDS for "Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-D-24)."	Parameters that create the greatest disruption to seismic survey activities in terms of area

Impact	Embedded Mitigation Measures	Maximum Design Scenario/Rochdale Envelope	Justification
restrict or cause interference with potential seismic survey activity (IOU-D-29).	Co181		affected and duration (see **paragraph 11.1.2.3**).
Drilling and the installation/ decommissioning of oil and gas infrastructure has the potential to be restricted by the presence of Hornsea Four infrastructure, safety zones and advisory safety distances (IOU-D-30).	Secondary: Co139 Tertiary: Co89 Co181	As per MDS for "Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-D-24)."	Parameters that create the greatest disruption to oil and gas drilling and installation activities in terms of area affected and duration (see **paragraph 11.1.2.3**).

11.10 Assessment Methodology

11.10.1 Impact Assessment Criteria

11.10.1.1 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts to CCS developments. The terms used to define sensitivity and magnitude are based on those used in the DMRB methodology, which is described in further detail in **Volume A1, Chapter 5: Environmental Impact Assessment Methodology**.

11.10.1.2 The criteria for defining sensitivity in this chapter for the assessment of potential impacts on CCS development activities are outlined in **Table 11.15**.

Table 11.15: Definition of terms relating to receptor sensitivity.

Sensitivity	Definition used in this chapter
Very High	Receptor or the activities of the receptor, is of critical importance to the local, regional or national economy and/or the receptor or the activities of the receptor, is highly vulnerable to impacts that may arise from the project and/or recoverability is long term or not possible.
High	Receptor or the activities of the receptor, is of high value to the local, regional or national economy and/or the receptor or the activities of the receptor, is generally vulnerable to impacts that may arise from the project and/or recoverability is slow and/or costly.
Medium	Receptor or the activities of the receptor, is of moderate value to the local, regional or national economy and/or the receptor or the activities of the receptor, is somewhat vulnerable to impacts that may arise from the project and/or has moderate to high levels of recoverability.
Low	Receptor or the activities of the receptor, is of low value to the local, regional or national economy and/or the receptor or the activities of the receptor, is not generally vulnerable to impacts that may arise from the project and/or has high recoverability.

11.10.1.3 The definitions of defining magnitude used in the assessment of potential impacts on CCS development activities are defined in **Table 11.16** below.

Table 11.16: Definition of terms relating to magnitude of an impact.

Magnitude of impact	Definition used in this chapter
Major	Total loss of ability to carry on activities and/or impact is of extended physical extent and/or long-term duration (i.e. total life of project and/or frequency of repetition is continuous and/or effect is not reversible for project (impact will be reversible post-decommissioning)).
Moderate	Loss or alteration to significant portions of key components of current activity and/or physical extent of impact is moderate and/or medium-term duration (i.e. operational period) and /or frequency of repetition is medium to continuous and/or effect is not reversible for project phase (impact will be reversible post-decommissioning).
Minor	Minor shift away from baseline, leading to a reduction in level of activity that may be undertaken and/or physical extent of impact is low and/or short to medium term duration (i.e. construction period) and/or frequency of repetition is low to continuous and/or effect is not reversible for project phase (impact will be reversible post-decommissioning).

Magnitude of impact	Definition used in this chapter
Negligible	Very slight change from baseline condition and/or physical extent of impact is negligible and/or short-term duration (i.e. less than two years) and/or frequency of repetition is negligible to continuous and/or effect is reversible.

11.10.1.4 The significance of the effect upon infrastructure and other users, in relation to CCS development activities is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The method employed for this assessment is presented in **Table 11.17** where a range of significance of effect is presented, the final assessment for each effect is based upon expert professional judgement.

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

Table 11.17: Matrix used for the assessment of the significance of the effect.

		Magnitude of impact (degree of change)			
		Negligible	*Minor*	*Moderate*	*Major*
Environmental value (sensitivity)	*Low*	Neutral or Slight (Not Significant)	Neutral or Slight (Not Significant)	Slight (Not Significant)	Slight (Not Significant) or Moderate (Significant)
	Medium	Neutral or Slight (Not Significant)	Slight (Not Significant) or Moderate (Significant)	Moderate or Large (Significant)	Moderate or Large (Significant)
	High	Slight (Not Significant)	Slight (Not Significant) or Moderate (Significant)	Moderate or Large (Significant)	Large or Very Large (Significant)
	Very High	Slight (Not Significant)	Moderate or Large (Significant)	Large or Very Large (Significant)	Very Large (Significant)

11.10.2 Oil and Gas Risk Assessment

11.10.2.1 The risk assessment provided in **Volume A5, Annex 11.1: Offshore Installation Interfaces** sets out the methodology used to evaluate the majority of risks for the interface between oil and gas assets and activities associated with the development of Hornsea Four. The risk significance used during this assessment is provided in **Table 11.18**. Where required, mitigation measures have been proposed that will ensure risks are ALARP for oil and gas operations and infrastructures.

11.10.2.2 Under the assessment methodology detailed in **Volume A5, Annex 11.1: Offshore Installations Interfaces**, impacts that are broadly acceptable or tolerable with mitigation are considered to be ALARP and therefore not significant. Impacts that are of an unacceptable risk level are deemed to be significant. **Table 11.18** details how the

outcomes of the assessment presented in **Volume A5, Annex 11.1: Offshore Installations Interfaces** have been translated into levels of significance for this chapter.

Table 11.18: Risk Significance as provided in Volume A5, Annex 11.1: Offshore Installation Interfaces.

Risk Significance	Description	Significance of effect
Broadly Acceptable	These are considered low risks and by their nature are ALARP.	**Not significant**
Tolerable with Mitigation	These are risks in the "ALARP" region, that can become acceptable with adequate risk reducing measures implemented.	**Not significant**
Un-acceptable risk level[8]	High risks that are un-acceptable that require to be eliminated/designed out or re-engineered to make them acceptable.	**Significant**

11.11 Impact Assessment

11.11.1.1 The construction, operation and maintenance, and decommissioning of Hornsea Four has the potential to result in direct and indirect impacts on infrastructure and other users. The following section provides an assessment of the potential impacts and the subsequent effects upon infrastructure and other users.

11.11.1.2 The assessment undertaken includes direct impacts upon relevant CCS and oil and gas assets (further detail of the oil and gas assessment is provided in **Section 11.11.2** below). For the purposes of this ES, therefore, the potential safety impacts are identified and discussed and the proposed approach to the more detailed assessment process to support the DCO application is described.

11.11.1.3 The assessments of impacts on oil and gas activity are considered from a safety perspective only and the associated conclusions reflect whether the presence of Hornsea Four has any implications for the safety of each stakeholder's assets and associated activities in line with the assessments presented in Section 7 to 19 of **Volume A5, Annex 11.1: Offshore Installations.** Issues of a commercial nature are therefore not considered in this impact assessment. However, further information on commercial considerations are addressed in Section 20 of **Volume A5, Annex 11.1: Offshore Installations**, with discussions ongoing with the relevant operators.

11.11.2 Oil and Gas Assessments

11.11.2.1 There are four main categories of potential impacts upon oil and gas receptors/operations that have been defined for the purposes of this assessment as follows:

- Those that relate to oil and gas exploration and production (including pipelines, seismic surveys and drilling, construction and decommissioning of platforms);

[8] It should be noted that the **Volume A5, Annex 11.1: Offshore Installation Interfaces**, and its associated appendices did not identify any assets or activities which would result in 'un-acceptable risk level'.

- Those that relate to safety of oil and gas platforms in relation to shipping and navigation (REWS and allision risk);
- Those that relate to helicopter access to oil and gas infrastructure and vessels; and
- Those which relate to the general safe operations of the oil and gas industry (microwave telecommunication links between platforms and diving operations).

11.11.2.2 In response to the consultation with relevant operators, further assessments have been undertaken and are presented in detail within **Volume A5, Annex 11.1: Offshore Installation Interfaces** (and its associated appendices). The scope and approach to the oil and gas assessment has been developed in consultation with relevant oil and gas operators and with due regard to the specific characteristics of their operations and assets. These studies have been incorporated into this oil and gas receptor assessment and will accompany the final DCO application.

11.11.2.3 The assessments that have been undertaken consider the potential impacts of Hornsea Four on oil and gas receptors. For certain impacts, assessment can be complicated due to unpredictable future oil and gas plans, with varying degrees of certainty associated with them. The approach outlined below has been taken for these impacts (both in isolation and within the cumulative assessment) to reflect this uncertainty.

11.11.2.4 Future developments are assessed where the information is available in the public domain and there is enough level of certainty to include the assessment. Oil and gas blocks which are currently unlicensed have not been considered in the EIA on the basis that there is currently no information (and therefore low data confidence) available on future potential activities. Furthermore, licence blocks which are currently licenced, where the terms of the licence expire prior to the offshore construction phase (i.e. prior to 2026) and/or operation and maintenance phase, and/or decommissioning phase of Hornsea Four (see **Section 11.7.1**), have not been considered on the basis of no temporal overlap and lack of information at time of writing to determine if these blocks will be extended in timescale.

11.11.3 Construction Phase

Hornsea Four construction activity, infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS site and associated development activity and infrastructure (IOU-C-1)

11.11.3.1 As detailed in **paragraph 11.7.1.54**, there is potential for an interaction between Hornsea Four and that part of the proposed Endurance CCS site currently associated with the proposed NZT and ZCH onshore projects. The Endurance CCS site spatially overlaps with Hornsea Four. For the purpose of this document this is referred to as the Array Overlap Area. The proposed Easington to Endurance CO_2 injection pipeline associated with the Endurance CCS site also overlaps with the Hornsea Four offshore ECC (see **Figure 11.8**). This is referred to as the ECC Overlap Area. Collectively, these areas are referred to as the Overlap Areas.

Magnitude of impact

11.11.3.2 Construction activity installed infrastructure and/or the presence of safety zones and advisory safety areas within the part of the Hornsea Four array area coincident with the

Overlap Areas may lead to effects on the development or operation of the Endurance CCS project including effects on, or restriction of access to, planned or installed CCS infrastructure such as wells, manifolds, surface platforms and flowlines. This could occur for the duration of the approximately three-year Hornsea Four construction period.

11.11.3.3 In addition, the installation of the Hornsea Four offshore export cables may also temporarily restrict access to the proposed Easington to Endurance CO_2 injection pipeline within the ECC Overlap Area.

11.11.3.4 Construction activity for Hornsea Four also has the potential to impact any ongoing operation or maintenance of the CCS installed infrastructure (noting that it is understood that the CCS project is planned to be operational from the mid-2020s). This could include, for example, restriction to CCS vessel and helicopter access to the site as a result of Hornsea Four construction vessels and partially completed structures within the Array Overlap Area.

11.11.3.5 Additionally, the Hornsea Four construction activity and/or the presence of installed infrastructure could also adversely affect ongoing development work for the CCS project such as, for example, the ability to undertake seismic surveys in the Array Overlap Area.

11.11.3.6 In the absence of any mitigation, the potential impact in the Overlap Areas is considered to occur throughout the construction phase and will affect a significant portion of the CCS project within the Array Overlap Area. It is noted that the effect from Hornsea Four in relation to the ECC Overlap Area will be reversible for the construction phase, with low reversibility in relation to Array Overlap Area.

11.11.3.7 The magnitude is, therefore, considered to be **moderate**, noting that, at this stage, there is a very high level of uncertainty associated with the planned works and activities within the Overlap Areas.

Sensitivity of receptor

11.11.3.8 The Endurance CCS site is considered to be of high value regionally and nationally, both in economic terms and contributing to government targets set out in the Energy White Paper[9] (Powering our Net Zero Future) and is therefore considered to be of **high** sensitivity within the Overlap Areas.

Significance of the effect

11.11.3.9 In the absence of any mitigation, therefore, the potential impact on the CCS development activities arising from the Hornsea Four construction, within the Overlap Areas, is considered to be **moderate** magnitude and the CCS project is deemed to have a **high** sensitivity, resulting in a significance of **moderate** or **large** (the extent of

[9] Department for Business, Energy & Industrial Strategy (2020). The Energy White Paper. Powering our Net Zero Future. December 2020.

significance being dependent on the final details of the CCS scheme and the extent of the interaction with Hornsea Four, but in any event, considered significant in EIA terms).

Mitigation

11.11.3.10 The Applicant has engaged with the developers of the Endurance CCS site during the pre-application phase with regards to developing an understanding of the proposed CCS development activities and also establishing the principles and process for communication, collaboration and co-existence for the construction phase. This engagement is ongoing, and it is expected that Hornsea Four will:

- Provide full details on the proposed construction activities and planned infrastructure that could impact on the CCS development activities to the developers of the Endurance CCS site to allow them to plan and design their projects accordingly;
- Establish a set of working principles through an Interface Management Group comprising the project managers for the Applicant and the developers of the Endurance CCS site, establishing communication and liaison on planned activities (such as planned construction and development activities) so as to be able to plan and reduce or avoid adverse effects;
- Establish the co-existence principles as the details of the Endurance CCS development site become more certain, on the basis of working together to minimise the effects on the Applicant's and the Endurance CCS development and maximise the opportunities for co-location and coexistence; and
- Work together to plan development activities and to identify synergies and opportunities common to both the Applicant's and the Endurance CCS development.

11.11.3.11 In addition to the above principles and processes, crossing and proximity agreements will be sought (Co107), particularly in relation to the Easington to Endurance CO_2 injection pipeline. Such agreements will include the ability of a pipeline operator to access their infrastructure during Hornsea Four construction as far as practical.

Residual Significance

11.11.3.12 With the development of effective mitigation, the impact on the proposed Endurance CCS site and associated development activity and infrastructure will have a residual magnitude of **negligible**, which combined with a **high** sensitivity, results in a residual significance of **slight**, which is not considered significant in EIA terms.

11.11.4 Construction: Oil and Gas Operations

11.11.4.1 The impacts of the offshore construction of Hornsea Four have been assessed on oil and gas receptors using the methodology described in **Section 11.10.2**. The impacts arising from the construction of Hornsea Four are listed in **Table 11.14**: along with the MDS against which each construction phase impact has been assessed. A description of the potential effects on oil and gas receptors caused by each identified impact is given below. Further details on all of these impacts and the associated assessments are provided in **Volume A5, Annex 11.1: Offshore Installation Interfaces**.

Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-C-2)

11.11.4.2 The presence of partially constructed infrastructure, safety zones and advisory safety distances during construction surrounding Hornsea Four infrastructure and construction activities may result in the temporary impact upon access to existing oil and gas pipelines and wells within the vicinity of Hornsea Four. This temporary restricted access has the potential to affect the safe operation of divers engaged in work at adjacent oil and gas infrastructure. The diving operations covered within **Volume A5, Annex 11.1: Offshore Installation Interfaces** were associated with pipeline maintenance and repair of oil and gas infrastructure.

11.11.4.3 As described in **Volume A5, Annex 11.1: Offshore Installation Interfaces**, operators with oil and gas assets which may be affected by temporary restrictions to diving operations include Gassco (Langeled pipeline, which crosses the Hornsea Four HVAC booster station search area), Shell (SEAL pipeline which crosses the Hornsea Four array area. Other pipelines which enter the Hornsea Four array area and cross the ECC include, Perenco operated pipelines associated with Ravenspurn Field platforms, Harbour Energy operated pipelines associated with Johnston wellheads, and the TBC operator[10] of the planned Platypus pipeline (which crosses Hornsea Four ECC). There are also 19 wells located within 1 km of Hornsea Four array area (see **paragraph 11.7.1.28**) and 32 wells within 1 km of Hornsea Four offshore ECC and HVAC booster station search area (see **paragraph 11.7.1.29**), which may also result in maintenance and repair activity being restricted temporarily during the installation of Hornsea Four infrastructure.

Potential impact

11.11.4.4 The temporary construction safety zones and advisory safety distances associated with Hornsea Four infrastructure and construction activities could lead to restricted access to existing oil and gas pipelines and wells, resulting in an adverse effect on the conduct of diving operations associated with repair and maintenance activities which could be required at the same time as construction works are occurring. The likelihood of this happening is considered to be extremely low, and the embedded mitigation measures (**Table 11.14**:) are considered to substantially reduce this risk.

11.11.4.5 With the exception of Gassco's Langeled pipeline and Shell's SEAL pipeline, all other oil and gas pipelines cross the offshore ECC and do not have pipeline crossings in areas of platform and/or substation. Therefore, access to these pipelines for repair and maintenance activities are not anticipated to be impaired during construction of Hornsea Four infrastructure. Furthermore, the majority of the remaining wells within the Hornsea Four array area (see **paragraph 11.7.1.29**) are abandoned and therefore no repair or maintenance activities will take place. A full assessment on Gassco and Shell activities is presented in Section 14 and Section 15, respectively of **Volume A5, Annex 11.1: Offshore Installation Interfaces**.

[10] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

11.11.4.6 During the construction phase of Hornsea Four, operators would also be provided with sufficient information on Hornsea Four installation activities through promulgation of NtM (Co89) and continued consultation, in order that repair and maintenance activities associated with oil and gas assets within the region can be planned and scheduled to avoid the construction temporally and spatially. This will be managed via standard site installation communication between interested parties.

Significance conclusions

11.11.4.7 As detailed in **Table 11.19**, impacts have been considered to be **broadly acceptable** for all operators and assets which may be temporarily impacted upon (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.19: Outcome of risk assessment – oil and gas pipelines (IOU-C-2).

Operator	Asset	Risk Assessment Outcome and Justification
Gassco	Langeled pipeline	Vessel Access: **Broadly acceptable**
		Diving Access: **Broadly acceptable**
Shell	SEAL pipeline	Vessel Access: **Broadly acceptable**
		Diving Access: **Broadly acceptable**

The piling of Hornsea Four wind turbine and substation foundations will generate vibration that may cause damage to existing pipelines and wells (IOU-C-3)

11.11.4.8 During construction the potential piling or drilling of WTG, HVAC booster stations and platform foundations will generate vibrations which may, in turn, have the potential to cause damage to existing oil and gas pipelines and wells. The temporary piling or drilling operations during construction could also lead to acoustic vibrations which could have an adverse effect on diving operations associated with oil and gas pipelines. As piling will only occur during the construction of Hornsea Four, this potential impact will only effect oil and gas receptors in the construction phase of works. Impact piling component will be intermittent and non-continuous during the installation campaign, with an expected maximum duration of 12 months.

11.11.4.9 The likelihood of vibrations affecting oil and gas pipelines and wells will be dependent upon the selected foundation design and installation method, which is also dependant on the ground conditions within the array area and the HVAC booster station search area. Ground shaking and associated vibrations generated from piling or drilling activities are expected to dissipate before reaching oil and gas pipelines and as such, there will be negligible impact to the pipeline.

Potential impact

11.11.4.10 Piling activities will be temporary (and intermittent), and therefore the minor vibrations that will be induced, and the expected dissipating of the ground shaking energy, together with the fact that the pipelines are free to move on the seabed, means that the impact to SEAL pipeline (Shell) is considered to be negligible. In addition, Harbour Energy's flowlines and pipelines are buried beneath the seabed and as a result the

likelihood for ground shaking from piling to cause damage is considered broadly acceptable. The ground shaking and vibrations from the installation of foundations at the HVAC booster station search area and within the array area, are not expected to impact the operations as these are expected to dissipate before reaching the pipelines. Moreover, there will be a 500 m exclusion zone between the platforms in the HVAC booster station(s) and nearby pipelines. The impact will therefore be negligible for the Platypus pipeline (TBC operator[11] (formerly Dana Petroleum)), the Langeled pipeline (Gassco) or the Perenco operated pipelines. Therefore, the structural integrity of these oil and gas pipelines are not expected to be impaired.

11.11.4.11 Moreover, vibrations from piling activity within the Hornsea Four array area are also considered to dissipate before reaching CCS pipelines associated with the Endurance CCS site within the Overlap Area.

11.11.4.12 Vibrations associated with the piling of foundations may pose a risk to the integrity of oil and gas wellheads and manifolds, due to ground shaking pressure waves. Harbour Energy operates several wells with the Hornsea Four array area associated with the Johnston Field (see **paragraph 11.7.1.23**). However, *'given the distance between foundations and subsea infrastructure, such pressure waves are expected to have dissipated over the distance and only result in minimal impact'* (see Section 17.7.2. in **Volume A5, Annex 11.1: Offshore Installation Interfaces**).

11.11.4.13 It is also anticipated that temporary restrictions to diving operations for repair and maintenance may occur during installation of Hornsea Four as a result of the piling activities associated with foundation installation leading to acoustic vibrations which could have an impact on diving operations. Diving associated with oil and gas pipeline and well repair and maintenance works within proximity of piling operations should be avoided during such operations.

11.11.4.14 The operators will be provided with sufficient information on the timing and execution of Hornsea Four construction activities (including specifically piling) through promulgation of NtM (Co89) and continued consultation with pipeline and well operators will be undertaken in order to ensure that foundation installation activities are planned in collaboration with operators in accordance with good practice.

Significance conclusions

11.11.4.15 As detailed in **Table 11.20**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.20: Outcome of risk assessment – piling (IOU-C-3).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow to Kilmar Service Spool pipelines	Vibration: **Broadly acceptable**
		Diving: **Broadly acceptable**

[11] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

Operator	Asset	Risk Assessment Outcome and Justification
	Kilmar Service pipelines	Vibration: **Broadly acceptable**
		Diving: **Broadly acceptable**
	Wells	Well integrity**: Broadly acceptable**
TBC[12] (formerly Dana Petroleum)	Platypus pipeline	Vibration**: Broadly acceptable**
Gassco	Langeled pipeline	Vibration**: Broadly acceptable**
		Diving: **Broadly acceptable**
NEO Energy	Babbage Export	Vibration: **Broadly acceptable**
		Diving: **Broadly acceptable**
	Babbage Wells	Well integrity**: Broadly acceptable**
Perenco	Intra-field flowlines and pipelines	Vibration**: Broadly acceptable**
		Diving: **Broadly acceptable**
	Wells	Well integrity: **Broadly acceptable**
Harbour Energy	Intra-field flowlines and pipelines	Vibration**: Broadly acceptable**
	Johnston Wells	Well integrity: **Broadly acceptable**
		Diving: **Broadly acceptable**
Shell	SEAL pipeline	Vibration: **Broadly acceptable**
		Diving: **Broadly acceptable**

Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells (IOU-C-4)

11.11.4.16 Damage to pipelines and wells can arise at the time of anchoring or subsequently if the vessel should drag its anchor due to meteorological ocean (metocean) conditions. Vessel traffic associated with the construction of the Hornsea Four infrastructure could result in theory result in anchor snagging and dropping on to existing oil and gas pipelines and wells.

Potential impact

11.11.4.17 There are six submarine pipelines located within the Hornsea Four array area; the SEAL pipeline and five pipelines associated with the Johnston Field (these are listed in **Table 11.11**). There are a further seven submarine pipelines crossing the Hornsea Four offshore ECC with one passing through the Hornsea Four HVAC booster station search area (Langeled pipeline).

11.11.4.18 'Planned' anchoring can take place for a number of reasons including adverse weather anchoring (e.g. seeking refuge), machinery failure (e.g. loss of steering) and subsea operations/survey vessels. Planned anchoring in close proximity to existing oil and gas pipelines and wells will not occur given that construction vessels will be aware of the

[12] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

locations of these assets (through consultation with operators and NtM), which are protected by a 500 m radius safety zone (UKHO 2020). Moreover, anchor spread for vessels supporting the construction of Hornsea Four will be controlled by SIMOPS and NtM, and in proximity to well locations there will be no requirement for the use of anchor spread. With the exception of Harbour Energy operated wells within the Hornsea Four array area (associated with the Johnston Field) the remaining wells are located outside of the array area, offshore ECC and HVAC booster station search area. Therefore, the likelihood of incidents leading to snagging, hooking or dropping is considered negligible (see **Volume A5, Annex 11.1: Offshore Installation Interfaces** for further details).

11.11.4.19 Due to the distance of the inter-field pipeline between Garrow and Kilmar from the Hornsea Four array area (7.5 km) and the type of installation vessels planned to be used for Hornsea Four, the likelihood of anchor incidents leading to damage is considered negligible.

Significance conclusions

11.11.4.20 As detailed in **Table 11.21**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.21: Outcome of risk assessment – anchor snagging (IOU-C-4).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow to Kilmar Service Spool pipelines	Anchor Snagging/ Dropping: **Broadly acceptable**
	Kilmar Service pipelines	Anchor Snagging/ Dropping: **Broadly acceptable**
	Wells	Well integrity**: Broadly acceptable**
TBC[13] (formerly Dana Petroleum)	Platypus pipeline	Anchor Snagging/ Dropping: B**roadly acceptable**
Gassco	Langeled pipeline	Anchor Snagging/ Dropping: **Broadly acceptable**
NEO Energy	Babbage Export	Anchor Snagging/ Dropping: **Broadly acceptable.**
	Babbage Wells	Well integrity: **Broadly acceptable.**
Perenco	Intra-field flowlines and pipelines	Anchor Snagging/ Dropping: **Broadly acceptable.**
	Wells	Well integrity**: Broadly acceptable.**
Harbour Energy	Intra-field flowlines and pipelines	Anchor Snagging/ Dropping: **Broadly acceptable.**
	Johnston Wells	Well integrity: **Broadly acceptable.**
Shell	SEAL pipeline	Anchor Snagging/ Dropping: **Broadly acceptable.**

[13] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

11.11.5 Construction: Oil and Gas Operations - Shipping and Navigation

11.11.5.1 The impacts of the offshore construction of Hornsea Four have been assessed on oil and gas receptors in relation to shipping and navigation. The impacts arising during the construction phase of Hornsea Four are listed in **Table 11.14**: along with the MDS against which each construction phase impact has been assessed. A description of the potential effects on oil and gas receptors caused by each identified impact is given below.

Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of Hornsea Four infrastructure (IOU-C-5)

11.11.5.2 An increased allision risk may arise as a result of a reduction in available sea room. As vessels are deviated due to the presence of Hornsea Four, it may increase the traffic density in the surrounding area. This, in turn, may result in them routeing closer to oil and gas platforms within the vicinity of Hornsea Four infrastructure, which has the potential to increase the likelihood of a vessel to oil and gas structure allision.

11.11.5.3 A study on vessel allision was conducted by Anatec for oil and gas assets close to Hornsea Four (Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report)). The assessment of the allision risk undertaken has focused on changes to vessel traffic patterns passing within 2 nm of the relevant oil and gas assets as a result of the presence of Hornsea Four. This has been based on the pre- and post-wind farm worst-case route deviations as identified and assessed within the NRA (**Volume A5, Annex 7.1: Navigational Risk Assessment**). As noted within **Chapter 7: Shipping and Navigation** it is not possible to consider all potential alternative routeing options as commercial traffic and therefore worst-case alternatives have been considered where possible in consultation with operators. All alternative routes maintain a minimum distance of 1 nm from offshore installations in line with the MGN 654 Shipping Route Template.

Potential impact

11.11.5.4 As stated in the Allision Technical Report (see Table 7.2 in Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces**) the greatest increase in vessel numbers is predicted within 2 nm of Alpha Petroleum operated Garrow NUI platform (two additional vessels per day), Perenco operated Ravenspurn North ST2 and Ravenspurn South A (two additional vessels per day, per platform), and NEO Energy operated Babbage platform (one additional vessel per day). No changes in vessel numbers were predicted for Ravenspurn North Complex, Ravenspurn North ST3, Ravenspurn South B, Ravenspurn South C and Kilmar NUI platforms. There is also no change in vessel numbers within 2 nm of Minerva platform (operated by Perenco), which is within 10 nm of the Hornsea Four offshore HVAC booster station search area. There is a decrease in the number of vessels within 2 nm of one vessel per day associated with the Tolmount Main platform.

11.11.5.5 As noted in the Allision Technical Report (Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces**) only two routes required deviation due to the presence of the Hornsea Four offshore HVAC booster station search area (Route 6 and Route 9, see **Volume A5, Annex 7.1: Navigational Risk Assessment**). These routes are predicted

to shift traffic west to avoid the potential booster station locations, which results in vessels moving away from Tolmount Main platform (Harbour Energy).

11.11.5.6 In order to reduce risks of allision with oil and gas infrastructure, ongoing consultation with and promulgation of information to oil and gas operators will be continued throughout the development process. Cooperation and liaison agreements will be developed with relevant oil and gas operators and Hornsea Four in terms of SIMOPS to ensure allision risks are minimised.

Significance conclusions

11.11.5.7 As detailed in **Table 11.22**, impacts have been considered to be broadly acceptable for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be not significant (as per **Table 11.18**).

Table 11.22: Outcome of risk assessment – allision risk (IOU-C-5).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow NUI	Vessel Impact: **Broadly acceptable**
Alpha Petroleum	Kilmar NUI	Vessel Impact: **Broadly acceptable**
NEO Energy	Babbage platform	Vessel Impact: **Broadly acceptable**
Perenco	Ravenspurn North Complex platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn North ST2 platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn North ST3 platform	Vessel Impact: **Broadly acceptable**
Perenco	Ravenspurn South A platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn South B platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn South C platform	Vessel Impact: **Broadly acceptable**
Perenco	Minerva	Vessel Impact: **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Vessel Impact: **Broadly acceptable**

Proximity to Hornsea Four infrastructure and associated works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-C-6)

11.11.5.8 This impact considers vessel access and the potential vessel route deviations to oil and gas installations only. An assessment on restrictions to helicopter access to existing or new oil and gas assets is provided in **Section 11.11.10**, and in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report). An assessment on route deviations to vessels is detailed in **Chapter 7: Shipping and Navigation**.

11.11.5.9 Note that Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report) shows that the implications of impaired access are commercial only and not safety related.

Potential impact

11.11.5.10 There are two active subsea structures (one manifold and one wellhead) associated with the Johnston Field (see **paragraph 11.7.1.28** for further details). The primary concern for these assets is available space within the array area for rig access and anchor spread (where required). It was raised during consultation that dive support vessel access will still be required to the Johnston wells (Harbour Energy), and it should be considered that access to the SEAL pipeline (Shell) may also be necessary.

11.11.5.11 The Tolmount Main platform (Harbour Energy) is positioned 2.15 nm from the HVAC booster station search area, however it should be considered that this is a worst-case distance, as the HVAC booster stations could ultimately be positioned anywhere within the search area. During installation of the HVAC booster station, it is not anticipated that there will be temporary loss of vessel access to the Langeled pipeline (Gassco). This is due to the planned 500 m exclusion/buffer zone between the HVAC booster stations and Langeled pipeline. There are two active platforms (Ravenspurn North CCW and Ravenspurn North CC (Perenco)) located within 1 km of the offshore ECC (closest to the array area, 1.6 nm), along with one active subsea protection structure and a wellhead (see **paragraph 11.7.1.24**). However, it is considered that all operations associated with Perenco's Ravenspurn North Complex will remain outside the array area. In relation to wells, there is one abandoned well (AB3 (43/26-6)) located within the ECC with 32 wells located within 1 km of the ECC, eight of which are operational (see **paragraph 11.7.1.29** for details). As per Section 8.3.2 of Appendix C **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report), large scale operations associated with oil and gas assets are able to be undertaken in proximity to wind farm structures.

11.11.5.12 NEO Energy's Babbage platform was specifically raised as a potential concern during consultation (see **Table 11.3**), as it is located approximately 4.31 km (2.33 nm) from the Hornsea Four array area. Discussions around marine access are ongoing with the operator, and it is noted that based on marine traffic analysis, activity associated with the Babbage platform such as routine support vessel visits from Great Yarmouth or Lowestoft will remain outside of the Hornsea Four array area. In addition, the majority of commercial vessels on affected routes will pass between Hornsea Four and Hornsea Project Two, or potentially choose alternate routes, including passing further from the assets given there is sea room available to do so.

11.11.5.13 During the Hornsea Four construction phase, operators would also be provided with sufficient information on the Hornsea Four installation activities through promulgation of NtM and continued consultation will be undertaken in order to ensure that construction activities are planned in collaboration with potentially affected operators (Harbour Energy, Gassco, Shell, NEO Energy and Perenco) in accordance with good practice. Advance warning and accurate location details of construction operations associated safety zones, and advisory passing distances will be provided to relevant operators as per Co89 (see **Volume A4, Annex 5.2: Commitment Register**). Also, for the duration of the construction period, Hornsea Four will monitor and report annually, vessel traffic as per Co98 (see **Volume A4, Annex 5.2: Commitment Register**).

11.11.5.14 Consideration will also be given to oil and gas assets when defining lighting and marking requirements and will include consultation with Perenco, NEO Energy and Harbour Energy. Any plans for new oil and gas infrastructure will be developed by operators with

an awareness of the presence of Hornsea Four. In the event that new infrastructure is planned in close proximity, consultation will take place between Hornsea Four and the relevant oil and gas operator.

Significance conclusions

11.11.5.15 As detailed in Table 11.23, safety impacts have been considered to be **broadly acceptable** for Johnston wells, and all other oil and gas assets (full assessments presented in Volume A5, Annex 11.1: Offshore Installation Interfaces). The effect will, therefore, be **not significant** (as per Table 11.18).

Table 11.23: Outcome of risk assessment – proximity (IOU-C-6).

Operator	Asset	Risk Assessment Outcome and Justification
NEO Energy	Babbage platform	Vessel Access (proximity): **Broadly acceptable**
Perenco	Ravenspurn North Complex platforms	Vessel Access (proximity): **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Vessel Access (proximity): **Broadly acceptable**
	Johnston wells	Vessel Access (proximity): **Broadly acceptable**

Wind turbines and associated works may result in deviations to routine support vessel routeing to oil and gas platforms (IOU-C-7)

11.11.5.16 This impact considers vessel access and the potential vessel route deviations to oil and gas installations only. An assessment on restrictions to helicopter access to existing or new oil and gas assets is provided in Section 11.11.10, and in Appendix A of Volume A5, Annex 11.1: Offshore Installation Interfaces (Helicopter Access Report). An assessment on route deviations to vessels is detailed in Chapter 7: Shipping and Navigation.

11.11.5.17 The Hornsea Four infrastructure, construction activity and associated safety and advisory zones has the potential to cause disruption of routine support vessel (e.g. supply and standby) access to oil and gas platforms. During construction of Hornsea Four, a number of installation and support vessels will be required within the array area and the offshore HVAC booster station search area. There is potential for impaired vessel access during this period to increase due to the presence of Hornsea Four installation vessels (and the associated safety zones) combined with the main vessel route changes and deviations, as a result of constructed Hornsea Four infrastructure.

Potential impact

11.11.5.18 There are no existing platforms within the Hornsea Four array area or within 1 km of the array area. There are also no platforms located within the offshore ECC or offshore HVAC booster station search area, however there are two active Perenco operated gas platforms, Ravenspurn North CCW and Ravenspurn North CC located 890 m and 920 m from the Hornsea Four ECC respectively (see Table 11.8). The 500 m safety zone around these platforms are therefore respectively 390 m and 420 m from the boundary of the ECC. A roaming safe passing distance of 500 m for mobile installation vessels within the

offshore ECC will be recommended, which may in exceptional circumstances, be increased to 1,000 m (depending on the nature of the installation works). This possible overlap is not anticipated to disrupt routine support vessel access to Ravenspurn North CCW or Ravenspurn North CC platforms due to the close communication which will be established between both parties to ensure that activities can be coordinated.

11.11.5.19 The assessment of route deviations detailed in **Volume A5, Annex 7.1: Navigational Risk Assessment** and in Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report) note oil and gas support vessels routinely transit across Hornsea Four array area, with the majority of the vessels on passage to and from oil and gas platforms. However, a significant majority of the baseline activity in relation to platforms in the vicinity of Hornsea Four recorded within Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report) remained outside of the Hornsea Four array area. Based upon these findings, it is estimated likely that routine support vessels will have to deviate by 4 nm for Kilmar NUI (Alpha Petroleum), by 0.3 nm for Garrow NUI (Alpha Petroleum) and 1 nm for the Trent NUI platform (Perenco). Furthermore, no notable deviations are anticipated for routine support vessel routeing to Tolmount Main platform (Harbour Energy). Moreover, it is anticipated that the majority of oil and gas support vessel activity for NEO Energy's Babbage platform and Perenco's Ravenspurn North CCW or Ravenspurn North CC platforms will remain outside the Hornsea Four array area and will not be affected by the construction activities.

11.11.5.20 In order to further reduce the impact of impairing support vessel access to oil and gas platforms, ongoing consultation and promulgation of information (e.g. NtM) with oil and gas operators (Perenco, NEO Energy and Harbour Energy) will be implemented. Advance warning and accurate location details of construction operations associated safety zones, and advisory passing distances will be given as per Co89 (see **Volume A4, Annex 5.2: Commitments Register**). Furthermore, consideration will also be given to planned and existing assets when defining lighting and marking requirements, through consultation with relevant oil and gas operators, including Perenco, NEO Energy and Harbour Energy (as well as with THLS and MCA). Any plans for new oil and gas platforms will be developed by operators with an awareness of the presence of Hornsea Four. In the event that new infrastructure is planned in close proximity, consultation will take place between Hornsea Four and the relevant oil and gas operator to establish close communication. Whilst this is not a legislative requirement the OGA interactive maps show the locations of wind farm developments.

Significance conclusions

11.11.5.21 As detailed in **Table 11.24**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.24: Outcome of risk assessment – deviation (IOU-C-7).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow NUI	Vessel Deviation: **Broadly acceptable**
	Kilmar NUI	Vessel Deviation: **Broadly acceptable**

Operator	Asset	Risk Assessment Outcome and Justification
NEO Energy	Babbage Platform	Vessel Deviation: **Broadly acceptable**
Perenco	Ravenspurn North CCW platform	Vessel Deviation: **Broadly acceptable**
	Ravenspurn North CC	Vessel Deviation: **Broadly acceptable**
	Trent platform	Vessel Deviation: **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Vessel Deviation: **Broadly acceptable**

11.11.6 Construction: Oil and Gas Operations – Future Development

11.11.6.1 The impacts of the offshore construction of Hornsea Four have been assessed on oil and gas receptors associated with future developments that might be brought forward by those operators that have been awarded licencing blocks. The impacts arising during the construction phase of Hornsea Four are listed in **Table 11.14**: along with the MDS against which each construction phase impact has been assessed. A description of the potential effects on oil and gas receptors caused by each identified impact is given below.

Hornsea Four infrastructure, safety zones, advisory safety distances and piling may restrict or cause acoustic interference with potential seismic survey activity (IOU-C-8)

11.11.6.2 The safety zones associated with the installation piling activities and the piling activity itself during construction of Hornsea Four infrastructure within the array area, offshore ECC and HVAC booster station search area, and the piling noise generated during installation has the potential to exclude or otherwise interfere with seismic surveys (particularly surveys conducted by conventional towed streamer seismic survey vessels) planned in the vicinity by oil and gas operators.

11.11.6.3 It is noted that the application of 500 m safety zones during construction (under the provisions of the Energy Act 2004) will temporarily increase the area of overlap, e.g. for infrastructure at the edge of the array area boundary. This will result in the temporary, intermittent restriction of the area available for seismic survey activity in areas where the construction safety zone is active (noting that this moves with the active construction activity rather than being applied to all turbine locations).

11.11.6.4 The Hornsea Four array area overlaps four licensed blocks and seven unlicensed blocks (**Table 11.5** and **paragraph 11.7.1.4**). Although any seismic surveys within these blocks are anticipated to be restricted to some extent, it is noted that other methods of seismic survey, such as the use of ocean bottom nodes and the use of fixed vertical cables, allow work to be completed in more congested environments. For example, the ocean bottom nodes can be used when there is sea surface congestion (i.e. wind turbines, platforms) and the vertical cables can be used when the sea floor is congested (i.e. with cables or pipelines).

11.11.6.5 The offshore ECC and HVAC booster station search area overlap nine licensed blocks and eight unlicensed blocks (**Table 11.6** and **paragraph 11.7.1.5**). Cable and HVAC installation, as well as safety zones of 500 m around the construction of the HVAC booster stations within the ECC, have the potential to exclude or limit conventional towed streamer seismic survey vessels.

Potential impact

11.11.6.6 A typical seismic survey period is six months and therefore there is the potential for surveys to take place within parts of the licenced blocks where construction activity has not yet commenced. For surveys in areas of active construction or where partially completed structures have been installed, there is the potential for an effect on survey operations. However, a relatively small number of blocks are affected overall.

11.11.6.7 The assessment of this potential impact is complicated by the fact that future oil and gas plans have a degree of uncertainty associated with them. For this reason, (noted above in **paragraphs 11.11.2.3** and **11.11.2.4**) the assessment has only been able to consider those licenced blocks with potential for spatial interactions, which are licenced beyond the start of Hornsea Four operation and maintenance phase.

11.11.6.8 Harbour Energy's Licence Block 43/27a is located within the Hornsea Four array area. As noted in **paragraph 11.7.1.23** Harbour Energy are planning to decommission the Johnston subsea infrastructure and therefore seismic survey activity is not considered applicable within **Volume A5, Annex 11.1: Offshore Installation Interfaces**. Moreover, the current licence block end date for 43/27a is 2025 (see **Table 11.5**). However, the remaining oil and gas licence blocks which overlap with the array area and the offshore ECC are considered below.

11.11.6.9 Seismic surveillance activities may be required in the future, around the Hornsea Four array. At the time of such activity, it is proposed that a co-existence plan will be developed to determine how the performance of such activity will be implemented without undue risk in the interfaces. If seismic survey activity is required in the future, it will be adequately planned and analysed in line with regulatory requirements, good engineering practice and the safe operability regime existing on the UK continental shelf. As such the activity would only proceed once identified risks have been demonstrated to be acceptable.

Significance conclusions

11.11.6.10 As detailed in **Table 11.25**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.25: Outcome of risk assessment – seismic survey activity (IOU-C-8).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Licence block 42/25a, 43/21a and 43/22a	Seismic Survey Activity: **Broadly acceptable**
NEO Energy	Licence block 48/2a	Seismic Survey Activity: **Broadly acceptable**
Perenco	Licence blook 42/28a, 42/28b, 42/29a, 42/30a, 47/4b, 43/26a and 43/24a	Seismic Survey Activity: **Broadly acceptable**
Harbour Energy	Licence block 43/26a, 43/27a, 42/28c, 42/28d, 42/28e and 42/29b	Seismic Survey Activity: **Broadly acceptable**

Drilling and the installation/decommissioning of oil and gas infrastructure has the potential to be restricted by the presence of Hornsea Four infrastructure, safety zones and advisory safety distances (IOU-C-9)

11.11.6.11 Drilling and the placement of infrastructure associated with gas field development may be restricted (but not prohibited) within the Hornsea Four array area, offshore ECC and HVAC booster station search area during the construction phase, due to the presence of the Hornsea Four infrastructure (and where relevant associated safety zones).

11.11.6.12 Drilling is restricted by the ability of the drill rig or vessel to access the drill location. For drilling to occur within the array area, ECC and HVAC booster station search area it would be dependent on the final layout of the array area (i.e. wind turbines, offshore platforms and array and interconnector cables) the export cables and the layout and location of the HVAC booster stations. It is noted that it is sometimes possible to directionally drill into a well location within the array or ECC if required. The restricted area may need to be extended further considering helicopter access requirements (see **Chapter 8: Aviation and Radar** and Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report).

11.11.6.13 The relevant operators with rights to licence blocks with spatial overlap with the Hornsea Four array area offshore ECC and HVAC booster station search area are summarised in **Table 11.25** and **Table 11.26** As discussed above in **paragraph 11.11.2.4**, only those blocks which are licenced beyond the start of Hornsea Four offshore construction and in which the future operations have a degree of both temporal and spatial certainty have been taken forward into the assessment.

Potential impact

11.11.6.14 The construction of Hornsea Four will likely also have an impact on the decommissioning activities associated with the Harbour Energy operated wells within the Johnston Field (Licence Block 42/27a). This includes potential effects on helicopter access to decommissioning vessels within the array area (see **Section 11.11.10** for further details). It should be noted that current indications are that Johnston Field assets will cease production in the 2020s decade, prior to the construction of Hornsea Four. Discussions between Hornsea Four and Harbour Energy are ongoing in order to reach coexistence between Hornsea Four construction and Johnston well decommissioning (see **Table 11.3**).

11.11.6.15 As detailed in **Volume A5, Annex 11.1: Offshore Installation Interfaces** exploration and appraisal drilling may be required around the Hornsea Four array area and offshore ECC. At the time of such activity, it is proposed that a co-existence plan will be developed which will include details on how the communication including SIMOPS activity for such plans would take place. If drilling activity is required in the future, it will be adequately planned and analysed in line with regulatory requirements, good engineering practice and the safe operability regime existing on the UK continental shelf. As such the activity would only proceed once identified risks have been demonstrated to be acceptable.

11.11.6.16 Harbour Energy's Licence Block 43/27a is located within the Hornsea Four array area. As noted in **paragraph 11.7.1.23** Harbour Energy are planning to decommission the Johnston subsea infrastructure and therefore drilling activity is not considered applicable

within **Volume A5, Annex 11.1: Offshore Installation Interfaces**. Moreover, the current licence block end date for 43/27a is 2025 (see **Table 11.5**). However, the remaining oil and gas licence blocks which overlap with the array area and the offshore ECC are considered below.

Significance conclusions

11.11.6.17 As detailed in **Table 11.26**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.26: Outcome of risk assessment – drilling and the installation of oil and gas infrastructure (IOU-C-9).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Licence block 42/25a, 43/21a and 43/22a	Drilling Activity: **Broadly acceptable**
NEO Energy	Licence block 48/2a	Drilling Activity: **Broadly acceptable**
Perenco	Licence blook 42/28a, 42/28b, 42/29a, 42/30a, 47/4b), 43/26a and 43/24a	Drilling Activity: **Broadly acceptable**
Harbour Energy	Licence block 43/26a, 43/27a, 42/28c, 42/28d, 42/28e and 42/29b	Drilling Activity: **Broadly acceptable**

11.11.7 Operation and Maintenance Phase

The operation and maintenance of the Hornsea Four infrastructure may have an impact on the operation of, or ongoing development of, the proposed Endurance CCS site and associated infrastructure (IOU-O-10)

11.11.7.1 As detailed in **paragraph 11.7.1.54**, there is potential for an interaction within the Overlap Areas.

Magnitude of impact

11.11.7.2 During the operational phase, a variety of infrastructure will be present within the Array Overlap Area, including wind turbines, inter-array cables and offshore platforms. There will be an ongoing programme of maintenance requiring regular vessel movements, helicopter movements and, exceptionally large vessels for major maintenance, repairs or renewals. Offshore export cables will have been laid within the ECC and will have crossed or been crossed by the Easington to Endurance CO_2 injection pipeline (see **Figure 11.8**). Around the installed infrastructure, advisory safety areas will be in place, with safety zones imposed around major maintenance activities.

11.11.7.3 There is the potential for the presence of the installed Hornsea Four infrastructure and the ongoing maintenance activity to have an impact on the siting, and access to CCS infrastructure including wells, manifolds, surface platforms and flowlines. The operation of Hornsea Four also has the potential to have an impact on the maintenance and operational activities associated with the CCS development and ongoing monitoring or development activities such as the conduct of seismic surveys.

11.11.7.4 The impact is predicted to affect a significant portion of the Endurance CCS project within the Array Overlap Area, be of medium-term duration (i.e. operational period), continuous, and of low reversibility (impact will be reversible post-decommissioning). The impact is predicted to potentially affect the receptor directly within the Overlap Areas. The magnitude is therefore, considered to be **moderate**, noting that there is currently a high level of uncertainty associated with the planned development activities associated with the Endurance CCS site within the Overlap Areas.

Sensitivity of receptor

11.11.7.5 As detailed in **paragraph 11.11.3.8**, the receptor is considered to be of **high** sensitivity (within the Overlap Areas).

Significance of the effect

11.11.7.6 In the absence of any mitigation, therefore, the potential impact on the CCS development activities arising from the operation and maintenance of Hornsea Four, within the Overlap Areas, is considered to be **moderate** magnitude and the Endurance CCS project is deemed to have a **high** sensitivity, resulting in a significance of **moderate** or **large** (the extent of significance being dependent on the final details of the CCS scheme and the extent of the interaction with Hornsea Four, but in any event, considered significant in EIA terms).

Mitigation

11.11.7.7 The Applicant has been actively engaging with the developers of the Endurance CCS site during the pre-application phase with regards to developing an understanding of the proposed CCS development activities and also establishing the principles and process for communication, collaboration and co-existence for the operations and maintenance phase. This engagement is ongoing, and it is expected that Hornsea Four will:

- Provide full details on the proposed Hornsea Four infrastructure and the planned operations and maintenance activity that could impact on the Endurance CCS development activities to the developers of the Endurance CCS site to allow them to plan and design their project accordingly;
- Establish a set of working principles through an Interface Management Group comprising the project managers for the Applicant and the developers of the Endurance CCS site, establishing communication and liaison on planned activities (such as planned operations and maintenance and development activities) so as to be able to plan and reduce or avoid adverse effects;
- Establish the co-existence principles as the details of the Endurance CCS site become more certain, on the basis of working together to minimise the effects on the Applicant's and the Endurance CCS developments and maximise the opportunities for co-location and coexistence; and
- Work together to plan development activities and to identify synergies and opportunities common to both the Applicant's and CCS developments.

11.11.7.8 In addition to the above principles and processes, temporary impact upon access to pipelines associated with the presence of Hornsea Four infrastructure would be considered in the crossing/proximity agreements to the extent that such a scenario

would not be an impediment to operations (Co107), particularly in relation to the Easington to Endurance CO_2 injection pipeline.

Residual Significance

11.11.7.9 With the development of effective mitigation, the impact within the Overlap Areas will have a residual magnitude of **negligible**, which combined with a **high** sensitivity, results in a residual significance of **slight**, which is not considered significant in EIA terms.

11.11.8 Operation and Maintenance: Oil and Gas Operations

11.11.8.1 The impacts of the operation and maintenance of Hornsea Four have been assessed on oil and gas receptors. The impacts arising from the operation and maintenance of Hornsea Four are listed in **Table 11.14**: along with the MDS against which each operation and maintenance phase impact has been assessed. A description of the potential effects on oil and gas receptors caused by each identified impact is given below.

Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-O-11)

11.11.8.2 Safety zones and advisory safety distances during operation and maintenance surrounding Hornsea Four infrastructure may result in the temporary impact upon access to existing oil and gas pipelines and wells within the vicinity of Hornsea Four. This temporary restricted access has the potential to affect the timing diving operations at adjacent oil and gas infrastructure. The diving operations covered within **Volume A5, Annex 11.1: Offshore Installation Interfaces** were associated with pipeline maintenance and repair of oil and gas infrastructure.

11.11.8.3 As described in **Volume A5, Annex 11.1: Offshore Installation Interfaces** operators with oil and gas assets which may be affected by temporary restrictions to diving operations include Gassco (Langeled pipeline, which crosses the Hornsea Four HVAC booster station search area), Shell (SEAL pipeline which crosses the Hornsea Four array area). Other pipelines which enter the Hornsea Four array area and cross the ECC include, Perenco operated pipelines associated with Cleeton, Neptune and Minerva platforms, (which crosses the offshore ECC) Harbour Energy operated pipelines associated with Johnston wellheads (within the array area) and the TBC operator[14] for the planned Platypus pipeline (which crosses Hornsea Four ECC).

Potential impact

11.11.8.4 The temporary safety zones and advisory safety distances associated with maintenance activities (typically 500 m), may restrict access to existing pipelines and wells within the Hornsea Four array area and along the offshore ECC and HVAC booster station search area. Temporary impact upon access to pipelines and wells associated with any temporary safety zones/advisory safety distances is considered to be limited in extent

[14] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

and infrequent. Pipelines located in close vicinity to the installed Hornsea Four infrastructure would be covered by a crossing/proximity agreement with the relevant operator so that there would not be an impediment to asset maintenance operations. Moreover, during Hornsea Four operation and maintenance, it is not anticipated that there will be disruption to or temporary impact upon access to the pipelines (Langeled and SEAL) due to the 500 m exclusion zone from the pipeline (UKHO 2020) (see **paragraph 11.7.1.34**). With the exception of Gassco's Langeled pipeline and Shell's SEAL pipeline, all other oil and gas pipelines cross the offshore ECC and do not have pipeline crossings in areas of platform and/or substation. Therefore, access to these pipelines are not anticipated to be impaired during operation and maintenance of Hornsea Four infrastructure.

11.11.8.5 Moreover, during Hornsea Four operation and maintenance, the Johnston wells and associated pipelines are anticipated to be abandoned or decommissioned (see Section 17.7.1 in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). Furthermore, the majority of the remaining wells within the Hornsea Four array area (see **paragraph 11.7.1.28**) are abandoned and therefore no repair or maintenance activities will take place. Two operational wells associated with the Johnston Field are located within the Hornsea Four array area. As noted above for pipelines, it is not anticipated that there will be disruption to or temporary impact upon access to wells. However, it should be noted that it has been indicated by Harbour Energy, that the Johnston field assets will cease production in the 2020s, prior to the operation of Hornsea Four. Discussions between Hornsea Four and Harbour Energy are ongoing in order to reach coexistence between Hornsea Four construction and Johnston well decommissioning (see **Table 11.3**).

11.11.8.6 Details of major maintenance and repair activities associated with Hornsea Four infrastructure will be provided to the relevant oil and gas operators through promulgation of NtM (Co89) and continued consultation in order that the respective asset owners can agree an approach for temporally, and/or spatially, deconflicting relevant repair and maintenance activities.

Significance conclusions

11.11.8.7 As detailed in **Table 11.27**, impacts have been considered to be **broadly acceptable** for all operators and assets which may be temporarily impacted (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.27: Outcome of risk assessment – oil and gas pipelines (IOU-O-11).

Operator	Asset	Risk Assessment Outcome and Justification
Gassco	Langeled pipeline	Vessel Access: **Broadly acceptable**
		Diving Access: **Broadly acceptable**
Shell	SEAL pipeline	Vessel Access: **Broadly acceptable**
		Diving Access: **Broadly acceptable**

Anchor snagging or anchor dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells (IOU-O-12)

11.11.8.8 Damage to pipelines and wells can arise at the time of anchoring or subsequently if the vessel should drag its anchor due to metocean conditions. Vessel traffic associated with the maintenance of Hornsea Four infrastructure could potentially result in anchor snagging and dropping on to those existing oil and gas pipelines and wells that lie within or close to the Hornsea Four array area and, less frequently, the ECC.

Potential impact

11.11.8.9 There are six submarine pipelines located within the Hornsea Four array area; the SEAL pipeline and five pipelines associated with the Johnston Field (these are listed in **Table 11.11**). There are a further seven submarine pipelines crossing the Hornsea Four offshore ECC with one passing through the Hornsea Four HVAC booster station search area (Langeled pipeline).

11.11.8.10 'Planned' anchoring can take place for a number of reasons including adverse weather anchoring (e.g. seeking refuge), machinery failure (e.g. loss of steering) and subsea operations/survey vessels. Planned anchoring in close proximity to existing oil and gas pipelines and wells will not occur given that operation and maintenance vessels will be aware of the locations of these assets as they are shown on charts (and through consultation with operators and NtM) and are protected by a 500 m radius safety zone (UKHO 2020). Moreover, any anchor spreads associated with vessels supporting the maintenance of Hornsea Four will be controlled by SIMOPS review and notified through the promulgation of NtMs (Co89), and in proximity to well locations there will be no requirement for the use of anchor spread. With the exception of Harbour Energy operated wells within the Hornsea Four array area (associated with the Johnston Well Head Protection Structure (WHPS) and Johnston Template/Manifold) the remaining wells are located outside of the array area, offshore ECC and HVAC booster station search area. Therefore, the likelihood of incidents leading to snagging, hooking or dropping is considered negligible (see **Volume A5, Annex 11.1: Offshore Installation Interfaces** for further details).

11.11.8.11 Due to the distance of the inter-field pipeline between Garrow and Kilmar from the Hornsea Four array area (7.5 km) and the type of maintenance vessels planned to be used for Hornsea Four, the likelihood of anchor incidents leading to damage is considered negligible.

11.11.8.12 The operation and maintenance activities will involve mainly crew transfer vessels, external inspection survey vessels, possibly accompanied by remotely operated vehicle (ROV) and are unlikely to make use of anchors or anchor spreads. Should cable inspection also involve repair activities, a diving support vessel may be required, which could involve anchoring in and around the crossing area of the cable; such activity would be subject to standard marine operation activities including SIMOPS review.

Significance conclusion

11.11.8.13 As detailed in Table 11.28, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in Volume A5, Annex 11.1: Offshore Installation Interfaces). The effect will, therefore, be **not significant** (as per Table 11.18).

Table 11.28: Outcome of risk assessment – anchor snagging (IOU-O-12).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow to Kilmar Service Spool pipelines	Anchor Snagging/ Dropping: **Broadly acceptable**
	Kilmar Service pipelines	Anchor Snagging/ Dropping: **Broadly acceptable**
	Wells	Well integrity: **Broadly acceptable**
TBC[15] (formerly Dana Petroleum)	Platypus pipeline	Anchor Snagging/ Dropping: **Broadly acceptable**
Gassco	Langeled pipeline	Anchor Snagging/ Dropping: **Broadly acceptable**
NEO Energy	Babbage Export	Anchor Snagging/ Dropping: **Broadly acceptable**
	Babbage Wells	Well integrity: **Broadly acceptable**
Perenco	Intra-field flowlines and pipelines	Anchor Snagging/ Dropping: **Broadly acceptable**
	Wells	Well integrity: **Broadly acceptable**
Harbour Energy	Intra-field flowlines and pipelines	Anchor Snagging/ Dropping: **Broadly acceptable**
	Johnston Wells	Well integrity: **Broadly acceptable.**
Shell	SEAL pipeline	Anchor Snagging/ Dropping: **Broadly acceptable.**

11.11.9 Operation and Maintenance: Oil and Gas Operations - Shipping and Navigation

11.11.9.1 The impacts of the offshore operation and maintenance of Hornsea Four on shipping and navigation have been assessed with regard to the consequential impacts on the safety of oil and gas receptors. The impacts arising during the operation and maintenance phase of Hornsea Four are listed in Table 11.14: along with the MDS against which each operation and maintenance phase impact has been assessed. A description of the potential effects on oil and gas receptors caused by each identified impact is given below.

Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of Hornsea Four infrastructure (IOU-O-13)

11.11.9.2 An increased allision risk may arise as a result of a reduction in available sea room to operate safely. As vessels are deviated due to the presence of Hornsea Four, it may

[15] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

increase the traffic density in the surrounding area. This in turn may result in vessels routeing closer to oil and gas platforms within the vicinity of Hornsea Four infrastructure, which has the potential to increase the likelihood of a vessel to oil and gas structure allision.

11.11.9.3 A study on vessel allision with assets close to Hornsea Four was conducted by Anatec (Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report)). The assessment of the allision risk undertaken has focused on changes to vessel traffic patterns passing within 2 nm of the relevant oil and gas assets as a result of the presence of the Hornsea Four array. This has been based on the pre- and post-wind farm worst-case route deviations as identified and assessed within the NRA (**Volume A5, Annex 7.1: Navigational Risk Assessment**). As noted within **Chapter 7: Shipping and Navigation** it is not possible to consider all potential alternative routeing options for commercial traffic and therefore worst-case alternatives have been considered where possible in consultation with operators. All alternative routes maintain a minimum distance of 1 nm from offshore installations in line with the MGN 654 Shipping Route Template.

Potential impact

11.11.9.4 As stated in the Allision Technical Report (see Table 7.2 in Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces**) the greatest increases in vessel numbers are predicted within 2 nm of the Alpha Petroleum operated Garrow NUI (two additional vessels per day), Perenco operated Ravenspurn North ST2 and Ravenspurn South A platforms (two additional vessels per day, per platform), and NEO Energy operated Babbage platform (one additional vessel per day). No changes in vessel numbers were predicted for the Ravenspurn North Complex, Ravenspurn North ST2, Ravenspurn North ST3, Ravenspurn South B, Ravenspurn South C or Kilmar NUIs. There is also no change in vessel number within 2 nm of the Minerva platform (operated by Perenco), which is within 10 nm of the Hornsea Four offshore HVAC booster station search area. There is a decrease in the number of vessels within 2 nm of the Tolmount Main platform, to one vessel per day.

11.11.9.5 As noted in the Allision Technical Report (Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces**) only two routes required deviation due the presence of the Hornsea Four offshore HVAC booster station search area (Route 6 and Route 9, see **Volume A5, Annex 7.1: Navigational Risk Assessment**). These routes are predicted to shift traffic west to avoid the potential booster station locations, which results in vessels moving away from the Tolmount Main platform.

11.11.9.6 In order to reduce risks of allision with oil and gas infrastructure, ongoing consultation with and promulgation of information (NtM (Co89)) to oil and gas operators and mariners will be implemented in order to ensure maintenance activities are planned in collaboration with potentially affected operators. Cooperation and liaison agreements will be developed with relevant oil and gas operators and Hornsea Four in terms of SIMOPS to ensure allision risks are minimised.

Significance conclusions

11.11.9.7 As detailed in **Table 11.29**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.29: Outcome of risk assessment – allision risk (IOU-O-13).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow NUI	Vessel Impact: **Broadly acceptable**
Alpha Petroleum	Kilmar NUI	Vessel Impact: **Broadly acceptable**
NEO Energy	Babbage Platform	Vessel Impact: **Broadly acceptable**
Perenco	Ravenspurn North Complex platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn North ST2 platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn North ST3 platform	Vessel Impact: **Broadly acceptable**
Perenco	Ravenspurn South A platforms	Vessel Impact: **Broadly acceptable**
	Ravenspurn South B platforms	Vessel Impact: **Broadly acceptable**
	Ravenspurn South C platform	Vessel Impact: **Broadly acceptable**
Perenco	Minerva	Vessel Impact: **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Vessel Impact: **Broadly acceptable**

Proximity to Hornsea Four infrastructure and associated works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-O-14)

11.11.9.8 This impact considers vessel access and the potential vessel route deviations to oil and gas installations only. An assessment on restrictions to helicopter access to existing or new oil and gas assets is provided in **Section 11.11.10** and in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report). An assessment on route deviations to vessels is detailed in **Chapter 7: Shipping and Navigation**.

11.11.9.9 Note that Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report) shows that the implications of impaired access are commercial only and not safety related.

Potential impact

11.11.9.10 There are two active subsea structures (one manifold and one wellhead) associated with the Johnston Field (see **paragraph 11.7.1.28** for details). It should be noted that current indications are that Johnston field assets will cease production in the 2020s, prior to the installation and operation of Hornsea Four. The primary concern related to these assets is available space within the array area for rig access and anchor spread (where required). It was raised during consultation that dive support vessel access will still be required to maintain the Johnston Field well assets as long as they remain operational (Harbour Energy), and it should be considered that access to the SEAL pipeline (Shell) may also be necessary. It may therefore be necessary for associated oil and gas maintenance vessels to enter the array area on occasion.

11.11.9.11 The Tolmount Main platform (Harbour Energy) is positioned 2.15 nm from the HVAC booster station search area, however it should be considered that this is a worst-case distance, as if HVAC booster stations are utilised then they could be positioned anywhere within the search area. As a result, no notable issues of access to Tolmount Main platform are considered likely. Impaired access to oil and gas subsurface assets can also occur as a result of the proposed HVAC booster stations. During the operational phases of Hornsea Four, it is not anticipated that there will be disruption to or loss of vessel access to the Langeled pipeline (Gassco). This is due to the planned 500 m buffer or 'set-back' zone between the HVAC booster stations and the Langeled pipeline. There are two active platforms (Ravenspurn North CCW and Ravenspurn North CC (Perenco)) located approximately 3 km from the Hornsea Four array area, along with one active subsea protection structure and a wellhead (see **paragraph 11.7.1.24**). However, it is considered that all operations associated with Perenco's Ravenspurn North Complex will remain outside the array area. In relation to wells, there is one abandoned well (AB3 (43/26-6)) located within the ECC with 32 wells located within 1 km of the ECC, eight of which are operational (see **paragraph 11.7.1.29** for details). As per Section 8.3.2 in Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report), it is feasible to undertake large scale operations associated with oil and gas assets in proximity to wind farm structures.

11.11.9.12 NEO Energy's Babbage platform was specifically raised as a potential concern during consultation with Spirit Energy (noting that Spirit Energy have since transferred operation of Babbage to NEO Energy), with the platform being located approximately 2.3 nm from the Hornsea Four array area. Discussions around marine access are ongoing with the operator, and it is noted that based on marine traffic analysis, vessel activity associated with the Babbage platform such as routine support vessel visits from Great Yarmouth or Lowestoft will remain outside of the Hornsea Four array area. In addition, the majority of commercial vessels on affected routes will pass between Hornsea Four and Hornsea Project Two, or potentially choose alternate routes, including passing further from the assets given there is sea room available to do so.

11.11.9.13 Any plans for new infrastructure will be developed by operators with an awareness of the presence of Hornsea Four. In the event that new infrastructure is planned in close proximity, consultation will take place between Hornsea Four and the relevant oil and gas operator to establish close communication. Although not a legislative requirement, the OGA interactive maps show the locations of wind farm developments.

Significance conclusions

11.11.9.14 As detailed in **Table 11.30**, safety impacts have been considered to be **broadly acceptable** for Johnston wells, and all other oil and gas assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.30: Outcome of risk assessment – proximity (IOU-O-14).

Operator	Asset	Risk Assessment Outcome and Justification
NEO Energy	Babbage Platform	Vessel Access (proximity): **Broadly acceptable**

Operator	Asset	Risk Assessment Outcome and Justification
Perenco	Ravenspurn North Complex platforms	Vessel Access (proximity): **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Vessel Access (proximity**): Broadly acceptable**
	Johnston wells	Vessel Access (proximity): **Broadly acceptable**

Wind turbines and associated works may result in deviations to routine support vessel routeing to oil and gas platforms (IOU-O-15)

11.11.9.15 This impact considers vessel access and the potential vessel route deviations to oil and gas installations only. An assessment on restrictions to helicopter access to existing or new oil and gas assets is provided in **Section 11.11.10** and in **Chapter 8: Aviation and Radar** and Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report). An assessment on route deviations to vessels is detailed in **Chapter 7: Shipping and Navigation**.

11.11.9.16 The Hornsea Four infrastructure and associated safety zones have the potential to cause disruption of routine support vessel (e.g. supply and standby) access to oil and gas platforms.

Potential impact

11.11.9.17 There are no existing platforms within the Hornsea Four array area or within 1 km of the array area. There are also no platforms located within the offshore ECC or offshore HVAC booster station search area, however there are two active Perenco gas platforms, Ravenspurn North CCW and Ravenspurn North CC located 890 m and 920 m from the Hornsea Four ECC respectively (see **Table 11.8**). The 500 m safety zones around these platforms are therefore respectively 390 m and 420 m from the boundary of the ECC. In the event of any maintenance works along these limited parts of the offshore ECC there may be a temporary overlap with the requested safety distances around maintenance vessels working along the ECC and the routine support vessels routeing to Ravenspurn North CCW and Ravenspurn North CC, although the likelihood of such an occurrence is considered to be extremely low. Even in the unlikely event of such an occurrence, significant disruption to vessel access to Ravenspurn North CCW or Ravenspurn North CC platforms would not be expected to occur due to the close communication which will be established between both parties to ensure that activities can be coordinated.

11.11.9.18 The assessment of route deviations detailed in **Volume A5, Annex 7.1: Navigational Risk Assessment** and within Appendix C of **Volume A5, Annex 11.1: Allision Technical Report** (Allision Technical Report) notes that oil and gas support vessels routinely transit across the proposed Hornsea Four array area, with the majority of the vessels on passage to and from the oil and gas platforms. However, a significant majority of the baseline vessel activity in relation to platforms within the vicinity of Hornsea Four recorded from the data summarised within Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report) occurred outside of the Hornsea Four array area. Based upon these findings, it is considered likely that routine support vessels will deviate by 4 nm for Kilmar NUI (Alpha Petroleum), by 0.3 nm for Garrow NUI (Alpha Petroleum)

and 1 nm for the Trent NUI platform (Perenco). Furthermore, no notable deviations are anticipated for routine support vessel routeing to Tolmount Main platform (Harbour Energy). Moreover, it is anticipated that the majority of oil and gas support vessel activity for NEO Energy's Babbage platform and Perenco's Ravenspurn North CCW and Ravenspurn North CC platforms will remain outside the Hornsea Four array area and will not be affected by Hornsea Four infrastructure and associated maintenance activities in terms of platform access.

11.11.9.19 Any plans for new oil and gas platforms will be developed by operators with an awareness of the presence of Hornsea Four. In the event that new infrastructure is planned in close proximity, consultation will take place between Hornsea Four and the relevant oil and gas operator to establish close communication. Although not linked to a legislative requirement, the OGA interactive maps do show the locations of wind farm developments.

Significance conclusions

11.11.9.20 As detailed in **Table 11.31**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.31: Outcome of risk assessment – deviation (IOU-O-15).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow NUI	Vessel Deviation: **Broadly acceptable**
	Kilmar NUI	Vessel Deviation: **Broadly acceptable**
NEO Energy	Babbage Platform	Vessel Deviation: **Broadly acceptable**
Perenco	Ravenspurn North CCW platform	Vessel Deviation: **Broadly acceptable**
	Ravenspurn North CC platform	Vessel Deviation: **Broadly acceptable**
	Trent platform	Vessel Deviation: **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Vessel Deviation: **Broadly acceptable**

The presence of new wind turbines in previously open sea areas may cause interference with the performance of the REWS located on oil and gas platforms (IOU-O-16)

11.11.9.21 REWS are primarily used to detect and track vessels navigating within the vicinity of offshore oil and gas assets and provide allision warning when vessels are in breach of defined CPA and TCPA parameters. The impact of offshore wind farms on REWS may arise from a number of factors such as; high radar returns from the turbines and associated offshore structures, shadowing (effectively a shadow is cast by the wind turbines which creates a region where the radar beam is unable to fully illuminate an object), increased number of detections and false alarm/track generation. Due to the presence of Hornsea Four infrastructure, existing main vessel routes will be deviated and as such vessels may be rerouted closer to oil and gas platforms equipped with REWS. This may also cause an increase in CPA/TCPA alarm rates (this effect is covered under IOU-O-17).

11.11.9.22 Platforms with REWS potentially within operational range of the Hornsea Four array area have been identified (see **paragraph 11.7.1.40**). Typically, a 30 km (16 nm) detection range is assumed as the minimum requirement for REWS to detect and track smaller vessels (100 m^2 RCS). Radar modelling has been carried out to predict the effect of Hornsea Four on the REWS installations at Ravenspurn North CC and Ravenspurn South B. The results of this modelling are presented in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report).

Potential impact

11.11.9.23 To further assess the ability of the REWS installations on Ravenspurn North CC and Ravenspurn South B platforms to detect vessels within the Hornsea Four array area, a constant false alarm rate (CFAR) threshold over the detection region was modelled (see Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). Section 7 in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report) identifies that the raised detection threshold levels caused by the presence of turbines will inherently cause some detection loss for vessels that are travelling through the Hornsea Four array area. This effect, in combination with potential shadowing effects, may cause the REWS to lose tracks of vessels and fail in raising TCPA alarms in a timely manner as stated for the CPA/TCPA alarm requirements (this effect is covered under IOU-O-17).

11.11.9.24 The REWS along with the alarms are detection methods only. As detailed in **Volume A5, Annex 11.1: Offshore Installation Interfaces** and in **paragraph 11.7.1.39** the REWS tracker is integrated with AIS data which is largely unaffected by the presence of wind turbines. In addition, platforms equipped with REWS are typically fitted with high frequency radio communications, which can be used to contact vessels in the area if a potential safety threat is detected or expected.

Significance conclusions

11.11.9.25 As detailed in **Table 11.32**, impacts have been considered to be **broadly acceptable** based on existing safeguards for all operators and assets protected by REWS radar coverage from Ravenspurn North CC and Ravenspurn South B platforms (see **paragraph 11.7.1.40**) (full assessments presented in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.32: Outcome of risk assessment – REWS (IOU-O-16).

Operator	Asset	Risk Assessment Outcome and Justification
Perenco	Ravenspurn North CC platform	REWS: **Broadly acceptable**
	Ravenspurn South B platform	REWS: **Broadly acceptable**

The presence of new wind turbines in previously open sea areas will deviate vessels which may cause a change in CPA and TCPA alarms at oil and gas platforms equipped with REWS (IOU-O-17)

11.11.9.26 A REWS uses radar returns to monitor and track vessels within the detection region and alert the operator when a proximity violation or a collision threat is detected. A REWS

uses a defined set of rules to identify a breach of the CPA and TCPA parameters. Typically, for both manned and NUI an Amber alarm is raised if a vessel is within CPA of 1 nm and a Red alarm is triggered if the CPA of a vessel is 0.27 nm. The Red TCPA alarms are raised for vessels that are on a collision vector 30 minutes away for manned installations and 15 minutes for NUIs, and an Amber alarm is raised for vessels that are 40 minutes away for manned installations and 25 minutes away for NUIs. To avoid alarms due to temporary vector breach of the TCPA while vessels are turning, TCPA alarms are only triggered if the vessel's vector remains in breach of the TCPA condition for a set number of radar rotations (typically 10 radar rotations). For Perenco's REWS, there is a delay of 90 seconds (or 36 radar rotations) before an alarm is triggered.

11.11.9.27 The predicted shipping route deviations were provided by Anatec, following a review of vessel movements in the region and are presented in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report). The impact has been assessed for Hornsea Four array area in isolation and cumulatively (**Section 11.12.4**) with Hornsea Project One, Hornsea Project Two and Hornsea Three (see **Annex 7.1: Navigation Risk Assessment**)

Potential impact

11.11.9.28 A statistical model was run to estimate the likelihood of CPA/TCPA alarms being triggered considering 1,000 vessel paths in both forward and reverse directions (a total of 2,000 runs) for the base-case (existing routes) and for the rerouted shipping traffic (deviated routes) with Hornsea Four in place (see Figure 28 and 30 in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). Further details on the parameters used in the model are presented in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report).

11.11.9.29 The modelling results indicate that while some platforms will not experience any change in the probability of alarms, other platforms are expected to see an increase of alarm rates due to the displacement of vessel traffic around the Hornsea Four array area. Following the installation of Hornsea Four, main vessel routes are expected to be rerouted around the Hornsea Four array area bringing some existing routes closer to some of the Perenco operated platforms (Ravenspurn North CC, Ravenspurn North ST2, Ravenspurn North ST3, Ravenspurn South A, Ravenspurn South B, Ravenspurn South C. Horton and Trent platforms). As detailed in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report) rerouting Route 6 (Grangemouth to Rotterdam) results in the predicted increase in alarm rates for these platforms (see Table 5 of Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). The deviated routes alter the direction and heading of vessels making them more likely to trigger TCPA alarms. Also, as some routes are deviated closer to the aforementioned platforms, the increased density of traffic along with the closer proximity is predicted to result in an increase in both CPA and TCPA alarms.

11.11.9.30 The REWS along with the alarms are detection methods only. An increase in alarms will indicate that the risk of allision is potentially increased. As detailed in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning

Technical Report), there will be no additional safety risk to the affected platforms within the 10 nm due to the potential increase in alarms.

Significance conclusions

11.11.9.31 As detailed in **Table 11.33**, impacts have been considered to be **broadly acceptable** for all operators and assets protected by REWS coverage from Ravenspurn North CC and Ravenspurn South B (see **paragraph 11.7.1.40**) (full assessments presented in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.33: Outcome of risk assessment – CPA Alarms (IOU-O-17).

Operator	Asset	Risk Assessment Outcome and Justification
Perenco	Ravenspurn North CC platform	CPA Alarms: **Broadly acceptable**
	Ravenspurn South B platform	CPA Alarms: **Broadly acceptable**
	Ravenspurn North ST2 platform	CPA Alarms: **Broadly acceptable**
	Ravenspurn North ST3 platform	CPA Alarms: **Broadly acceptable**
	Ravenspurn South A platform	CPA Alarms: **Broadly acceptable**
	Ravenspurn South C platform	CPA Alarms: **Broadly acceptable**

11.11.10 Operation and Maintenance: Oil and Gas Operations – Helicopter Operations

11.11.10.1 The impacts of the offshore operation and maintenance of Hornsea Four have been assessed on oil and gas helicopter operations. The impacts arising during the operation and maintenance phase of Hornsea Four are listed in **Table 11.14**: along with the MDS against which each operation and maintenance phase impact has been assessed. A description of the potential effects on oil and gas helicopter operations is provided below.

Hornsea Four infrastructure and associated works may restrict or hamper helicopter access to oil and gas platforms (IOU-O-18)

11.11.10.2 The operation of Hornsea Four infrastructure has the potential to result in reduced helicopter access to oil and gas platforms in the vicinity of Hornsea Four. A detailed assessment of the potential impacts on helicopter operations at relevant oil and gas platforms has been completed; further details are provided in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report). This report includes Commercial Air Transport (CAT) weather limits, as a series of filters, to the meteorological data provided by a duty holder with assets close to the Hornsea Four array area and ECC in order to understand the potential operational impact on the installations. The report has used the Perenco operated Ravenspurn North platform as a case study due to its relatively close proximity to the Hornsea Four array area (3 km (1.6 nm)) and because it is permanently manned, therefore presenting the worst case scenario. A summary of all results from the helicopter access assessment is presented in Table 6.1, under Section 6 of Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report).

11.11.10.3 It is considered that there will be no additional impact on helicopter access to oil and gas platforms located beyond the 10 nm of Study Area 2 (see **Figure 11.5**) due to the distance of these assets from the Hornsea Four array area. Furthermore, they are outside the 9 nm consultation zone guidance required by CAP 764 (CAA 2016). This includes the Tolmount Main platform (Harbour Energy) which is located beyond the 10 nm buffer.

Potential impact

11.11.10.4 No approach limitations in relation to en-route descent will be imposed on oil and gas platforms adjacent to Hornsea Four (see Section 1.3 of Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report)). The assessment also concludes that shuttling flight procedures can be used as an alternative approach profile within the Ravenspurn Field. Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report) predicts that the impact of Hornsea Four on Ravenspurn North. However, the data showed that the duration for which an ARA was obstructed was low (typically only a few hours at a time) and so there were unlikely to be any long periods of time when CAT helicopter operations were inhibited. The assessment also notes that the impact on other Perenco operated oil and gas platforms within the Ravenspurn Field (Ravenspurn North ST2, Ravenspurn North ST3, Ravenspurn South A, Ravenspurn South B, and Ravenspurn South C) from Hornsea Four on their access will be lower than that for Ravenspurn North. In addition to these Perenco operated platforms, the report also assesses the impact to Alpha Petroleum's Garrow and Kilmar NUIs and NEO Energy's Babbage platform, which are within the 10 nm of Study Area 2 and concluded potentially impaired helicopter access to these platforms. However, the impact of Hornsea Four on their access will be even lower than the impact on Ravenspurn North.

11.11.10.5 The presence of Hornsea Four infrastructure will not introduce additional requirements in relation to navigational failure or extreme meteorological conditions or require new flight procedures for any oil and gas platform within the 10 nm study area. Furthermore, as stated in **Volume A5, Annex 11.1: Offshore Installation Interfaces** the safety risk associated with helicopter transport to oil and gas platforms will remain unchanged as helicopter transport will not take place should there be additional risk brought about by a combination of meteorological conditions and the presence of the Hornsea Four array.

11.11.10.6 It is also noted in **Volume A5, Annex 11.1: Offshore Installation Interfaces** that Hornsea Four will not impose any restrictions, including no take off or approach limitations, on Search and Rescue (SAR) operated helicopter flights to nearby installations.

Significance conclusions

11.11.10.7 As detailed in **Table 11.34**, safety impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report)). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.34: Outcome of risk assessment – helicopter access to oil and gas platforms (IOU-O-18).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow NUI	Helicopter Access - CAT: **Broadly acceptable**

Operator	Asset	Risk Assessment Outcome and Justification
		Helicopter Access - SAR: **Broadly acceptable**
	Kilmar NUI	Helicopter Access - CAT: **Broadly acceptable**.
		Helicopter Access - SAR: **Broadly acceptable**
NEO Energy	Babbage platform	Helicopter Access - CAT: **Broadly acceptable**
		Helicopter Access - SAR: **Broadly acceptable**
Perenco	Ravenspurn North CCW platform	Helicopter Access - CAT: **Broadly acceptable**.
		Helicopter Access - SAR: **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Helicopter Access - CAT: **Broadly acceptable**
		Helicopter Access - SAR: **Broadly acceptable**

11.11.10.8 As per Co102 (see **Volume A4, Annex 5.2: Commitment Register**), the CAA will be informed of the locations, heights and lighting status of the wind turbines and HVAC booster stations, to allow inclusion on Aviation Charts.

Hornsea Four infrastructure and associated works may restrict or hamper helicopter access to oil and gas vessels (IOU-O-19)

11.11.10.9 The presence of the Hornsea Four infrastructure, particularly in the array area, has the potential to affect the operation of helicopters to and from oil and gas service vessels where they are stationed in close proximity to the Hornsea Four infrastructure. Potential impacts related to the presence of Hornsea Four infrastructure were assessed in in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report). The Johnston Field wellheads are located approximately 2 nm inside the boundary of the Hornsea Four array area. As a result, any CAT helicopter operations would have to be conducted under visual flight rule (VFR) conditions, potentially restricting operations to daylight only. However, Harbour Energy are considering ceasing production of the Johnston wellheads in the 2020s, prior to the start of Hornsea Four array construction and therefore helicopter operations would only be relevant for the duration of the following decommissioning period (if that had not been completed prior to the Hornsea Four operational phase)

11.11.10.10 In order to help achieve a safe operating environment, industry best practice, including HeliOffshore Approach Path Management Guidelines, have been applied. It should be noted that the presence of Hornsea Four infrastructure will not introduce additional requirements in relation to navigational failure or extreme meteorological conditions or require new flight procedures.

Potential impact

11.11.10.11 Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report) concludes that the presence of the Hornsea Four infrastructure will not impose or subject approach limitations on oil and gas vessels which are associated with Perenco operated assets within Ravenspurn Field and Alpha Petroleum operated Garrow and Kilmar NUIs. Furthermore, as stated in **Volume A5, Annex 11.1: Offshore Installation Interfaces** the safety risk associated with helicopter transport to oil and gas vessels will remain unchanged due to the presence of Hornsea Four infrastructure as

helicopter transport will not take place should there be any risk brought about by a combination of meteorological conditions and the presence of the Hornsea Four array.

11.11.10.12 For SAR operations to oil and gas vessels, the presence of Hornsea Four will not change or introduce additional requirements in relation to navigational failure, extreme weather/environmental conditions and will not require new flight procedures. It is also noted in **Volume A5, Annex 11.1: Offshore Installation Interfaces** that Hornsea Four will not impose any restrictions, or impair helicopter access to and from Harbour Energy decommissioning vessels during the decommissioning of Johnston well assets.

Significance conclusion

11.11.10.13 As detailed in **Table 11.35**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments are presented in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report)). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.35: Outcome of risk assessment – helicopter access to oil and gas vessels (IOU-O-19).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow NUI	Helicopter Access - CAT: **Broadly acceptable**
		Helicopter Access - SAR: **Broadly acceptable**
	Kilmar NUI	Helicopter Access - CAT: **Broadly acceptable**
		Helicopter Access - SAR: **Broadly acceptable**
NEO Energy	Babbage platform	Helicopter Access - CAT: **Broadly acceptable**
		Helicopter Access - SAR: **Broadly acceptable**
Perenco	Ravenspurn North CCW platform	Helicopter Access - CAT: **Broadly acceptable**
		Helicopter Access - SAR: **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Helicopter Access - CAT: **Broadly acceptable**
		Helicopter Access - SAR: **Broadly acceptable**
	Johnston wells	Helicopter Access - CAT: **Broadly acceptable**
		Helicopter Access - SAR: **Broadly acceptable**

11.11.11 Operation and Maintenance: Oil and Gas Operations – Future Development

11.11.11.1 The impacts of the operations and maintenance phase of Hornsea Four have been assessed on the future development of oil and gas licencing blocks recently awarded to a number of operators. The impacts arising during the operation and maintenance phase of Hornsea Four are listed in **Table 11.14**: along with the MDS against which each operation and maintenance phase impact has been assessed. A description of the potential effects on oil and gas receptors caused by each identified impact is given below.

Hornsea Four infrastructure, safety zones and advisory safety distances may restrict or cause interference with potential seismic survey activity (IOU-O-20)

11.11.11.2 Hornsea Four infrastructure and the presence of safety zones associated with maintenance activities and requested safety distances around maintenance vessels carrying out activities along the ECC and within the array area and HVAC booster station search area could exclude conventional towed streamer seismic survey vessels from parts of these areas and/or restrict access.

11.11.11.3 As discussed in **paragraph 11.11.2.4** only those blocks that are licenced beyond the start of Hornsea Four operation and maintenance phase and in which future seismic survey operations have a degree of both spatial and temporal certainty, with information available in the public domain, have been taken forward into the assessment. These blocks are listed in **Table 11.36**.

11.11.11.4 The Hornsea Four array area overlaps with four licenced blocks (**Table 11.25**) and the offshore ECC and HVAC booster station search area overlap with nine licenced blocks (**Table 11.26**) in which seismic surveys could be restricted to varying extents.

Potential impact

11.11.11.5 Harbour Energy's Licence Block 43/27a is located within the Hornsea Four array area. As noted in **paragraph 11.7.1.23** Harbour Energy are planning to decommission the Johnston subsea infrastructure and therefore seismic survey activity is not considered applicable within **Volume A5, Annex 11.1: Offshore Installation Interfaces**. However, the remaining oil and gas licence blocks which overlap with the array area and the offshore ECC are considered below.

11.11.11.6 Seismic survey activities may be planned in the future, around the Hornsea Four array. At the time of such activity, it is proposed that a co-existence plan is developed detailing how seismic survey activity will be implemented without undue interface risk. If seismic survey activity is required in the future, it will be adequately planned and analysed in line with regulatory requirements, good engineering practice and the safe operability regime existing on the UK continental shelf. As such, the activity would only proceed once residual risks are deemed to be acceptable.

Significance conclusions

11.11.11.7 As detailed in **Table 11.36**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments are presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.36: Outcome of risk assessment – seismic survey activity (IOU-O-20).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Licence block 42/25a, 43/21a and 43/22a	Seismic Survey Activity: **Broadly acceptable**
NEO Energy	Licence block 48/2a	Seismic Survey Activity: **Broadly acceptable**
Perenco	Licence block 42/28a, 42/28b, 42/29a, 42/30a, 47/4b, 43/26a and 43/24a	Seismic Survey Activity: **Broadly acceptable**
Harbour Energy	Licence block 43/26a, 42/28c, 42/28d, 42/28e and 42/29b	Seismic Survey Activity: **Broadly acceptable**

Drilling and the installation/decommissioning of oil and gas infrastructure has the potential to be restricted by the presence of Hornsea Four infrastructure, safety zones and advisory safety distances (IOU-O-21)

11.11.11.8 Drilling and the placement of infrastructure associated with gas field development may be prohibited within 1 km of Hornsea Four turbine positions (based on the presence of 500 m safety zones around oil and gas platforms, jack-up drill rigs, and subsea well-heads/templates and the presence of 500 m safety zones around Hornsea Four turbines) during the operational and maintenance phase.

11.11.11.9 As discussed in **paragraph 11.11.2.4**, only those blocks that are licenced beyond the start of Hornsea Four operation and maintenance phase and in which future drilling operations have a degree of both spatial and temporal certainty, with information available in the public domain, have been taken forward into the assessment. These blocks are listed in **Table 11.37**.

Potential impact

11.11.11.10 The operation of Hornsea Four may also restrict the decommissioning activities associated with the Harbour Energy operated wells within the Johnston Field (Licence Block 42/27a) where these are still in operation during the Hornsea Four operational phase. This includes helicopter access to decommissioning vessels within the array area (see **Section 11.11.10** for further details). It should be noted that current indications are that Johnston Field assets will cease production in the 2020s decade, prior to the operation of Hornsea Four. Discussions between Hornsea Four and Harbour Energy are ongoing in order to facilitate coexistence between Hornsea Four construction and Johnston well decommissioning (see **Table 11.3**).

11.11.11.11 As detailed in **Volume A5, Annex 11.1: Offshore Installation Interfaces** exploration and appraisal drilling may be planned within and around the Hornsea Four array area and offshore ECC. At the time of such activity, it is proposed that a co-existence plan is developed that details communication channels and SIMOPS activity. If drilling and further field development activity is to be undertaken in the future, it will be adequately planned and analysed in line with regulatory requirements, good engineering practice and the safe operability regime existing on the UK continental shelf. As such the activity would only proceed once residual risks are deemed to be acceptable.

11.11.11.12 Harbour Energy's Licence Block 43/27a is located within the Hornsea Four array area. As noted in **paragraph 11.7.1.23** Harbour Energy are planning to decommission the Johnston subsea infrastructure and therefore drilling and further field development

activity is not considered applicable within **Volume A5, Annex 11.1: Offshore Installation Interfaces**. Moreover, the current licence block end date for 43/27a is 2025 (see **Table 11.5**). However, the remaining oil and gas licence blocks which overlap with the array area and the offshore ECC are considered below.

Significance conclusions

11.11.11.13 As detailed in **Table 11.37**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.37: Outcome of risk assessment – drilling and the installation of oil and gas infrastructure (IOU-O-21).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Licence block 42/25a, 43/21a and 43/22a	Drilling Activity: **Broadly acceptable**
NEO Energy	Licence block 48/2a	Drilling Activity: **Broadly acceptable**
Perenco	Licence blook 42/28a, 42/28b), 42/29a, 42/30a, 47/4b), 43/26a and 43/24a	Drilling Activity: **Broadly acceptable**
Harbour Energy	Licence block 43/26a, 43/27a, 42/28c, 42/28d and 42/28e and 42/29b	Drilling Activity: **Broadly acceptable**

11.11.12 Operation and Maintenance: Oil and Gas Operations - General

Impact of physical presence of wind turbines in Hornsea Four array area on microwave links (IOU-O-22)

11.11.12.1 The presence of the Hornsea Four turbines during the operation and maintenance phase has the potential to obstruct or interfere with a number of microwave links that may be used as part of the communications systems on oil and gas platforms. A microwave link is a communications system that uses a beam of radio wave in the microwave frequency range to transmit information between two fixed locations. Microwave links operate on a LOS basis and may therefore be affected by the presence of the Hornsea Four infrastructure where it interrupts such a LOS connection.

11.11.12.2 Microwave links in the vicinity of Hornsea Four array area have been identified within **Volume A5, Annex 11.1: Offshore Installation Interfaces**. The microwave link from the Ravenspurn North platform to Trent transmits directly across the Hornsea Four array area. The planned future microwave links from the Ravenspurn North platform to Alpha Petroleum's Garrow and Kilmar NUI's) would also transmit across the Hornsea Four array area if they are installed and if they take the most direct route.

Potential impact

11.11.12.3 The presence of the Hornsea Four infrastructure will potentially obstruct or interfere with the current and future microwave links operated by Perenco for Perenco's Ravenspurn North and Trent and Alpha Petroleum's Garrow and Kilmar NUI's (noting that this is dependent upon the final layout and location of the installed Hornsea Four infrastructure). As Ravenspurn North is the main hub for communication across to Trent

and the proposed microwave communication link to Alpha Petroleum's Garrow and Kilmar NUI's, the impact will be contained within the spatial extent of the Hornsea Four array area and, where such an effect occurs, it will be of long-term temporary duration (for the life of the Hornsea Four project or until the relevant oil and gas installations are decommissioned).

11.11.12.4 Interference with microwave communication links could potentially result in loss of or interruptions to the direct communication between Ravenspurn North and Trent, and the planned Ravenspurn North to Garrow and Kilmar NUIs. Microwave communications between some or all of these platforms may therefore require mitigation in order to avoid, where possible, disruption and allow continued operations. It should be noted that there are microwave communication links in operation, successfully running through windfarms without obstruction or interference from the windfarm. During consultation with Sprit Energy, it was noted that the microwave links which run across the West of Duddon Sands offshore wind farm have not experienced any interferences or obstructions from the offshore wind farm (see Figure 16-8 and Section 16.6.15 within **Volume A5, Annex 11.1: Offshore Installation Interfaces)**.

Significance conclusion

11.11.12.5 A further detailed assessment of the potential impacts on microwave communications was completed as part of the overarching oil and gas assessment within **Volume A5, Annex 11.1: Offshore Installation Interfaces**. The assessment identified the potential for direct disruption of microwave communications from Ravenspurn North as a result of the operating Hornsea Four array area. However, the microwave links are communication mechanisms. **Volume A5, Annex 11.1: Offshore Installation Interfaces** notes '*Interference with microwave links will not in itself introduce additional safety risk. On this basis it is considered that the potential of interference with microwave communication will not result in additional safety risk*'.

11.11.12.6 As detailed in **Table 11.38**, safety impacts have been considered to be **broadly acceptable** for all assessed operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.38: Outcome of risk assessment – microwave communication (IOU-O-22).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow NUI	Microwave Communication: **Broadly acceptable**
	Kilmar NUI	Microwave Communication: **Broadly acceptable**
Perenco	Ravenspurn North CCW platform	Microwave Communication: **Broadly acceptable**
	Trent platform	Microwave Communication: **Broadly acceptable**

Further mitigation

11.11.12.7 In order to minimise the impact of Hornsea Four turbines on the performance of the microwave links, suitable improvement measures have been identified within **Volume A5, Annex 11.1: Offshore Installation Interfaces**. It is understood that the link from Ravenspurn North to the Trent platform is important to Perenco operations and it would be challenging to re-route this signal (see Figure 16.9 in **Volume A5, Annex 11.1: Offshore Installation Interfaces**) and will therefore be accommodated by Hornsea Four. Moreover, communication between platforms (Kilmar NUI to Rvenspurn North and Garrow NUI to Ravenspurn North) could be maintained with limited interreference from Hornsea Four by using an alternative route, which avoids crossing the Hornsea Four array area. In order to avoid direct disruption from the Hornsea Four array area and maintain communication between platforms, the proposed alternative route, routed via the Cleeton platform is the basis of the proposed mitigation solution. This will result in a microwave link from Ravenspurn North to Cleeton to Garrow to Kilmar and finally Trent (see Figure 16.10 in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). This route has been defined in consultation with Perenco (see **Table 11.3**).

11.11.13 Decommissioning Phase

Hornsea Four decommissioning activity, infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS site and associated development activity and infrastructure (IOU-D-23)

11.11.13.1 As detailed in **paragraph 11.7.1.54**, there is potential for an interaction within the Overlap Areas.

Magnitude of impact

11.11.13.2 Decommissioning activity, partially decommissioned infrastructure and/or the presence of safety zones or advisory safety distances within the Array Overlap Area may lead to effects on the development or operation of the Endurance CCS associated projects including effects on, or restriction of access to, planned or installed CCS infrastructure such as wells, manifolds, surface platforms and flowlines. This could occur for the duration of the approximately three-year Hornsea Four decommissioning period.

11.11.13.3 In addition, the decommissioning of the Hornsea Four offshore export cables may also temporarily restrict access to the proposed Easington to Endurance CO_2 injection pipeline within the ECC Overlap Area (see **Figure 11.8**).

11.11.13.4 Decommissioning activity for Hornsea Four also has the potential to impact any ongoing operation or maintenance of the CCS installed infrastructure. This could include, for example, include restriction to CCS vessel and helicopter access to the site as a result of Hornsea Four decommissioning vessels and/or activity and the presence of partially decommissioned structures within the Array Overlap Area.

11.11.13.5 Additionally, the Hornsea Four decommissioning activity and/or the presence of partially decommissioned infrastructure could also adversely affect ongoing development work for the Endurance CCS project such as, for example, the ability to undertake seismic surveys in the Array Overlap Area.

11.11.13.6 In the absence of any mitigation, the potential impact on that part of the Endurance CCS project within the Overlap Areas is considered to occur throughout the decommissioning phase and will affect a significant portion of the CCS project within the Overlap Areas.

11.11.13.7 The magnitude is therefore, considered to be **moderate**, noting that, at this stage, there is a very high level of uncertainty associated with the planned works and activities within the Overlap Areas.

Sensitivity of receptor

11.11.13.8 As detailed in **paragraph 11.11.3.8**, the receptor is considered to be of **high** sensitivity (within the Array Overlap Area).

Significance of the effect

11.11.13.9 In the absence of any mitigation, therefore, the potential impact on the CCS development activities arising from the decommissioning of Hornsea Four, within the Array Overlap Area, is considered to be **moderate** magnitude and the Endurance CCS project is deemed to have a **high** sensitivity, resulting in a significance of **moderate** or **large** (the extent of significance being dependent on the final details of the CCS scheme and the extent of the interaction with Hornsea Four, but in any event, considered significant in EIA terms).

Mitigation

11.11.13.10 The Applicant has been actively engaging with the developers of the Endurance CCS site during the pre-application phase with regards to developing an understanding of the proposed CCS development activities and also establishing the principles and process for communication, collaboration and co-existence for the decommissioning phase. This engagement is ongoing, and it is expected that Hornsea Four will:

- Provide full details on the proposed Hornsea Four infrastructure and the planned decommissioning activity that could impact on the CCS development activities to the developers of the Endurance CCS site to allow them to plan and design their project accordingly;
- Establish a set of working principles through an Interface Management Group comprising the project managers for the Applicant and the developers of the Endurance CCS site, establishing communication and liaison on planned activities (such as planned operations and maintenance and development activities) so as to be able to plan and reduce or avoid adverse effects;
- Establish the co-existence principles as the details of the Endurance CCS developments become more certain, on the basis of working together to minimise the effects on the Applicant's and Endurance CCS development and maximise the opportunities for co-location and coexistence; and
- Work together to plan development activities and to identify synergies and opportunities common to both the Applicant's and Endurance CCS development.

11.11.13.11 In addition to the above principles and processes, any temporary impact upon access to pipelines associated with Hornsea Four decommissioning activities would be considered

in the crossing/proximity agreements to the extent that such a scenario would not be an impediment to operations (Co107), particularly in relation to the Easington to Endurance CO_2 injection pipeline.

11.11.13.12 It is important to note that regulations governing CCS projects mandate that the responsibility for the storage site remains with the storage site operators until:

- When all available evidence indicates that the stored CO_2 will be completely and permanently contained; or
- A minimum period of 20 years has elapsed.

11.11.13.13 Following this, the responsibility for the storage site should be transferred to the state (The Crown Estate, 2021). As such, the Applicant will engage directly with the state when this transfer of responsibility occurs, which could coincide with Hornsea Four operations and maintenance or decommissioning operations.

Residual Significance

11.11.13.14 With the development of effective mitigation, the impact on that part of the CCS development within the Overlap Areas will have a residual magnitude of **negligible**, which combined with a **high** sensitivity, results in a residual significance of **slight**, which is not considered significant in EIA terms.

11.11.14 Decommissioning: Oil and Gas Operations

11.11.14.1 The impacts of the offshore decommissioning of Hornsea Four have been assessed on oil and gas receptors. The environmental impacts arising from the decommissioning of Hornsea Four are listed in **Table 11.14**: along with MDS against which, each decommissioning phase impact has been assessed.

Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-D-24)

11.11.14.2 The decommissioning process for Hornsea Four could result in the temporary impact upon access to existing oil and gas pipelines and wells in the vicinity of Hornsea Four due to the imposition of temporary safety zones and advisory safety area for Hornsea Four decommissioning activities, where such oil and gas installations are still in place and have not been decommissioned during the 35-year operational life of the Hornsea Four project.

11.11.14.3 Any temporary restricted access has the potential to affect the safe operation of divers engaged in work at adjacent oil and gas infrastructure. The diving operations covered within **Volume A5, Annex 11.1: Offshore Installation Interfaces** were associated with pipeline maintenance and repair to oil and gas infrastructure.

11.11.14.4 As described in **Volume A5, Annex 11.1: Offshore Installation Interfaces** operators that currently have active oil and gas assets which may, in some part, be affected by temporary restrictions to diving operations include Gassco (Langeled pipeline, which crosses the Hornsea Four HVAC booster station search area), Shell (SEAL pipeline which

crosses the Hornsea Four array area). Other pipelines which enter the Hornsea Four array area and cross the ECC include Perenco operated pipelines associated with Ravenspurn Field platforms, Harbour Energy operated pipelines associated with Johnston wellheads and the TBC operator[16] for the planned Platypus pipeline (which crosses Hornsea Four ECC).

11.11.14.5 There are also 19 wells located within 1 km of Hornsea Four array area (see **paragraph 11.7.1.28**) and 32 wells within 1 km of Hornsea Four offshore ECC and HVAC booster station search area (see **paragraph 11.7.1.29**), which may also result in maintenance and repair activity being restricted temporarily during the decommissioning of Hornsea Four infrastructure, although given the spatial separation of these assets from the array area and ECC such effects are considered less likely.

Potential impact

11.11.14.6 The temporary decommissioning safety zones and advisory safety distances associated with Hornsea Four infrastructure could lead to restricted access to certain of the currently existing oil and gas pipelines and wells where those assets have not been previously decommissioned during the 35-year operational life of the Hornsea Four project, resulting in the potential for an adverse effect on diving operations associated with repair and maintenance activities as a result of decommissioning activities associated with Hornsea Four infrastructure.

11.11.14.7 Temporary impact upon access to pipelines and wells associated with any temporary safety zones/advisory safety distances is considered to be limited in extent, temporary and intermittent. With the exception of Gassco's Langeled pipeline and Shell's SEAL pipeline, all other oil and gas pipelines cross the offshore ECC and do not have pipeline crossings in areas of platform and/or substation decommissioning. Therefore, access to these pipelines are not anticipated to be impaired during decommissioning of Hornsea Four infrastructure. Furthermore, the remaining wells within the Hornsea Four array area (see **paragraph 11.7.1.29**) are anticipated to be all abandoned during Hornsea Four decommissioning and therefore no repair or maintenance activities will take place. A full assessment on Gassco and Shell activities is presented in Section 12 and Section 13, respectively of **Volume A5, Annex 11.1: Offshore Installation Interfaces**.

11.11.14.8 Information on Hornsea Four decommissioning activities would be provided through promulgation of NtM and continued consultation with relevant operators in order to ensure that repair and maintenance work (including diving activity) associated with oil and gas assets within the region can be planned and scheduled to avoid restrictions temporally and spatially due to the Hornsea Four decommissioning activities. Appropriate liaison will be undertaken to ensure information on the decommissioning of Hornsea Four infrastructure is circulated in a NtM and other appropriate media (see **Table 11.13**, Co89, Co94, Co96, Co102, C0139 and Co181).

[16] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

Significance conclusions

11.11.14.9 As detailed in **Table 11.39**, impacts have been considered to be **broadly acceptable** for all operators and assets which may be temporarily impacted upon (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.39: Outcome of risk assessment – oil and gas pipelines (IOU-D-24).

Operator	Asset	Risk Assessment Outcome and Justification
Gassco	Langeled pipeline	Vessel Access: **Broadly acceptable**
		Diving Access**: Broadly acceptable**
Shell	SEAL pipeline	Vessel Access: **Broadly acceptable**
		Diving Access: **Broadly acceptable**

Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells (IOU-D-25)

11.11.14.10 Damage to pipelines and wells can arise at the time of anchoring or subsequently if the vessel should drag its anchor due to metocean conditions. Vessel traffic associated with the decommissioning of Hornsea Four infrastructure may result in anchor snagging and dropping on to existing oil and gas pipelines and wells.

Potential impact

11.11.14.11 There are six submarine pipelines located within the Hornsea Four array area; the SEAL pipeline and five pipelines associated with the Johnston Field (these are listed in **Table 11.11**). There are a further seven submarine pipelines crossing the Hornsea Four offshore ECC with one passing through the Hornsea Four HVAC booster station search area, the Langeled pipeline.

11.11.14.12 'Planned' anchoring can take place for a number of reasons including adverse weather anchoring (e.g. seeking refuge), machinery failure (e.g. loss of steering) and subsea operations/survey vessels. Planned anchoring in close proximity to existing oil and gas pipelines and wells will not occur given that decommissioning vessels will be aware of the locations of these assets as they are shown on charts (and through consultation with operators and NtM) and pipelines and wells are protected by a 500 m radius safety zone (UKHO 2020). The Hornsea Four decommissioning activities are currently based on reverse installation and is assumed to involve similar vessels to those used for construction (see **Table 11.14**:). Therefore, the likelihood of incidents leading to snagging, hooking or dropping is considered negligible (see **Volume A5, Annex 11.1: Offshore Installation Interfaces** for further details). Moreover, anchor spread for vessels supporting the decommissioning of Hornsea Four will be controlled by SIMOPS review and notified through the promulgation of NtMs (Co89), and in proximity to well locations there will be no requirement for the use of anchor spread.

11.11.14.13 Harbour Energy operated wells within the Hornsea Four array area (associated with the Johnston WHPS and Johnston Template/Manifold) will have been decommissioned prior to the Hornsea Four decommissioning phase and are therefore not considered. The

remaining wells are located outside of the array area, offshore ECC and HVAC booster station search area. Therefore, the likelihood of incidents leading to snagging, hooking or dropping is considered negligible (see **Volume A5, Annex 11.1: Offshore Installation Interfaces** for further details).

11.11.14.14 Due to the distance of the inter-field pipeline between Garrow and Kilmar from the Hornsea Four array area (7.5 km) and the type of decommissioning vessels likely to be used for Hornsea Four, the likelihood of anchor incidents leading to damage of these assets is considered negligible.

Significance conclusion

11.11.14.15 As detailed in **Table 11.40**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.40: Outcome of risk assessment – anchor snagging (IOU-D-25).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow to Kilmar Service Spool pipelines	Anchor Snagging/ Dropping: **Broadly acceptable**
	Kilmar Service pipelines	Anchor Snagging/ Dropping: **Broadly acceptable**
	Wells	Well integrity: **Broadly acceptable**
TBC[17] (formerly Dana Petroleum)	Platypus pipeline	Anchor Snagging/ Dropping: **Broadly acceptable**
Gassco	Langeled pipeline	Anchor Snagging/ Dropping: **Broadly acceptable**
NEO Energy	Babbage Export	Anchor Snagging/ Dropping: **Broadly acceptable**
	Babbage Wells	Well integrity: **Broadly acceptable**
Perenco	Intra-field flowlines and pipelines	Anchor Snagging/ Dropping: **Broadly acceptable**
	Wells	Well integrity: **Broadly acceptable**
Shell	SEAL pipeline	Anchor Snagging/ Dropping: **Broadly acceptable.**

11.11.15 Decommissioning: Oil and Gas Operations – Shipping and Navigation

11.11.15.1 The impacts of the offshore decommissioning of Hornsea Four have been assessed on oil and gas receptors associated with shipping and navigation. The impacts arising during the decommissioning phase of Hornsea Four are listed in **Table 11.14**: along with the MDS against which each decommissioning phase impact has been assessed. A description of the potential effects on oil and gas receptors caused by each identified impact is given below.

[17] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of partially decommissioned Hornsea Four infrastructure (IOU-D-26)

11.11.15.2 An increased allision risk may arise as a result of a reduction in available sea room to operate safely. As vessels are deviated due to the presence of Hornsea Four, it may increase the traffic density in surrounding area. This in turn may result in them routeing closer to oil and gas platforms within the vicinity of Hornsea Four infrastructure, which has the potential to increase the likelihood of a vessel to oil and gas structure allision. However, the main vessel routes will have been deviated throughout the lifetime of the project, due to the presence of Hornsea Four infrastructure. Due to presence of decommissioning vessels and associated safety zones, decommissioning may lead to increased encounters between vessels and oil and gas platforms in the vicinity of Hornsea Four infrastructure (for those platforms that have not been decommissioned during the 35-year operational life of the Hornsea Four project).

11.11.15.3 A study on vessel allision was conducted by Anatec on assets close to Hornsea Four (Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report). The assessment of the allision risk undertaken has focused on changes to vessel traffic patterns passing within 2 nm of the relevant assets as a result of Hornsea Four. This has been based on the pre- and post-wind farm worst-case route deviations as identified and assessed within the NRA (**Volume A5, Annex 7.1: Navigational Risk Assessment**). As noted within **Chapter 7: Shipping and Navigation** it is not possible to consider all potential alternative routeing options for commercial traffic and therefore worst-case alternatives have been considered where possible in consultation with operators. All alternative routes maintain a minimum distance of 1 nm from offshore installations in line with the MGN 654 Shipping Route Template.

Potential impact

11.11.15.4 As stated in the Allision Technical Report (see Table 7.2 in Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces**) the greatest increase in vessel numbers is predicted within 2 nm of the Alpha Petroleum operated Garrow NUI platform (two additional vessels per day), the Perenco operated Ravenspurn North ST2 and Ravenspurn South A platforms (two additional vessels per day, per platform), and NEO Energy operated Babbage platform (one additional vessels per day). No changes in vessel numbers were predicted for Ravenspurn North Complex, Ravenspurn North ST3, Ravenspurn South B, Ravenspurn South C and Kilmar NUI platforms. There is also no change in vessel numbers with 2 nm of the Minerva platform (operated by Perenco), which is within 10 nm of the Hornsea Four offshore HVAC booster station search area. There is a decrease in the number of vessels within 2 nm of one vessel per day associated with the Tolmount Main platform. Furthermore, due to the decreasing number of wind farm structures in place as the decommissioning phase progresses and the lack of any surface structure in situ post decommissioning, the impact of the presence of Hornsea Four is considered to be reversible following decommissioning.

11.11.15.5 As noted in the Allision Technical Report (Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces**) only two routes required deviation due the presence of the Hornsea Four offshore HVAC booster station search area (Route 6 and Route 9, see **Volume A5, Annex 7.1: Navigational Risk Assessment**). These routes are predicted to shift traffic west to avoid the potential booster station locations, which results in vessels

moving away from Tolmount Main platform. Furthermore, as noted in paragraph 11.11.15.4, the lack of surface structures in situ post decommissioning will mean any route deviation as a result of the HVAC booster stations and associated decommissioning works will be reversible.

11.11.15.6 In order to reduce the risk of allision with oil and gas infrastructure during the decommissioning phase, ongoing consultation and promulgation of information with oil and gas operators will be implemented. Cooperation and liaison agreements with relevant oil and gas operators and Hornsea Four in terms of SIMOPS to ensure allision risks are minimised.

Significance conclusions

11.11.15.7 As detailed in Table 11.41, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in Volume A5, Annex 11.1: Offshore Installation Interfaces). The effect will, therefore, be **not significant** (as per Table 11.18).

Table 11.41: Outcome of risk assessment – allision risk (IOU-D-26).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow NUI	Vessel Impact: **Broadly acceptable**
Alpha Petroleum	Kilmar NUI	Vessel Impact: **Broadly acceptable**
NEO Energy	Babbage Platform	Vessel Impact: **Broadly acceptable**
Perenco	Ravenspurn North Complex platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn North ST2 platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn North ST3 platform	Vessel Impact: **Broadly acceptable**
Perenco	Ravenspurn South A platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn South B platform	Vessel Impact: **Broadly acceptable**
	Ravenspurn South C platform	Vessel Impact: **Broadly acceptable**
Perenco	Minerva	Vessel Impact: **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Vessel Impact: **Broadly acceptable**

Proximity to Hornsea Four infrastructure partially decommissioned and associated decommissioning works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-D-27)

11.11.15.8 This impact considers vessel access and the potential vessel route deviations to oil and gas installations only. An assessment on restrictions to helicopter access to existing or new oil and gas assets is provided in Section 11.11.10 and in Chapter 8: Aviation and Radar and Appendix A of Volume A5, Annex 11.1: Offshore Installation Interfaces (Helicopter Access Report). An assessment on route deviations to vessels is detailed in Chapter 7: Shipping and Navigation.

11.11.15.9 Note that Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report) shows that the implications of impaired access are commercial only and not safety related.

11.11.15.10 The decommissioning of Hornsea Four infrastructure may result in periods during which access to oil and gas assets is restricted. Certain operations will require additional sea room beyond the 500 m threshold of the safety zones (e.g., where support tugs are required, anchor spreads etc). Similarly, routeing to the assets for operations involving larger vessels (such as a jack up rigs) and any supporting tugs will need to be planned with respect to the available sea room, noting that limits on spacing in this regard may restrict the periods in which the assets can be practicably accessed for such operations (e.g., allowable weather), and/or restrict the types of vessels that can be used. Furthermore, adverse weather routeing may result in a vessel being unable to make passage due to presence of Hornsea Four infrastructure and decommissioning activities. A definition of adverse weather in the context of vessel routeing is provided in Section 16 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

Potential impact

11.11.15.11 There are two active subsea structures (one manifold and one wellhead) associated with the Johnston Field connected to the Ravenspurn North CCW platform (see **paragraph 11.7.1.28** for details). It should be noted that current indications are that Johnston Field assets will cease production in the 2020s, prior to the construction of Hornsea Four and as a result, are anticipated to no longer be an issue for vessel access during the Hornsea Four decommissioning phase. The primary concern for these subsea assets is available space within the array area for rig access and anchor spread (where required). It should be considered that access to SEAL pipeline (Shell) may also be necessary. It may therefore be necessary for oil and gas service vessel to enter the Hornsea Four array area during the decommissioning phase.

11.11.15.12 The Tolmount Main platform is positioned 2.15 nm from the HVAC booster station search area, however it should be considered that this is a worst-case distance, as if HVAC booster stations are utilised then they could be positioned anywhere within the search area. Therefore, no notable issues of access to Tolmount Main platform are considered likely. During decommissioning of the HVAC booster station, it is not anticipated that there will be temporary loss of vessel access to the Langeled pipeline (Gassco). This is due to the planned 500 m exclusion/buffer zone between the HVAC booster stations and Langeled pipeline. There are two active platforms (Ravenspurn North CCW and Ravenspurn North CC (Perenco)) located approximately 3 km from the Hornsea Four array area, along with two active subsea protection structures and a wellhead (see **paragraph 11.7.1.24**). However, it is considered that all operations associated with Perenco's Ravenspurn North Complex will remain outside the array area. In relation to wells, there is one abandoned well (AB3 (43/26-6)) located within the ECC with 32 wells located within 1 km of the ECC, eight of which are operational (see **paragraph 11.7.1.29** for details). As per Section 8.3.2 within Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report), large scale operations associated with oil and gas assets are able to be undertaken in proximity to wind farm structures. Impacts arising from Hornsea Four decommissioning activities are

not considered likely given the spatial separation between Hornsea Four array and these Ravenspurn platforms and associated subsea structures.

11.11.15.13 NEO Energy's Babbage platform was specifically raised as a potential concern during consultation (see **Table 11.3**), with the platform being located approximately 2.3 nm from the Hornsea Four array area. Discussions around marine access are ongoing with the relevant operator, and it is noted that based on marine traffic analysis, activity associated with the Babbage platform such as routine support vessel visits from Great Yarmouth or Lowestoft will remain outside of the Hornsea Four array area. In addition, the majority of commercial vessels on affected routes will pass between Hornsea Four and Hornsea Project Two, or potentially choose alternate routes, including passing further from the assets given there is sea room available to do so. Therefore, on the assumption that this asset has not been decommissioned itself during the 35-year operational phase of the Hornsea Four project, impacts arising from the Hornsea Four decommissioning activities are not considered likely given the spatial separation.

11.11.15.14 Focused promulgation of NtM and continued consultation with affected operators (Harbour Energy, Gassco, Shell, NEO Energy and Perenco). Advance warning and accurate location details of decommissioning operations and associated safety zones, and advisory passing distances will be given as per Co89 (see **Volume A4, Annex 5.2: Commitment Register**). Also, for the duration of the decommissioning period, Hornsea Four will monitor and report annually, vessel traffic as per Co98 (see **Volume A4, Annex 5.2: Commitment Register**). Any plans for new infrastructure will be developed by operators with an awareness of the presence of Hornsea Four. In the event that new infrastructure is planned in close proximity, consultation will take place between Hornsea Four and the relevant oil and gas operator to establish close communication during the decommissioning phase.

Significance conclusions

11.11.15.15 As detailed in **Table 11.42**, safety impacts have been considered to **broadly acceptable** for Johnston wells, and all other oil and gas assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.42: Outcome of risk assessment – proximity (IOU-D-27).

Operator	Asset	Risk Assessment Outcome and Justification
NEO Energy	Babbage Platform	Vessel Access (proximity): **Broadly acceptable**
Perenco	Ravenspurn North Complex platforms	Vessel Access (proximity): **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Vessel Access (proximity): **Broadly acceptable**
	Johnston wells	Vessel Access (proximity): **Broadly acceptable**

Wind turbine decommissioning and associated works may result in deviations to routine support vessel routeing to oil and gas platforms (IOU-D-28)

11.11.15.16 This impact considers vessel access and the potential vessel route deviations to oil and gas installations only. An assessment on restrictions to helicopter access to existing or new oil and gas assets is provided in **Section 11.11.10** and in **Chapter 8: Aviation and Radar** and Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report). An assessment on route deviations to vessels is detailed in **Chapter 7: Shipping and Navigation**.

11.11.15.17 The decommissioning of Hornsea Four infrastructure and the associated safety zones has the potential to cause disruption of routine support vessel assess to oil and gas platforms. During the decommissioning of Hornsea Four, a number of Hornsea Four related supply/support vessels will be required within the array area and the offshore HVAC booster station area. Given the presence of these additional vessels and the main vessel route changes and vessel deviations, the potential for impaired access to oil and gas platforms during this period may increase.

Potential impact

11.11.15.18 There are currently no existing platforms within the Hornsea Four array area or within 1 km of the array area. There are also currently no platforms located within the offshore ECC or offshore HVAC booster station search area; however, there are currently two active Perenco operated gas platforms, Ravenspurn North CCW and Ravenspurn North CC located approximately 890 m and 920 m from the Hornsea Four ECC respectively (see **Table 11.9**). The 500 m safety zone around these platforms are therefore respectively 390 m and 420 m from the boundary of the ECC. In the event of decommissioning works along these limited parts of the offshore ECC there may be an overlap with the decommissioning safety distances and the routine support vessels routeing to Ravenspurn North CCW and Ravenspurn North CC, although the likelihood of such an occurrence is considered to be extremely low. Even in the unlikely event of such an occurrence, significant disruption to vessel access to Ravenspurn North CCW or Ravenspurn North CC platforms would not be expected to occur due to the close communication which will be established between both parties to ensure that activities can be coordinated.

11.11.15.19 The assessment of route deviations detailed in **Volume A5, Annex 7.1: Navigational Risk Assessment** and within Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report) notes that oil and gas support vessel routinely transit across Hornsea Four array area, with the majority of the vessels on passage to and from oil and gas platforms. However, a significant majority of the baseline activity in relation to the currently existing platforms in the vicinity of Hornsea Four recorded within Appendix C of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Allision Technical Report) remained outside of the Hornsea Four array area. Based upon these findings, it is considered likely that routine support vessels will have to deviate by 4 nm for Kilmar NUI (Alpha Petroleum), an estimated 0.3 nm for Garrow NUI (Alpha Petroleum) and 1 nm for the Trent NUI platform (Perenco). No notable deviations are anticipated for routine support vessel routeing to Tolmount Main platform (Harbour Energy). Moreover, it is anticipated that the majority of oil and gas support vessel activity

for NEO Energy's Babbage platform and Perenco's Ravenspurn North CCW or Ravenspurn North CC platforms will remain outside the Hornsea Four array area and will not be affected by the construction activities.

11.11.15.20 As the number of wind farm and HVAC structures in place decreases as the decommissioning phase progresses and given the lack of any surface structure in situ post decommissioning, the impact of the presence of Hornsea Four is considered reversible. Moreover, the majority of oil and gas support vessel activity for the Babbage platform (NEO Energy) will remain outside the Hornsea Four array area and will not be affected by the decommissioning of Hornsea Four in terms of access to the platform, given that it is located south of the offshore ECC.

11.11.15.21 Any plans for new oil and gas platforms will be developed by operators with an awareness of the presence of Hornsea Four. In the event that new infrastructure is planned in close proximity, consultation will take place between Hornsea Four and the relevant oil and gas operator to establish close communication. Whilst this is not a legislative requirement the OGA interactive maps show the locations of wind farm developments.

Significance conclusions

11.11.15.22 As detailed in **Table 11.43**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.43: Outcome of risk assessment – deviation (IOU-D-28).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Garrow NUI	Vessel Deviation: **Broadly acceptable**
	Kilmar NUI	Vessel Deviation: **Broadly acceptable**
NEO Energy	Babbage Platform	Vessel Deviation: **Broadly acceptable**
Perenco	Ravenspurn North Complex platforms	Vessel Deviation: **Broadly acceptable**
	Trent platform	Vessel Deviation: **Broadly acceptable**
Harbour Energy	Tolmount Main platform	Vessel Deviation: **Broadly acceptable**

11.11.16 Decommissioning: Oil and Gas Operations – Future Development

11.11.16.1 The impacts of the offshore decommissioning of Hornsea Four have been assessed with regard to future developments by those operators recently awarded oil and gas licencing blocks. The impacts arising during the decommissioning phase of Hornsea Four are listed in **Table 11.14** along with the MDS against which each decommissioning phase impact has been assessed. A description of the potential effects on oil and gas receptors caused by each identified impact is given below.

Hornsea Four infrastructure, safety zones and advisory safety distances may restrict or cause interference with potential seismic survey activity (IOU-D-29)

11.11.16.2 The activities associated with the decommissioning of Hornsea Four infrastructure within the array area, offshore ECC and HVAC booster stations and associated safety zones during decommissioning, have the potential to exclude or otherwise interfere with seismic surveys (particularly surveys conducted by conventional towed streamer seismic survey vessels) planned in the vicinity by oil and gas operators.

11.11.16.3 As discussed in **paragraph 11.11.2.4**, only those blocks that are licenced beyond the start of Hornsea Four decommissioning phase and in which future seismic survey operations have a degree of both spatial and temporal certainty, with information available in the public domain, have been taken forward into the assessment. These blocks are listed in **Table 11.44**.

Potential impact

11.11.16.4 Harbour Energy's Licence Block 43/27a is located within the Hornsea Four array area. As noted in **paragraph 11.7.1.23** Harbour Energy are planning to decommission the Johnston subsea infrastructure and therefore seismic survey activity is not considered applicable within **Volume A5, Annex 11.1: Offshore Installation Interfaces**. Moreover, as detailed in **Table 11.5** and **Table 11.6**, Harbour Energy's 43/27a and 42/28d licences will have likely ended prior to decommissioning with their anticipated licence block end dates in 2025 and 2031 respectively. However, the remaining oil and gas licence blocks which overlap with the array area and the offshore ECC are considered below.

11.11.16.5 Seismic surveillance activities may be required in the future, around the Hornsea Four array. At the time of such activity, it is proposed that the co-existence plan will develop how the performance of such activity will be implemented without undue risk in the interfaces. If seismic survey activity is required in the future, it will be adequately planned and analysed in line with regulatory requirements, good engineering practice and the safe operability regime existing on the UK continental shelf. As such the activity would only proceed once identified risks have been demonstrated to be acceptable.

11.11.16.6 Embedded mitigation together with the notification of the decommissioning of the wind farm and promulgation of information on decommissioning activities will be publicised in advance via NtM (Co89). Sufficient information exchange between parties and continued consultation will be in place to avoid conflicting interactions. Any future operator of the unlicensed blocks will be aware of Hornsea Four and will have taken potential coexistence into consideration. Appropriate liaison will be undertaken to ensure information on the decommissioning of the wind farm is circulated in a NtM and other appropriate media (see **Table 11.13**, Co89, Co139 and Co181).

Significance conclusions

11.11.16.7 As detailed in **Table 11.44**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

Table 11.44: Outcome of risk assessment – seismic survey activity (IOU-D-29).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Licence block 42/25a, 43/21a and 43/22a	Seismic Survey Activity: **Broadly acceptable**
NEO Energy	Licence block 48/2a	Seismic Survey Activity: **Broadly acceptable**
Perenco	Licence blook 42/28a, 42/28b, 42/29a, 42/30a, 47/4b, 43/26a and 43/24a	Seismic Survey Activity: **Broadly acceptable**
Harbour Energy	Licence block 43/26a, 42/28c, 42/28e and 42/29b	Seismic Survey Activity: **Broadly acceptable**

Drilling and the installation/decommissioning of oil and gas infrastructure has the potential to be restricted by the presence of Hornsea Four infrastructure, safety zones and advisory safety distances (IOU-D-30)

11.11.16.8 Drilling and the placement of infrastructure associated with gas field development may be restricted (but not prohibited) within the Hornsea Four array area, offshore ECC and HVAC booster station search area during the decommissioning phase, due to the presence of the Hornsea Four infrastructure and where relevant, associated safety zones. Drilling is restricted by the ability of the drill rig or vessel to access the drill location. It is noted that it is sometimes possible to directionally drill into a well location within the array, ECC or HVAC booster station area if required during decommissioning.

11.11.16.9 As discussed above in **paragraph 11.11.2.4**, only those blocks which are licenced beyond the start of Hornsea Four offshore construction and in which the future operations have a degree of both temporal and spatial certainty have been taken forward into the decommissioning phase assessment.

Potential impact

11.11.16.10 As detailed in **Volume A5, Annex 11.1: Offshore Installation Interfaces** exploration and appraisal drilling may be required around the Hornsea Four array area and offshore ECC. At the time of such activity, it is proposed that the co-existence plan will develop how the communication including SIMOPS activity for such plans would take place. If drilling activity is required in the future, it will be adequately planned and analysed in line with regulatory requirements, good engineering practice and the safe operability regime existing on the UK continental shelf. As such the activity would only proceed once identified risks have been demonstrated to be acceptable.

11.11.16.11 Embedded mitigation together with the notification of the decommissioning of the wind farm and promulgation of information on decommissioning activities will be publicised in advance via NtM. Sufficient information exchange between parties and continued consultation will be in place to avoid conflicting interactions. Any future operator of the unlicensed blocks will be aware of Hornsea Four and will have taken potential coexistence into consideration. Appropriate liaison will be undertaken to ensure information on the decommissioning of the wind farm is circulated in a NtM and other appropriate media (see **Table 11.13**, Co89, Co139 and Co181).

Significance conclusions

11.11.16.12 As detailed in Table 11.45, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in Volume A5, Annex 11.1: Offshore Installation Interfaces). The effect will, therefore, be **not significant** (as per Table 11.18).

Table 11.45: Outcome of risk assessment – drilling and the installation of oil and gas infrastructure (IOU-D-30).

Operator	Asset	Risk Assessment Outcome and Justification
Alpha Petroleum	Licence block 42/25a, 43/21a and 43/22a	Drilling Activity: **Broadly acceptable**
NEO Energy	Licence block 48/2a	Drilling Activity: **Broadly acceptable**
Perenco	Licence blook 42/28a, 42/28b), 42/29a, 42/30a, 47/4b), 43/26a and 43/24a	Drilling Activity: **Broadly acceptable**
Harbour Energy	Licence block 43/26a, 43/27a, 42/28c, 42/28d, 42/28e and 42/29b	Drilling Activity: **Broadly acceptable**

11.12 Cumulative Effect Assessment (CEA)

11.12.1 Cumulative Effect Assessment Methodology

11.12.1.1 Cumulative effects can be defined as effects upon a single receptor from Hornsea Four when considered alongside other 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.

11.12.1.2 A screening process has identified a number of reasonably foreseeable projects and developments which may act cumulatively with Hornsea Four. The full CEA long 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 Volume A4, Annex 5.4: Location of Offshore Cumulative Schemes.

11.12.1.3 In assessing the potential cumulative effects 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 as described within their MDS. 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.

11.12.1.4 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 CEA 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 effects with Hornsea Four. The proposed tier structure is intended to ensure that there is a clear understanding of the level of confidence in the CEAs provided in the Hornsea Four ES. An explanation of each tier is included in Table 11.46.

Table 11.46: 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.

11.12.1.5 The plans and projects selected as relevant to the CEA of impacts to infrastructure and other users, primarily oil and gas operations and assets but also CCS projects, are based on an initial screening exercise undertaken on a long list (see **Volume A4, Annex 5.3: Offshore Cumulative Effects**). A consideration of effect-receptor pathways, data confidence and temporal and spatial scales is necessary in order to select projects for a topic-specific short-list.

11.12.1.6 For the majority of potential effects for oil and gas interests, planned projects were screened into the assessment. The following criteria were used in the CEA screening process, which matches the three study areas defined earlier in **Section 11.5**:

- The Order Limits for Hornsea Four array area, ECC and HVAC booster station search area as detailed in **Volume A5, Annex 11.1: Offshore Installation Interfaces**, along with a 1 km buffer around Hornsea Four array area, ECC and HVAC booster station search area. This buffer is based upon the 500 m safety zones which will be applied for in relation to the construction, maintenance and decommissioning of Hornsea Four turbines and platforms together with 500 m safety zones that are implemented around subsea pipelines and active oil and gas (UKHO 2020);
- A 10 nm (18.52 km) buffer is used to identify projects that may act in a cumulative manner in relation to helicopter and vessel access to oil and gas platforms within and in the vicinity of Hornsea Four; and
- An area which is beyond the 10 nm of Study Area 2, within which a 30 km maximum range of the REWS located on oil and gas platforms as provided within Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report) from the Hornsea Four array for projects that have a cumulative impact on REWS.

11.12.1.7 Please note, there are no oil and gas platforms or infrastructure within 1 km of Hornsea Four that would act cumulatively on the Endurance CCS site. All wells within the vicinity or within the Endurance CCS site are abandoned and the sole platform currently within the Endurance CCS AfL site is Garrow NUI, which is over 7 km from Hornsea Four.

11.12.1.8 The specific projects scoped into the CEA for oil and gas as well as the tiers into which they have been allocated are presented in **Table 11.47** below and are illustrated in **Figure 11.9**. Note that this table only includes the projects screened into the assessment for CCS and oil and gas receptors based on the criteria outlined above. For the full list of projects considered, including those screened out; please see **Volume A4, Annex 5.3: Offshore Cumulative Effects**.

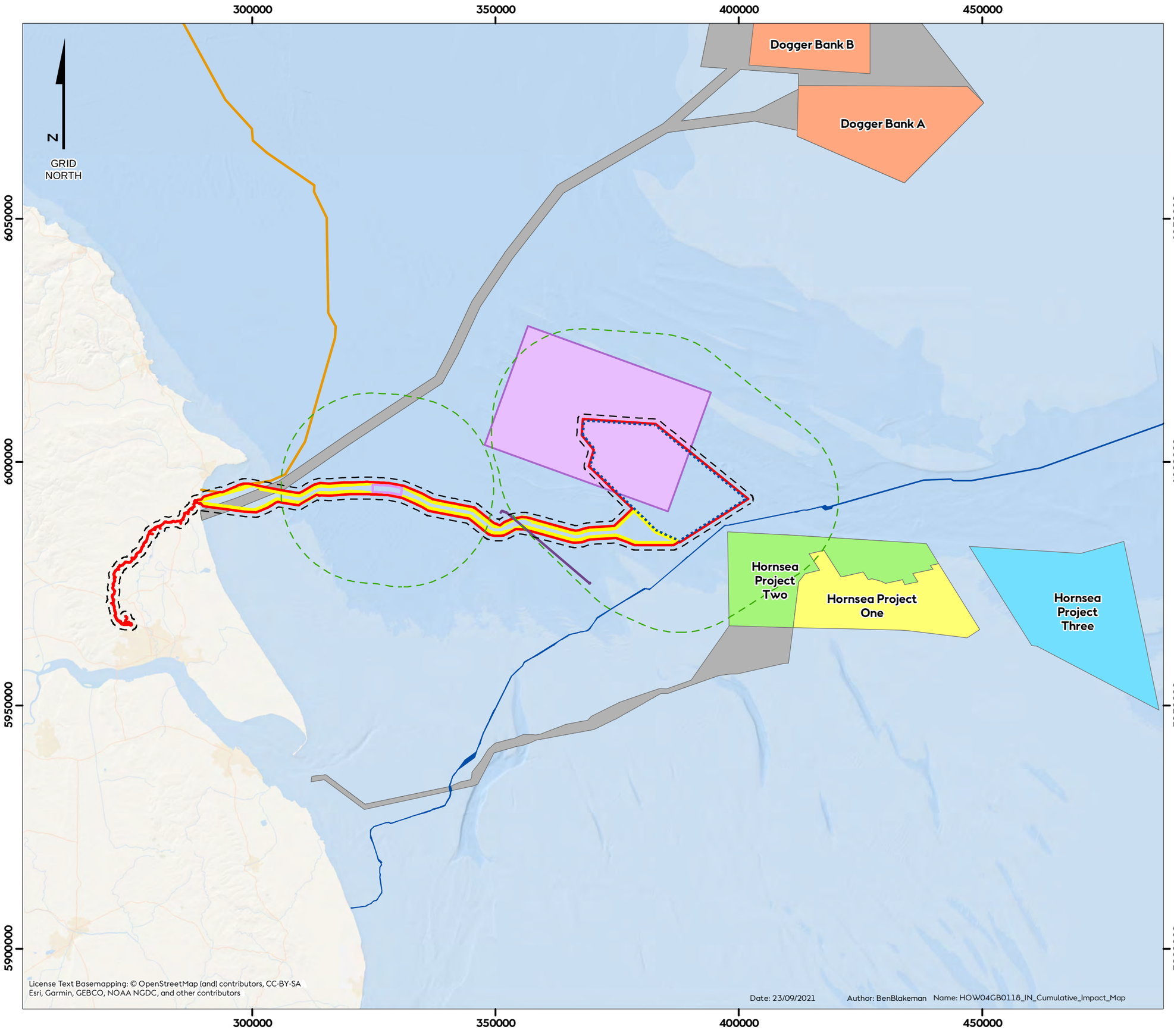
11.12.1.9 It is noted that offshore wind farms seek consent for an MDS and the 'as built' offshore wind farm will be selected from the range of consented scenarios. In addition, the MDS's quoted in applications are often refined during the determination period of the application. For example, it is noted that the application for Hornsea Project One considered a maximum of 332 turbines but was ultimately awarded consent for 240 turbines, with the operational Hornsea Project One consisting of 174 turbines. Similarly, Hornsea Project Two has gained consent for an overall maximum of 300 turbines, as opposed to 360 considered in the application and the as built number of turbines is scheduled to be 165. This process of refinement can result in a reduction of associated project parameters, for example the number and length of cables to be installed and the number of offshore substations. Within the CEA assessment, the project parameters of 174 turbines for Hornsea Project One and the planned 165 turbines for Hornsea Project Two have been used. It should be noted that the offshore export cable corridors for both of these projects are beyond the Study Areas for Hornsea Four and these parameters have not been considered.

11.12.1.10 The CEA presented in this infrastructure and other users' chapter has been undertaken on the basis of information presented in the relevant ESs (or other publicly available information) for other projects, plans and activities. **Table 11.47** identifies the projects that have been screened into the infrastructure and other users' cumulative assessment.

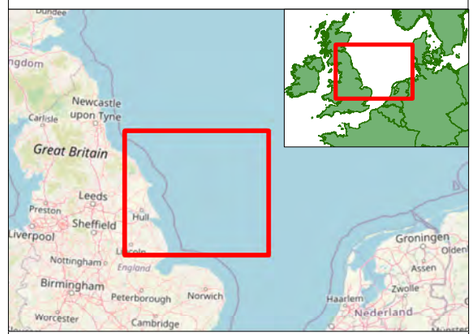
Hornsea Four

Figure 11.9

Projects screened into the CEA



- Order Limits
- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Study Area 1: Area with Potential Interfaces with Other Users (1km)
- Study Area 2: Aviation and Vessel Access (10nm)
- Hornsea Project One
- Hornsea Project Two
- Hornsea Project Three
- Dogger Bank A and B
- Offshore Wind Farm Export Cable Corridor
- Viking Link Cable
- Scotland England Green Link 2 (SEGL2)
- Platypus Pipeline
- Carbon Capture Storage Endurance AfL Site



Coordinate system: ETRS 1989 UTM Zone 31N

Scale@A3: 1:750,000

0 20 40 Kilometres

0 10 20 Nautical Miles

REV	REMARK	DATE
....	First Issue	17/06/2019
A	Updated following PEIR consultation, for DCO	23/09/2021

Projects screened into the CEA
Document no: HOW04GB0118
Created by: BPHB
Checked by: LS
Approved by: LK

GoBe

Ørsted

Table 11.47: Project screened into the infrastructure and other users CEA.

Tier	Project/plan	Details/ relevant dates	Distance to Hornsea Four Array (km)	Distance to Hornsea Four ECC (km)	Distance to Hornsea Four HVAC Booster Station Search Area (km)	Reason for inclusion in CEA
1	Hornsea Project Two	Under construction 2020 – 2022	3.46	10.61	67.23	Potential temporal overlap of operation of Hornsea Project Two with the construction and operation of Hornsea Four.
	Hornsea Project One*	Operational	16.84	26.56	83.33	Potential temporal overlap of operation of Hornsea Project One with the construction and operation of Hornsea Four.
	Hornsea Three	Under construction 2024 – 2030s	46.47	60.28	116.91	Potential temporal overlap of construction and operation of Hornsea Three with the construction and operation of Hornsea Four.
	Viking Link Interconnector	Planned construction 2020 – 2023	1.98	4.04	42.23	Potential temporal overlap of operation of Viking Link with the construction and operation of Hornsea Four.
	Dogger Bank A Export Cables (previously Dogger Bank Creyke Beck A)	Planned construction 2021 – 2024	25.13	0.00	9.16	Potential temporal and spatial overlap of the operation of Dogger Bank A ECC with the construction and operation of Hornsea Four ECC.
	Dogger Bank B Export Cables (previously Dogger Bank Creyke Beck B)	Planned construction 2021 – 2024	25.13	0.00	9.16	Potential temporal and spatial overlap of the operation of Dogger Bank B ECC with the construction and operation of Hornsea Four ECC.

Tier	Project/plan	Details/ relevant dates	Distance to Hornsea Four Array (km)	Distance to Hornsea Four ECC (km)	Distance to Hornsea Four HVAC Booster Station Search Area (km)	Reason for inclusion in CEA
	Hornsea Project Two Export Cables	Planned construction 2020 - 2022	3.46	10.61	67.23	Potential temporal overlap of operation of Hornsea Project Two ECC with the construction and operation of Hornsea Four.
	Platypus Pipeline	Planned construction 2020 - 2022	17.01	0.00	20.56	Potential temporal and spatial overlap of the operation of Platypus Pipeline (operator TBC[18] (formerly Dana Petroleum)) with the construction and operation of the Hornsea Four ECC.
	Johnston Well WHPS	Operational – scheduled decommissioning to begin in 2020s.	0.00	2.83	57.79	Potential temporal and spatial overlap of decommissioning of Johnston WHPS with the construction of Hornsea Four.
	Johnston Template/ Manifold	Operational – scheduled decommissioning to begin in 2020s.	0.00	2.86	51.65	Potential temporal and spatial overlap of decommissioning of Johnston Template/ Manifold with the construction of Hornsea Four.
3	Endurance CCS site	Not consented. Pre-planning application accepted for examination (16/08/2021).	0.00	2.15	18.78	Potential temporal and spatial overlap of the construction and operation of part of the Endurance CCS area with construction and operation of Hornsea Four array.

[18] Dana Petroleum have withdrawn from this license block, TBC until the OGA approve and confirm new licence block operator.

Tier	Project/plan	Details/ relevant dates	Distance to Hornsea Four Array (km)	Distance to Hornsea Four ECC (km)	Distance to Hornsea Four HVAC Booster Station Search Area (km)	Reason for inclusion in CEA
	SEGL2 Interconnector	Not consented. Planned construction 2025 – 2030	53.53	0.15	16.12	Potential temporal overlap of construction and operation of SEGL2 with the construction and operation of Hornsea Four.

* note that although Hornsea Project One is operational, the impacts of the operational offshore wind farm are included in the cumulative assessment in combination with Hornsea Four and Hornsea Project Two and Hornsea Three for shipping and navigational assessments. Hornsea Project One has therefore included in the above Table under Tier 1.

11.12.1.11 Certain effects assessed for the project alone are not considered in the cumulative assessment due to:

- The highly localised nature of the impacts (i.e., they occur entirely within the Hornsea Four Order Limits only);
- There being no temporal overlap of phases for projects screened in the CEA; and
- Management measures in place for Hornsea Four will also be in place on other projects reducing the risk of cumulative effects occurring.

11.12.1.12 The effects excluded from the CEA for the above reasons are:

- Potential conflicts with oil and gas seismic activity along the Hornsea Four offshore ECC;
- Potential effect of restriction on oil and gas drilling and the placement of infrastructure within the offshore ECC and within 500 m of the Hornsea Four ECC;
- Effect of piling of wind turbines and substation foundations will generate underwater noise that may cause acoustic interference with oil and gas seismic survey operations;
- The potential impacts of piling at Hornsea Four on the safety of diving operations that may be required at oil and gas assets; and
- Potential temporary loss or restricted access to subsea cables for repair and maintenance.

11.12.1.13 Therefore, the effects that are included in the CEA are as follows:

- Potential temporary impact upon access to existing pipelines and wells for repairs and maintenance due to Hornsea Four safety and advisory zones;
- Potential damage to existing pipeline and wells from anchor snagging or dropping from vessel traffic associated with Hornsea Four;
- Conflicts with oil and gas seismic survey activity within the Hornsea Four array area alongside other plans/projects;

- Restriction on oil and gas drilling around the placement of infrastructure within the Hornsea Four array and within 500 m of the boundary at the Hornsea Four array area alongside other plans/projects;
- Impacts on helicopter access to existing platforms;
- Impacts on helicopter access to vessels operating in the vicinity of platforms and/or subsea assets;
- Wind turbines and associated infrastructure forming a physical obstruction and may disrupt vessel access to oil and gas platforms and subsurface infrastructure;
- Interference with the performance of the REWS located on oil and gas platforms;
- Deviate vessels which may cause a change in CPA/TCPA alarms at oil and gas platforms equipped with REWS;
- Potential allision risk to oil and gas platform due to vessels being deviated by Hornsea Four; and
- Potential interference of Hornsea Four turbines and other projects with microwave links disrupting oil and gas communications.

11.12.1.14 Although several cables and pipelines have been scoped into the CEA, due to their proximity to Hornsea Four, it is expected that commercial crossing agreements will be agreed upon between developers and asset owners. As such it is considered unlikely that any significant cumulative impacts would occur, so the issue is not considered further in the CEA. Due to such crossing agreements and lack of interaction with Hornsea Four array area and HVAC booster station search area, the Platypus pipeline; Dogger Bank A Export Cables and Dogger Bank B Export Cables; SEGL2 Interconnector; and the Viking Link Interconnector have been excluded from CEA. Therefore, the only three projects which are considered to have the potential to act in a cumulative manner with Hornsea Four on oil and gas receptors are Hornsea Project One, Hornsea Project Two and the proposed Endurance CCS site.

11.12.1.15 The cumulative MDS describes in **Table 11.48** has been selected as that having the potential to result in the greatest cumulative effect on an identified receptor group. The cumulative effects presented and assessed in this section have been selected from the details provided in the project description for Hornsea Four (summarised for oil and gas in **Table 11.14**:), as well as the information available on other projects and plans in order to inform a cumulative MDS. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project design envelope to that assessed here, be taken forward in the final design scheme.

Table 11.48: Cumulative MDS table.

Project Phase	Potential Impact	Maximum Design Scenario	Justification
Oil and Gas Operations			
Operation and Maintenance	Cumulative effects of Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance.	MDS for Hornsea Four plus the full development of the following projects within 1 km of Hornsea Four: **Tier 1:** • No Tier 1 projects identified. **Tier 2:** • No Tier 2 projects identified. **Tier 3:** • Endurance CCS site.	Development resulting in restricted access for repair and maintenance of existing pipelines and wells.
Operation and Maintenance	Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells.	MDS for Hornsea Four plus the cumulative full development of the following projects within 1 km of Hornsea Four: **Tier 1:** • No Tier 1 projects identified. **Tier 2:** • No Tier 2 projects identified. **Tier 3:** • Endurance CCS site.	Development resulting in the greatest potential for damage to existing pipelines and wells.
Oil and Gas Operations: Shipping and Navigation Impacts			
Operation and Maintenance	Cumulative effect of potential allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of Hornsea Four infrastructure.	MDS for Hornsea Four plus the cumulative full development of the following projects within 30 km of Hornsea Four: **Tier 1:** • Hornsea Project One; and • Hornsea Project Two. **Tier 2:** • No Tier 2 projects identified. **Tier 3:** • No Tier 3 projects identified.	Development which reduces sea room and creates the greatest potential disturbance to shipping routes which may increase allision risk between vessels and oil and gas infrastructure.

Project Phase	Potential Impact	Maximum Design Scenario	Justification
Operation and Maintenance	Cumulative effect of interference with the performance of the REWS located on oil and gas platforms.	MDS for Hornsea Four plus the cumulative full development of the following projects within 30 km of Hornsea Four: **Tier 1:** • Hornsea Project One; • Hornsea Project Two; and • Hornsea Three. **Tier 2:** • No Tier 2 projects identified. **Tier 3:** • No Tier 3 projects identified.	The scenario which has the greatest amount of infrastructure creating the largest area of RCS and correspondingly greatest effect on REWS.
Operation and Maintenance	Cumulative effect of the presence of new wind turbines in previously open sea areas will deviate vessels which may cause a change in CPA and TCPA alarms at oil and gas platforms equipped with REWS.	MDS for Hornsea Four plus the cumulative full development of the following projects within 30 km of Hornsea Four: **Tier 1:** • Hornsea Project One; • Hornsea Project Two; and • Hornsea Three. **Tier 2:** • No Tier 2 projects identified. **Tier 3:** • No Tier 3 projects identified.	Development which reduces sea room and creates the greatest potential disturbance to shipping routes which may impact safety at oil and gas infrastructure.
Oil and Gas Operation: Aviation Impacts			
Operation and Maintenance	Cumulative effect of impacts on helicopter access to oil and gas platforms.	MDS for Hornsea Four plus the cumulative full development of the following projects within 10 nm (18.52 km) of Hornsea Four: **Tier 1:** • Hornsea Project Two. **Tier 2:** • No Tier 2 projects identified. **Tier 3:** • No Tier 3 projects identified.	Inclusion of other developments which have the potential to affect access to platforms, leading to the maximum potential impact upon access to an individual platform.

Project Phase	Potential Impact	Maximum Design Scenario	Justification
Operation and Maintenance	Cumulative effect of impacts on helicopter access to oil and gas vessels operating in the vicinity of platforms and/or subsea assets.	MDS for Hornsea Four plus the cumulative full development of the following projects within 10 nm (18.52 km) of Hornsea Four: **Tier 1:** • Hornsea Project Two. **Tier 2:** • No Tier 2 projects identified. **Tier 3:** • No Tier 3 project identified.	Inclusion of other developments which have the potential to affect helicopter access to oil and gas vessels operating in the vicinity of oil and gas infrastructure, leading to the maximum potential impact upon helicopter access to the oil and gas support vessels.

11.12.2 Cumulative Effect Assessment

11.12.2.1 A description of the significance of cumulative effects on infrastructure and other users arising from each identified impact is given below.

11.12.3 Operation and Maintenance: Oil and Gas

Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance

Tier 3

Potential impact

11.12.3.1 The planned developments associated with the Endurance CCS site (see **Table 11.47**), 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.

11.12.3.2 Information provided by Harbour Energy (see **Table 11.3**) suggests the Johnston field infrastructure is likely to be decommissioned prior to Hornsea Four operation and maintenance phase and therefore cumulative effects between the Endurance CCS site and Hornsea Four are considered unlikely. Furthermore, the remaining wells within the Hornsea Four array area (see **paragraph 11.7.1.28**) and inside the Endurance CCS site are abandoned and therefore no repair or maintenance activities will take place.

Significance conclusions

11.12.3.3 Due to the anticipated decommissioning of Johnston Field assets (Premier Oil 2019) impacts are considered to be **broadly acceptable** for all operators and assets associated within Hornsea Four array area and the Endurance CCS site. The effect will, therefore, be **not significant** (as per **Table 11.18**).

Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells

Tier 3

Potential impact

11.12.3.4 As detailed in **paragraph 11.7.1.54**, there is potential for an interaction between Hornsea Four and the proposed Endurance CCS site. The operation of the planned developments associated with the Endurance CCS site (see **Table 11.47**), could potentially result in anchor snagging or dropping on oil and gas assets. However, there are currently no active wells within the Endurance CCS site, and the location of any pipeline or abandoned wells within the Hornsea Four array area and the Endurance CCS site are protected by a 500 m radius safety zone (UKHO 2020). Furthermore, planned anchoring in close proximity to existing oil and gas pipelines and wells is limited given that vessels will be aware of the locations of these assets as they are shown on charts (and through consultation with operators and NtM).

Significance conclusions

11.12.3.5 The inter-field pipeline between the Garrow and Kilmar NUIs is the only pipeline which overlaps with the proposed Endurance CCS site, however, due to the distance of the inter-field pipeline from the Hornsea Four array area (7.5 km) and the type of vessels planned to be used for Hornsea Four, the likelihood of anchor incidents leading to damage is considered **not significant** and therefore cumulative effect is not assessed further for this pipeline.

11.12.3.6 As mentioned in **paragraph 11.12.3.2** above, the majority of wells located in this region are abandoned and the location of any operational wells within and in proximity to Hornsea Four array area, ECC or HVAC booster station search area will be shown on Admiralty charts.

11.12.4 Operation and Maintenance: Oil and Gas - Shipping and Navigation Impacts

Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of Hornsea Four infrastructure

11.12.4.1 Vessel routing with Hornsea Four in place, as identified in the NRA (**Volume A5, Annex 7.1: Navigational Risk Assessment**), takes into consideration the other Hornsea projects within the region including Hornsea Project One and Hornsea Project Two, with vessels passing south-east of Hornsea Four and travel between Hornsea Four and Hornsea Project Two array areas or those choosing to transit around the north-western corner of the Hornsea Four array area. It should be noted that within the NRA (**Volume A5, Annex 7.1: Navigational Risk Assessment**), Hornsea Project One is operational and Hornsea Project Two is under construction at the time of the vessel traffic surveys and as such is considered part of the baseline.

11.12.4.2 The re-routeing of vessel traffic can increase allision risk with oil and gas platforms located in proximity to Hornsea Four. The NEO Energy operated Babbage platform is located approximately 2.8 nm south-west of the gap between the Hornsea Four and Hornsea Project Two array areas. Apart from Hornsea Project Two and Hornsea Four, there are no other surface installations in close proximity to this gap.

Tier 1

Potential impact

11.12.4.3 Taking into consideration the main route deviations, the minimum distance between a main route and an oil and gas platform is always greater than 1 nm. Given that vessels frequently pass within 1 nm of offshore infrastructure, it can be inferred that there is sufficient sea room available for vessels to make the required deviations without being at high risk of an allision with a surface platform.

11.12.4.4 There are seven of the 14 main routes affected due to the presence of both Hornsea Four and Hornsea Project Two, with the level of deviation varying between a 4.2 nm decrease for Route 8 and a 6.7 nm increase for Route 4 (see Table 20.2 in **Volume A5, Annex 7.1: Navigational Risk Assessment**). These deviations will result in main routes travelling closer to Ravenspurn North ST2, Ravenspurn South A (Perenco), Garrow NUI

(Alpha Petroleum) and Babbage (NEO Energy) platforms. No changes in vessel numbers were predicted for Ravenspurn North Complex, Ravenspurn North ST3 Ravenspurn South B, Ravenspurn South C and Kilmar NUI platforms. There is also no change in vessel number within 2 nm of the Minerva platform (operated by Perenco), which is within 10 nm of the Hornsea Four offshore HVAC booster station search area. There is a decrease of one vessel per day in the number of vessels passing within 2 nm of the Tolmount Main platform.

11.12.4.5 As described in **paragraph 11.11.9.6**, there are mitigation measures which can reduce the risk of allision with oil and gas platforms as a result of vessel deviation. In order to reduce risks of allision with oil and gas infrastructure, ongoing consultation with and promulgation of information (NtM (Co89)) to oil and gas operators and mariners will be implemented in order to ensure maintenance activities are planned in collaboration with potentially affected operators. Cooperation and liaison agreements will be developed with relevant oil and gas operators and Hornsea Four in terms of SIMOPS to ensure allision risks are minimised. Further measures are also detailed in **Volume A5, Annex 11.1: Offshore Installation Interfaces**.

Significance conclusions

11.12.4.6 As detailed in **Table 11.29**, impacts have been considered to be **broadly acceptable** for all operators and assets (full assessments presented in **Volume A5, Annex 11.1: Offshore Installation Interfaces**). The effect will, therefore, be **not significant** (as per **Table 11.18**).

The presence of new wind turbines in previously open sea areas may cause interference with the performance of the REWS located on oil and gas platforms

11.12.4.7 The physical presence of wind turbines and associated offshore structures has the potential to interfere with the performance of the REWS (see **paragraph 11.11.9.21**). This system is sometimes used by oil and gas operators as an integral part of their anti-allision safety systems for their offshore platforms. Platforms with REWS potentially within operational range of the Hornsea Four array area have been identified (see **paragraph 11.7.1.40**). The assessment undertaken in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report) includes the REWS systems on the Ravenspurn North CC and Ravenspurn South B.

11.12.4.8 The cumulative impact assessment of Hornsea Four and Hornsea Project One and Hornsea Project Two on the Ravenspurn North CC and Ravenspurn South B REWS was modelled in the same manner as that shown previously for Hornsea Four alone (see Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). The assessment was based on the final design information for Hornsea Project One, Hornsea Project Two and information available in in the Hornsea Three ES (see Table 3 in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). It is noted however, that the project parameters quoted in ES's, particularly offshore wind farms, are often refined during the determination period of the application or post consent.

Tier 1

Potential impact

11.12.4.9 The results for Ravenspurn North CC indicate that the raw, single scan detection performance of the REWS due to the presence of Hornsea Four in isolation and cumulatively with Hornsea Project One and Hornsea Project Two is affected adversely within the wind farm regions. Radar detection of vessels travelling within the modelled Hornsea Projects (One, Two and Three) may be lost temporarily as they move close to the modelled turbines located within the radar range (see Figure 15 in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). The loss of detection is mainly caused by the elevated threshold levels due to the presence of the turbines while a small amount of losses are expected to occur due to shadowing.

11.12.4.10 Ravenspurn South B REWS detection performance will only experience a small number of additional detection gaps caused by turbines at the edge of Hornsea Project Two (see Figure 22 in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). The radar coverage of a 100 m^2 target is expected to be approximately 30 km around the REWS while the detection of turbines is expected to extend up to the radar horizon. Assessing the impact of the cumulative case on the detection of a small 100 m^2 target may not show a significant difference when compared to Hornsea Four in isolation; however, it is important to consider when looking at larger vessels (1,000 gross tons (GT) or more) and when assessing the effects of rerouted traffic around the projects.

Significance conclusions

11.12.4.11 The cumulative impact of Hornsea Four and Hornsea Project One, Hornsea Project Two and Hornsea Three may cause interference with the performance of the REWS, located on oil and gas platforms. However, it should be noted that a reduction in the number of turbines is expected for Hornsea Three, which will reduce the effects on the REWS. The results from Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report) '*indicate that the raw, single scan detection performance of the REWS due to the presence of Hornsea Four in isolation and cumulatively with Hornsea Project One and Hornsea Project Two is affected adversely within the wind farm regions*'. However, it is also indicated that this loss will be temporary and the integration of AIS data with the REWS will provide an alternative source of vessel information and location (see **paragraph 11.7.1.39**). Therefore, as detailed in **Table 11.32**, impacts have been considered to be **broadly acceptable** based on existing safeguards for all operators and assets protected by REWS radar coverage from Ravenspurn North CC and Ravenspurn South B (see **paragraph 11.7.1.40**) (full assessments presented in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)). The effect will, therefore, be **not significant** (as per **Table 11.18**).

11.12.4.12 Details of mitigation are listed within **Volume A5, Annex 11.1: Offshore Installation Interfaces** in order to ensure risks are minimised for impacts arising from Hornsea Four alone will be sufficient to reduce cumulative impacts associated with Hornsea Four in combination with Hornsea Project One, Hornsea Project Two and Hornsea Three.

The presence of new wind turbines in previously open sea areas will deviate vessels which may cause a change in CPA and TCPA alarms at oil and gas platforms equipped with REWS

11.12.4.13 Existing shipping routes will be altered by the physical presence of Hornsea Four and other Hornsea projects (Hornsea Project One, Hornsea Project Two and Hornsea Three) which may result in vessels being rerouted nearer the platforms protected by the REWS. This may cause an increase in the CPA/TCPA alarm rates at these platforms (see **paragraph 11.11.9.26**).

11.12.4.14 This assessment considers the effects of rerouted shipping lanes on the Ravenspurn North CC, Ravenspurn South B, Ravenspurn North ST2, Ravenspurn North ST3, Ravenspurn South A, Ravenspurn South C, Cleeton CC, Neptune, Hoton, Hyde, Trent and A1D platforms (which are protected by REWS located on Ravenspurn North CC, Ravenspurn South B and Cleeton CC platforms (currently all are operated by Perenco)). Cleeton CC platform REWS has not been included in the assessment as the predicted rerouted shipping lanes are expected to either remain unchanged or move further away from this platform (see Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report)).

Tier 1

Potential impact

11.12.4.15 The vessel traffic around Hornsea Four considered cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three was modelled based on the predicted reroutes. This data was then used to create 1,000 runs for each route for each direction (2,000 runs in total) (see Figure 32 in Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report) for the modelled routes for the alarm assessment).

11.12.4.16 To understand the potential impact of Hornsea Four on the alarm rates, the modelled data from the existing base case was compared against the post construction modelling results. The comparison looks at the number of alarms each platform is expected to have in a one-year period. The data compares both Amber and Red TCPA alarms for the base case and Hornsea Four alongside Hornsea Project One, Hornsea Project Two and Hornsea Three.

11.12.4.17 It can be noted that modelling results for the yearly alarm rates for Hornsea Four only and Hornsea Four in combination with Hornsea Project One, Hornsea Project Two and Hornsea Three are similar in numbers (see Table 5 of within Appendix B of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Radar Early Warning Technical Report). This is the case as most routes will follow the same path.

Significance conclusion

11.12.4.18 As the number of alarm rates do not fluctuate between the assessment of Hornsea Four in isolation and Hornsea Four and Hornsea Project One, Hornsea Project Two and Hornsea Three cumulatively, the significance will be the same as that of Hornsea Four alone (**not significant**) (see **paragraph 11.11.9.31** and **Table 11.33**). The cumulative

impact of Hornsea Four and Hornsea Project One and Hornsea Project Two may cause an increase in CPA and TCPA alarm rates on oil and gas platforms.

11.12.5 Operation and Maintenance: Oil and Gas – Helicopter Access Impacts

Hornsea Four infrastructure and associated works may restrict or hamper helicopter access to oil and gas platforms

Tier 1

11.12.5.1 There is potential for cumulative effect as a result of operation and maintenance activities associated with Hornsea Four and other projects (**Table 11.47**). For the purposes of this ES, this additive impact has been assessed within 10 nm (18.52 km) from Hornsea Four, which is considered to be the maximum range where aviation cumulative effect may occur due to aviation obstacles to rotary aircraft operating offshore, although some impacts are likely to be localised to the Hornsea Four array area. The projects identified for this tier are listed at **Table 11.48**.

11.12.5.2 The offshore project 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 the Hornsea offshore projects may impact oil and gas related helicopter operations.

Potential impact

11.12.5.3 As noted in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report) Babbage platform (NEO Energy) is the only oil and gas platform which may be impacted upon by the cumulative effects of both Hornsea Four and Hornsea Project Two.

11.12.5.4 The presence of Hornsea Four and Hornsea Project Two infrastructure will not introduce additional requirements in relation to navigational failure or extreme meteorological conditions or require new flight procedures for any oil and gas platform within the 9 nm consultation zone. Furthermore, as stated in **Volume A5, Annex 11.1: Offshore Installation Interfaces** the safety risk associated with helicopter transport to oil and gas platforms will remain unchanged due to the presence of Hornsea Four infrastructure as helicopter transport will not take place should there be any risk brought about by a combination of meteorological conditions and the presence of the Hornsea Four array.

11.12.5.5 As considered in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report) the receptor may be affected directly during limited occasions of poor inflight visibility in terms of access but this will not lead to any additional safety risk.

Significance conclusion

11.12.5.6 Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report) provides details of the assessment of helicopter access to oil and gas platforms potentially impacted by the installation of Hornsea Four. Using Ravenspurn North as a case study (which is the only manned platform within proximity to Hornsea

Four), the results of the assessment indicate that it is unlikely that there will be any long periods of time when oil and gas platform helicopter operations are inhibited, but in any case, any effect on helicopter access will not lead to any additional safety risk. As detailed in Table 11.34, impacts have been considered to be **broadly acceptable** for all operators and assets. The effect will, therefore, be **not significant** (as per Table 11.18).

11.12.5.7 As per Co102 (see Volume A4, Annex 5.2: Commitment Register), the CAA will be informed of the locations, heights and lighting status of the wind turbines and HVAC booster stations, to allow inclusion on Aviation Charts.

Hornsea Four infrastructure and associated works may restrict or hamper helicopter access to oil and gas vessels

Tier 1

11.12.5.8 There is potential for cumulative effect as a result of operational activities associated within Hornsea Four and other projects (Table 11.47). For the purposes of this ES, this additive impact has been assessed within 10 nm (18.52 km) from Hornsea Four, which is considered to be the maximum range where aviation cumulative effect may occur due to aviation obstacles to rotary aircraft operating offshore, although some impacts are likely to be localised to the Hornsea Four array area. The projects identified for this tier are listed at Table 11.48.

11.12.5.9 The offshore project that will contribute to interfere with helicopter access to vessels operating in the vicinity of oil and gas platforms and/or subsea assets near Hornsea Four is Hornsea Project Two. The cumulative increase in aviation obstacles from the Hornsea offshore projects (Hornsea Four and Hornsea Project Two) may impact oil and gas related helicopter operations.

Potential impact

11.12.5.10 The presence of Hornsea Four and Hornsea Project Two infrastructure will not introduce additional requirements in relation to navigational failure or extreme meteorological conditions or require new flight procedures for any oil and gas platform within the 9 nm consultation zone. Furthermore, as stated in Volume A5, Annex 11.1: Offshore Installation Interfaces the safety risk associated with helicopter transport to oil and gas vessels will remain unchanged due to the presence of Hornsea Four infrastructure as helicopter transport will not take place should there be any risk brought about by a combination of meteorological conditions and the presence of the Hornsea Four array.

11.12.5.11 As per Co102 (see Volume A4, Annex 5.2: Commitment Register), the CAA will be informed of the locations, heights and lighting status of the wind turbines and HVAC booster stations, to allow inclusion on Aviation Charts.

Significance conclusion

11.12.5.12 As detailed in Table 11.35, impacts have been considered to be broadly acceptable for all operators and assets. The effect will, therefore, be not significant (as per Table 11.18).

11.13 Transboundary Effects

11.13.1.1 Transboundary effects are defined as those effects upon the receiving environment of other European Economic Area (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 (Annex L of the Scoping Report, Orsted 2018), which identified that there was no potential for significant transboundary effects arising from Hornsea Four upon the interest of other EEA States with regard to CCS and oil and gas operations.

11.14 Inter-related Effects

11.14.1.1 Inter-related effects consider impacts from the construction, operation or decommissioning of Hornsea Four on the same receptor (or group). The potential inter-related effects that could arise in relation to infrastructure and other users are presented in

11.14.1.2 Table 11.49. Such inter-related effects include both:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, operation and maintenance, and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one phase were assessed in isolation; and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor (or group). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

11.14.1.3 A description of the process to identify and assess these effects is presented in Section 5.8 of Volume A1, Chapter 5: Environmental Impact Assessment Methodology.

Table 11.49: Inter-related effects assessment for infrastructure and other users.

Project phase(s)	Nature of inter-related effect	Assessment alone	Inter-related effects assessment
Project-lifetime effects			
Construction, operation and decommissioning	Physical impact on or temporary impact upon access to existing pipelines and wells	Not significant	The presence of Hornsea Four infrastructure, safety zones and advisory safety distances may restrict access to existing pipelines and wells during all phases of the project. Mitigation measures, including crossing and proximity agreements are detailed in Table 11.13. Therefore, across the project lifetime, the effects on oil and gas operations are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phase.
	Physical restriction on space for future seismic surveys	Not significant	As noted in Volume A5, Annex 11.1: Offshore Installation Interfaces seismic surveillance activities may be planned outside the Hornsea Four array. At the time of such activity, it is proposed that a co-existence plan is developed those details communication channels and

			SIMOPS activity. Therefore, across the project lifetime, the effects on oil and gas operations are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phase.
	Physical restriction on space for future oil and gas drilling and placement of infrastructure	Not significant	As noted in **Volume A5, Annex 11.1: Offshore Installation Interfaces** exploration and appraisal drilling may be planned in and around the Hornsea Four array area and offshore ECC. At the time of such activity, it is proposed that a co-existence plan is developed those details communication channels and SIMOPS activity. Therefore, across the project lifetime, the effects on oil and gas operations are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phase.
	Potential increase in allision risk between vessels and oil and gas platforms due to the presence of Hornsea Four	Not significant	Hornsea Four infrastructure will result in deviations to current main vessel routes. Mitigation measures are detailed in **Table 11.13**, and all alternative routes will maintain a minimum distance of 1 nm from offshore installations in line with the MGN 654 Shipping Route Template. In addition, the frequency of vessels not under command is extremely low. With the proposed mitigation implemented, across the project lifetime, the effects on oil and gas operations are not anticipated to interact in such a way as to result in combined effects of greater significance than the assessments presented for each individual phase.
Receptor-led effects			
The interaction of the physical presence the Hornsea Four array area on REWS and the deviation of shipping routes towards platforms with REWS installed.			An inter-related effect may arise on the Ravenspurn North CC and Ravenspurn South B platforms REWS. The potential for wind turbines to interfere with the performance of the REWS was identified as **broadly acceptable**. The effect is considered **not significant** during the operational phase of Hornsea Four. The potential for wind turbines to deviate vessels nearer the platforms protected by REWS causing a change in CPA and TPCA alarms was predicted to result in an effect of **not significant**. Therefore, these effects are considered not likely to interact in a way that will result in an effect of any greater significance than that predicted for each individual effect.
The interaction of disruption of vessel access to oil and gas platforms and subsea infrastructure and disruption of helicopter access to oil and gas platforms, helideck equipped drilling rigs and vessels conducting operations at subsea infrastructure on the same receptor (oil and gas operator).			Disruption of helicopter access to oil and gas platforms, drilling rigs and operational vessels has been assessed as **not significant**. Disruption of vessel access to oil and gas assets has been assessed as **not significant**. It is possible for both helicopter and vessel access to existing and future infrastructure to be disrupted by the presence of Hornsea Four. Consultation with Harbour Energy has indicated that there are currently no confirmed timescales for decommissioning of the Johnston Field wells (see **paragraph 11.7.1.23**). Mitigation measures are detailed in **Table 11.13.** Therefore, the significance of these combined effects on oil and gas

	operators will not be of any greater significance than the effects when assessed in isolation.

11.14.1.4 There are no inter-related effects that are of greater significance than those assessed in isolation.

11.15 Conclusion and Summary

11.15.1.1 This chapter has investigated the potential impacts that may arise as a result of the construction, operation and decommissioning of Hornsea Four on infrastructure and other users. Only impacts on CCS and oil and gas assets were scoped into the EIA.

11.15.1.2 As detailed in **paragraph 11.11.1.3**, all oil and gas assessments presented in this chapter are considered from a safety perspective and the associated conclusions reflect whether the presence of Hornsea Four has any implications for the safety of each stakeholder's assets and associated activities. Issues of a commercial nature are not considered in this impact assessment (although further information is provided in Section 18 of **Volume A5, Annex 11.1: Offshore Installation Interfaces**) and are the subject to ongoing discussions between the Applicant and the relevant operators.

11.15.1.3 **Table 11.50** presents a summary of the impacts assessed within the ES, any mitigation and residual effects.

Table 11.50: Summary of potential impacts assessed for infrastructure and other users.

Impact and Phase	Receptor and value/ sensitivity	Magnitude and significance	Mitigation	Residual impact
Construction				
Hornsea Four construction activity, infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS site and associated development activity and infrastructure (IOU-C-1).	CCS operators High	Moderate Moderate / Large (significant)	A number of mitigation measures have been listed under **paragraph 11.11.3.10.**	Not significant
Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-C-2).	Oil and gas pipeline and well operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
The piling of Hornsea Four wind turbine and substation foundations will generate vibration that may cause damage to existing pipelines and wells (IOU-C-3).	Oil and gas pipeline and well operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells (IOU-C-4).	Oil and gas pipeline and well operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	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 (IOU-C-5).	Oil and gas platform operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Proximity to Hornsea four infrastructure and associated works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-C-6).	Oil and gas pipeline, well and platform operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant

Impact and Phase	Receptor and value/ sensitivity	Magnitude and significance	Mitigation	Residual impact
Wind turbines and associated works may result in deviations to routine support vessel routeing to oil and gas platforms (IOU-C-7).	Oil and gas platform operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Hornsea Four infrastructure, safety zones, advisory safety distances and piling may restrict or cause acoustic interference with potential seismic survey activity (IOU-C-8).	Licence block operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Drilling and the installation/ decommissioning of oil and gas infrastructure has the potential to be restricted by the presence of Hornsea Four infrastructure, safety zones and advisory safety distances (IOU-C-9).	Licence block operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Operation and Maintenance				
The operation and maintenance of the Hornsea Four infrastructure may have an impact on the operation of, or ongoing development of the proposed Endurance CCS site and associated infrastructure. (IOU-O-10).	CCS operators High	Moderate Moderate / Large (significant)	A number of mitigation measures have been listed under **paragraph 11.11.7.7**.	Not significant
Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-O-11).	Oil and gas pipeline and well operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells (IOU-O-12).	Oil and gas pipeline and well operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	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 (IOU-O-13).	Oil and gas platform operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant

Impact and Phase	Receptor and value/ sensitivity	Magnitude and significance	Mitigation	Residual impact
Proximity to Hornsea Four infrastructure and associated works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-O-14).	Oil and gas pipeline, well and platform operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Wind turbines and associated works may result in deviations to routine support vessel routeing to oil and gas platforms (IOU-O-15).	Oil and gas platform operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
The presence of new wind turbines in previously open sea areas may cause interference with the performance of the REWS located on oil and gas platforms (IOU-O-16).	Oil and gas platform operators	N/A Not significant	A number of improvement measures have been identified within **Volume A5, Annex 11.1: Offshore Installation Interfaces**	Not significant
The presence of new wind turbines in previously open sea areas will deviate vessels which may cause a change in CPA and TCPA alarms on oil and gas platforms equipped with REWS (IOU-O-17).	Oil and gas platform operators	N/A Not significant	Improvement measures have been suggested in **Volume A5, Annex 11.1: Offshore Installation Interfaces** in order to ensure risk are minimised.	Not significant
Hornsea Four infrastructure and associated works may restrict or hamper helicopter access to oil and gas platforms (IOU-O-18).	Helicopter operators	N/A Not significant	A number of measures have been identified which will improve the access to each installation in poor weather as provided in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report).	Not significant
Hornsea Four infrastructure and associated works may restrict or hamper helicopter access to oil and gas vessels (IOU-O-19).	Helicopter operators	N/A Not significant	A number of measures have been identified which will improve the access to oil and gas service vessels within the array area as provided in Appendix A of **Volume A5, Annex 11.1: Offshore Installation Interfaces** (Helicopter Access Report).	Not significant

Impact and Phase	Receptor and value/ sensitivity	Magnitude and significance	Mitigation	Residual impact
Hornsea Four infrastructure, safety zones and advisory safety distances may restrict or cause acoustic interference with potential seismic survey activity (IOU-O-20).	Licence block operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Drilling and the installation/decommissioning of oil and gas infrastructure has the potential to be restricted by the presence of Hornsea Four infrastructure, safety zones and advisory safety distances (IOU-O-21).	Licence block operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Impact of physical presence of wind turbines in Hornsea Four array area on microwave links (IOU-O-22).	Oil and gas platform operators	N/A Not significant	Recommendation of an alternative microwave communication route to avoid Hornsea Four or a corridor of '*free air*' through Hornsea Four, as provided in **Volume A5, Annex 11.1: Offshore Installation Interfaces**.	Not significant
Decommissioning				
Hornsea Four decommissioning activity, infrastructure, safety zones and advisory safety distances may restrict access to the proposed Endurance CCS site and associated development activity and infrastructure. (IOU-D-23)	CCS operators High	Moderate Moderate / Large (significant)	A number of mitigation measures have been listed under **paragraph 11.11.13.10.**	Not significant
Hornsea Four infrastructure, safety zones and advisory safety distances may lead to a temporary impact upon access to existing pipelines and wells for repairs and maintenance (IOU-D-24).	Oil and gas pipeline and well operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant

Impact and Phase	Receptor and value/ sensitivity	Magnitude and significance	Mitigation	Residual impact
Anchor snagging or dropping from vessel traffic associated with Hornsea Four that may cause damage to existing pipelines and wells (IOU-D-25).	Oil and gas pipeline and well operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Allision risk to oil and gas platforms due to vessels being deviated from existing routes due to the presence of partially decommissioned Hornsea Four infrastructure (IOU-D-26).	Oil and gas platform operators.	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Proximity to Hornsea Four infrastructure partially decommissioned and associated decommissioning works may restrict or hamper vessel access to oil and gas platforms and subsurface infrastructure during certain periods (e.g., allowable weather) (IOU-D-27).	Oil and gas pipeline, well and platform operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Wind turbine decommissioning and associated works may result in deviations to routine support vessel routeing to oil and gas platforms (IOU-D-28).	Oil and gas platform operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Hornsea Four infrastructure, safety zones, advisory safety distances and piling may restrict or cause acoustic interference with potential seismic survey activity (IOU-D-29).	Licence block operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant
Drilling and the installation/ decommissioning of oil and gas infrastructure has the potential to be restricted by the presence of Hornsea Four infrastructure, safety zones and advisory safety distances (IOU-D-30).	Licence block operators	N/A Not significant	None proposed beyond existing commitments in **Table 11.13**.	Not significant

11.16 References

Civil Aviation Authority (CAA) (2016) CAP 764 CAA Policy and Guidelines on Wind Turbines, Sixth Edition. Available at: https://publicapps.caa.co.uk/docs/33/CAP764%20Issue6%20FINAL%20Feb.pdf [Accessed August 2021]

Department for Energy and Climate Change (2010). UK Carbon Capture and Storage (CCS) Commercial Scale Demonstration Programme. Office of Carbon Capture and Storage. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47995/1075-uk-ccs-commercialscale-demonstration-programme-fu.pdf [Accessed August 2021].

Department for Energy and Climate Change (DECC) (2011a). Overarching National Policy Statement for Energy (EN-1), Presented to Parliament pursuant to Section 5(9) of The Planning Act 2008, July 2011, London: The Stationery Office. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf [Accessed August 2021]

Department for Energy and Climate Change (DECC) (2011b). National Policy Statement for Renewable Energy Infrastructure (EN-3). Presented to Parliament pursuant to Section 5(9) of The Planning Act 2008, July 2011, London: The Stationery Office. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/37048/1940-nps-renewable-energy-en3.pdf [Accessed August 2021]

Department for Energy and Climate Change (DECC) (2011c). UK Offshore Energy Strategic Environmental Assessment Report 2: Environmental Report. Non-Technical Summary. Available at: https://www.gov.uk/government/publications/uk-offshore-energy-strategic-environmental-assessment-2-environmental-report [Accessed August 2021]

Department for Energy and Climate Change (DECC) (2016). UK Offshore Energy Strategic Environmental Assessment: Appendix 1H: Other Users. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/504567/OESEA3_A1h_Other_users.pdf [Accessed September 2021].

Department for Business, Energy and Industrial Strategy (BEIS) (2019). Environmental Data – Standalone Operations. Available at: https://itportal.beis.gov.uk/eng/fox/live/PETS_EXTERNAL_PUBLICATION/main [Accessed August 2021]

Department for Business, Energy and Industrial Strategy (BEIS) (2020). Environmental Data – Drilling Operations. Available at: https://itportal.beis.gov.uk/eng/fox/live/PETS_EXTERNAL_PUBLICATION/main [Accessed August 2021]

Department for Environment, Food and Rural Affairs (DEFRA) (2014). East Inshore and East Offshore Marine Plans. Available at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/312496/east-plan.pdf [Accessed August 2021]

European Subsea Cables Association (2016). ESCA Guideline No.6 The Proximity of Offshore Renewable Energy Installations & Submarine Cable Infrastructure in UK Waters;

Harbour Energy (2021). About Us - Premier Oil. Available at: https://www.harbourenergy.com/about-us/our-history/premier-oil/ [Accessed August 2021].

HM Government (2017). The Clean Growth Strategy Leading the way to a low carbon future. Available at: https://www.gov.uk/government/publications/clean-growth-strategy [Accessed August 2021].

Marine Policy Statement (MPS) (2011). UK Marine Policy Statement. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69322/pb3654-marine-policy-statement-110316.pdf [Accessed August 2021]

National Grid Electricity Transmission (NGET) (2021). Request For a Direction by The Secretary Of State Under Section 35 of The Planning Act 2008 ("PA 2008") Relating to The Great Britain to Norway Multi-Purpose Interconnector (Currently Known As "Continental Link"). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011895/NGV_Request_for_s35_Direction_28_June_2021_-_Continental_Link_Multi-Purpose_Interconnector.pdf [Accessed August 2021].

Offshore Engineering (2021). Harbour energy delays North Sea field start-up as platform issues found. Available at: https://www.oedigital.com/news/489320-harbour-energy-delays-north-sea-field-start-up-as-platform-issues-found [Accessed August 2021].

Oil and Gas Authority (OGA) (2018a). MER UK Award Case Studies – Tolmount Development. Available at: https://www.ogauthority.co.uk/media/5105/tomount-development.jpg [Accessed August 2021]

Oil and Gas Authority (OGA) (2018b). Guidance for application for suspension of inactive wells. Available at: https://www.ogauthority.co.uk/media/5108/oga-suspended-wells-guidance.pdf [Accessed August 2021]

Oil and Gas Authority (OGA) (2019a). Oil and Gas Licencing Rounds. Available at: https://www.ogauthority.co.uk/licensing-consents/licensing-rounds/offshore-licensing-rounds/#tabs [Accessed August 2021]

Oil and Gas Authority (OGA) (2019b). Offshore licences. Available at: https://www.ogauthority.co.uk/licensing-consents/types-of-licence/ [Accessed August 2021]

Oil and Gas Authority (OGA) (2020a). Licence Data. Available at: https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/licence-data/ [Accessed August 2021]

Oil and Gas Authority (OGA) (2020b). 32nd Licensing Round Awards 2020 - Tracking Spreadsheet. Available at: https://www.ogauthority.co.uk/media/6674/32nd-round-winner-by-block.pdf [Accessed August 2021]

Oil and Gas Authority (OGA) (2020c). Offer of Awards for the UK's 32nd Offshore Licensing Round – Press Release. Available at: https://www.ogauthority.co.uk/news-publications/news/2020/offer-of-awards-for-the-uk-s-32nd-offshore-licensing-round/ [Accessed August 2021]

Oil and Gas UK (2015). Guidelines for the Abandonment of Wells, Issue 5, July 2015, Available at: https://oilandgasuk.co.uk/product/guidelines-package-abandonment-of-wells/ [Accessed August 2021]

Oil and Gas UK (2019a). Decommissioning Insight 2019. Available at: https://oilandgasuk.cld.bz/Decommissioning-Insight-2019 [Accessed August 2021]

Oil and Gas UK (2019b). Oil and Gas UK's Business Outlook Report. Available at: https://oilandgasuk.cld.bz/Business-Outlook-2019 [Accessed August 2021]

Oil and Gas UK (2020). Oil and Gas UK: Business Outlook 2020: Markets & Investment. Available at: https://oilandgasuk.cld.bz/OGUK-Business-Outlook-2020-Markets-Investments [Accessed August 2021]

Oil and Gas UK (2021). Oil and Gas UK: Business Outlook 2021. Available at: https://cld.bz/HQL6b1y/19/ [Accessed July 2021].

Orsted (2018). Hornsea Four Environmental Impact Assessment Scoping Report. Available at: https://hornseaprojects.co.uk/-/media/WWW/Docs/Corp/UK/Hornsea-Project-Four/Scoping-Report/Hornsea-Four-Scoping-Report-LOW-RES [Accessed August 2021]

Orsted (2019) Hornsea Four Preliminary Environmental Information Report. Available at: https://orstedcdn.azureedge.net/-/media/www/docs/corp/uk/hornsea-project-four/01-formal-consultation/pier/volume-2/peir-volume-2-chapter-12-infrastructure-and-other-users.ashx?la=en&rev=036b8bd38b5c4d188f0a77259579d3d1&hash=5B9939A193C5FA53E1E268A7DC7BF596 [Accessed August 2021].

Premier Oil (2016). Acquisition of E.ON UK North Sea Assets. Available at: http://www.premier-oil.com/sites/default/files/presentation/acquisition-of-e-ons-uk-assets-v2.pdf [Accessed January 2021]

Premier Oil (2017). Tolmount Area Development Offshore Environmental Statement: November 2017. Available at: https://www.premier-oil.com/sites/default/files/files/ab-to-xgl-hs-se-sn-0001.pdf [Accessed January 2021]

Premier Oil (2019). Environmental Statement. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/896311/Premier_Oil_UK_-_Environmental_Statement_2019_.pdf [Accessed August 2021]

Planning Inspectorate (PINS) (2018). Hornsea Four Scoping Opinion. November 2018. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010098/EN010098-000064-H4WF%20-%20Scoping%20Opinion.pdf [Accessed August 2021]

Step Change in Safety (2017) Marine Operations: 500 m Safety Zone. Available at: https://www.guidance.eu.com/assets/_managed/cms/files/MarineOperations500mzoneguidance.pdf [Accessed August 2021]

UK Hydrographic Office (UKHO) (2020). Admiralty: The Mariners Handbook. NP100, 12th Edition. Available at: https://www.admiralty.co.uk/publications/publications-and-reference-guides/admiralty-mariners-handbook [Accessed September 2021].