Hornsea Project Four: Preliminary Environmental Information Report (PEIR)

Volume 2,
Chapter 8: Shipping and Navigation

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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 m length are required to carry AIS.
Base Case	The assessment of risk based on current shipping densities and traffic types as well as the marine environment.
Collision	The act or process of colliding (crashing) between two moving objects.
Commitment	A term used interchangeably with mitigation. Commitments are embedded mitigation measures. Commitments are either primary (design) or tertiary (Inherent) and embedded within the assessment at the relevant point in the Environmental Impact Assessment (EIA) (e.g. at Scoping or Preliminary Environmental Information Report (PEIR)). The purpose of Commitments are to reduce and/or eliminate Likely Significant Effects (LSEs), in EIA terms.
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 1, Chapter 4: Project Description**. This envelope is used to define Hornsea Four for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Environmental Statement (ES)	A document reporting the findings of the Environmental Impact Assessment (EIA) and produced in accordance with the EIA Directive as transposed into United Kingdom (UK) law by the EIA Regulations.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Future Case	The assessment of risk based on the predicted growth in future shipping densities and traffic types as well as foreseeable changes in the marine environment.
Global Maritime Distress and Safety System (GMDSS) Sea Area	GMDSS sea areas serve two purposes: to describe areas where GMDSS services are available, and to define what radio equipment GMDSS ships must carry (carriage requirements).
International Maritime Organization (IMO) Routeing	Predetermined shipping routes established by the IMO.
Layout Principles	A set of rules relating to the final array layout designed to ensure that post consent the array layout chosen for Hornsea Four satisfactorily meets both navigational and Search and Rescue (SAR) requirements.
Main Route	Defined transit route (mean position) of commercial vessels identified within the specified shipping and navigation study area.
Marine Environmental High Risk Area (MEHRA)	Areas in UK coastal waters where ships' masters are advised of the need to exercise more caution than usual i.e. crossing areas of high environmental sensitivity where there is a risk of pollution from merchant shipping.
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

Term	Definition
	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.
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 or PEIR).
Not Under Command (NUC)	Under Part A of the International Regulations for Preventing Collisions at Sea (COLREGS), the term "vessel not under command" means a vessel which through some exceptional circumstance is unable to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel.
Offshore Renewable Energy Infrastructure (OREI)	As defined by *Marine Guidance Note 543 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response* (MCA, 2016). For the purpose of this report and in keeping with the consistency of the EIA, OREI can mean offshore Wind Turbine Generators (WTG) and the associated electrical infrastructure such as offshore transformer substations, offshore High Voltage Direct Current (HVDC) converter substations, accommodation platforms and High Voltage Alternating Current (HVAC) booster stations.
Radio Detection and Ranging (Radar)	An object-detection system which uses radio waves to determine the range, altitude, direction or speed of objects.
Regular Operator	Commercial operator whose vessel(s) are observed to transit through a particular region on a regular basis.
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.
Traffic Separation Scheme (TSS)	A traffic-management route-system ruled by the International Maritime Organization (IMO). The traffic-lanes (or clearways) indicate the general direction of the vessels in that zone; vessels navigating within a TSS all sail in the same direction or they cross the lane in an angle as close to 90 degrees (°) as possible.
Unique Vessel	An individual vessel identified on any particular calendar day, irrespective of how many tracks were recorded for that vessel on that day. This prevents vessels being over counted. Individual vessels are identified using their Maritime Mobile Service Identity (MMSI).

Acronyms

Acronym	Definition
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
BMAPA	British Marine Aggregate Producers Associations
CEA	Cumulative Environmental Assessment
COLREGS	Convention for the Prevention of Collisions at Sea
DCO	Development Consent Order
DECC	Department for Environment and Climate Change
DFT	Department for Transport
DML	Deemed Marine Licence
EEA	European Economic Area
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ERCoP	Emergency Response Cooperation Plan
FSA	Formal Safety Assessment
GBS	Gravity Base Structures
GLA	General Lighthouse Authority
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IMO	International Maritime Organization
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MHCC	Marine Helicopter Coordination Centre
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MMSI	Maritime Mobile Service Identity
MOD	Ministry of Defence
NAVTEX	Navigational Telex
NPS	National Policy Statement
NRA	Navigation Risk Assessment
NSIP	Nationally Significant Infrastructure Project
NUC	Not Under Command
OREI	Offshore Renewable Energy Installation
PEIR	Preliminary Environmental Impact Assessment
PEXA	Practice and Exercise Area
REZ	Renewable Energy Zone
RNLI	Royal National Lifeboat Institute
RYA	Royal Yachting Association
SAR	Search and Rescue
SOLAS	Safety of Life at Sea Convention

Acronym	Definition
SONAR	Sound Navigation Ranging
TCE	The Crown Estate
TH	Trinity House
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency
WTG	Wind Turbine Generator

Units

Unit	Definition
km	Kilometres
kt	Knot
m	Metres
nm	Nautical Miles

8.1 Introduction

8.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the preliminary results of the Environmental Impact Assessment (EIA) for the potential impacts of the Hornsea Project Four offshore wind farm (hereafter Hornsea Four) on shipping and navigation. Specifically, this chapter considers the potential impact of Hornsea Four seaward of Mean High Water Springs (MHWS) during its construction, operation and maintenance, and decommissioning phases.

8.1.1.2 Orsted Hornsea Project Four Limited (the Applicant) is proposing to develop Hornsea Four. Hornsea Four will be located approximately 65 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 1, 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 1, Chapter 4: Project Description** for full details on the Project Design).

8.1.1.3 This chapter summarises information contained within **Volume 5, Annex 8.1: Navigational Risk Assessment** (draft NRA).

8.2 Purpose

8.2.1.1 The primary purpose of the Environmental Statement (ES) is to support the Development Consent Order (DCO) application for Hornsea Four under the Planning Act 2008 (the 2008 Act). This PEIR constitutes the Preliminary Environmental Information for Hornsea Four and sets out the findings of the EIA to date to support pre-application consultation activities required under the 2008 Act. The EIA will be finalised following completion of pre-application consultation and the Final ES will accompany the application to the Planning Inspectorate (PINS) for Development Consent.

8.2.1.2 This PEIR chapter:

- Presents the existing environmental baseline established from desk studies, and consultation;
- Presents the potential environmental effects on shipping and navigation arising from Hornsea Four, based on the information gathered and the analysis and assessments undertaken to date;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible adverse environmental effects identified in the EIA process.

8.3 Planning and Policy Context

8.3.1.1 Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to shipping and navigation is contained in the NPS for

Renewable Energy Infrastructure (EN-3, Department for Environment and Climate Change (DECC), 2011).

8.3.1.2 Overarching NPS EN-1 does not specifically refer to shipping and navigation but the overarching guidance principles in general have been considered. NPS EN-3 includes guidance on what matters are to be considered in the assessment. These are summarised in **Table 8.1** below.

Table 8.1: Summary of NPS EN-3 policy provision relevant to shipping and navigation.

Summary of NPS EN-3 Provisions	How and Where Considered in the PEIR
"Applicants should establish stakeholder engagement with interested parties in the navigation sector early in the development phase of the proposed offshore wind farm and this should continue throughout the life of the development including during the construction, operation and decommissioning phases. Such engagement should be taken to ensure that solutions are sought that allow offshore wind farms and navigation uses of the sea to successfully co-exist." (paragraph 2.6.153 of NPS EN-3).	Engagement with navigation stakeholders has taken place from an early stage in the development of Hornsea Four. **Section 8.4** summarises key issues raised during consultation specific to shipping and navigation.
"Assessment should be underpinned by consultation with the MMO, Maritime and Coastguard Agency (MCA), the relevant General Lighthouse Authority, the relevant industry bodies (both national and local) and any representatives of recreational users of the sea, such as the Royal Yachting Association (RYA), who may be affected." (paragraph 2.6.154 of NPS EN-3).	The consultation summarised in **Section 8.4** includes issues raised by the organisations stated.
"Information on internationally recognised sea lanes is publicly available and this should be considered by applicants prior to undertaking assessments. The assessment should include reference to any relevant, publicly available data available on the Maritime Database." (paragraph 2.6.155 of NPS EN-3).	**Section 8.7.2** provides information on International Maritime Organization (IMO) Routeing measures in proximity to Hornsea Four.
"Applicants should undertake a Navigational Risk Assessment (draft NRA) in accordance with relevant Government guidance prepared in consultation with the MCA and the other navigation stakeholders listed above." (paragraph 2.6.156 of NPS EN-3).	See **Volume 5, Annex 8.1: Navigational Risk Assessment**.
"The potential effect on recreational craft, such as yachts, should be considered in any assessment." (paragraph 2.6.160 of NPS EN-3).	**Section 8.11** considers the impacts of Hornsea Four on recreational craft. Recreational activity including recreational fishing has also been considered in **Volume 2, Chapter 12: Infrastructure and Other Users**.

8.3.1.3 NPS EN-3 also highlights several factors relating to the determination of an application and in relation to mitigation. These are summarised in **Table 8.2** below.

Table 8.2: Summary of NPS EN-3 policy on decision making relevant shipping and navigation.

Summary of NPS EN-3 Provisions	How and where Considered in the PEIR
"*Consent shall not be granted to the construction or extension of an offshore wind farm if the development is likely to interfere with the use of recognised sea lanes essential to international navigation.*" (paragraph 2.6.161 of NPS EN-3).	Section 8.7.2 provides information on IMO Routeing measures in proximity to Hornsea Four.
"*Site selection should have been made with a view to avoiding or minimising disruption or economic loss to the shipping and navigation industries.*" (paragraph 2.6.162 of NPS EN-3).	The impact of Hornsea Four, and cumulatively with other projects, plans and activities, are considered in Section 8.12 and Section 8.12 and includes an analysis of the potential for disruption and economic loss to the shipping and navigation industries.
"*Negative impacts on less strategically important shipping routes should be reduced to As Low as Reasonably Practicable (ALARP).*" (paragraph 2.6.163 of NPS EN-3).	Section 8.7.2 and Section 8.7.3 undertake an analysis of all shipping including main routes in proximity to the Hornsea Four array area and HVAC booster station search area. The impact assessment methodology in Section 8.10 considers Formal Safety Assessment (FSA) and ALARP parameters.
"*A detailed Search and Rescue (SAR) Response Assessment should be undertaken prior to the commencement of construction.*" (paragraph 2.6.164 of NPS EN-3).	As part of Hornsea Four compliance with Marine Guidance Note (MGN) 543 an Emergency Response and Cooperation Plan (ERCoP) will be developed for all phases, as noted in Section 8.8.2. An ERCoP is also a Condition of the deemed Marine Licences (dMLs) for Hornsea Four. It is noted post consent that Hornsea Four will be required to comply with MCA and HSE regulatory expectations for emergency response arrangements for the offshore renewable energy industry (2018).
"*Applications which pose unacceptable risks to navigational safety after all possible mitigation measures have been considered will not be consented.*" (paragraph 2.6.165 of NPS EN-3).	A baseline description of Hornsea Four and cumulatively with other projects, plans and activities is shown Section 8.12 and Section 8.13. Further assessment work will be undertaken post Section 42 Consultation.
"*The scheme must be designed to minimise the effects on recreational craft.*" (paragraph 2.6.166 of NPS EN-3).	Section 8.8.2 summarises commitments included as part of Hornsea Four and also details impacts on recreational craft. Impact assessments for recreational vessels is included in Section 8.11.
"*The extent and nature of any obstruction of or danger to navigation which is likely to be caused by the development will be considered.*" (paragraph 2.6.168 of NPS EN-3).	A technical assessment is included in Volume 5, Annex 8.1: Navigational Risk Assessment. An impacts assessment is undertaken in Section 8.11.
"*Cumulative effects of the development with other relevant proposed, consented and operational wind farms will be considered.*" (paragraph 2.6.169 of NPS EN-3).	A baseline description of Hornsea Four and cumulatively with other projects, plans and activities is shown Section 8.12. Further assessment work will be undertaken post Section 42 Consultation.

8.4 Consultation

8.4.1.1 Consultation is a key part of the DCO application process. An overview of the project consultation process are presented within **Volume 1, Chapter 6: Consultation**.

8.4.1.2 A summary of the key issues raised during consultation specific to shipping and navigation is outlined below in **Table 8.3**, together with how these issues have been considered in the production of this PEIR.

8.4.1.3 Consultation with oil and gas operators is included **Volume 2, Chapter 12: Infrastructure and Other Users**.

Table 8.3: Consultation responses.

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
MCA and Trinity House (TH)	2 August 2018, Consultation meeting	Hazard Workshop would be a useful exercise to undertake as part of the draft NRA process.	A Hazard Workshop was undertaken with stakeholders as part of the draft NRA process with a hazard log created using the findings and used to inform the impact assessment (see **Section 8.11**).
		Summer season for vessel traffic survey should consider a period between June and August (inclusive) and winter season should consider a period between October and March (inclusive). With the seasonality taken into account the data can be up to 24 months old at the time of the submission of the ES.	The vessel traffic data used for the baseline navigation review includes data from June 2018 (summer) and January/February 2019 (winter). It is noted that a vessel-based survey will be carried out for the summer period in 2019 and analysed in the final version of the draft NRA as part of the ES (see **Table 8.5**).

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
MCA	26 November 2018, Scoping Opinion	The development area carries a significant amount of through traffic, with a number of important shipping routes in close proximity, and attention needs to be paid to routing, particularly in heavy weather ensuring shipping can continue to make safe passage without significant large-scale deviations.	Section 15 and 17 of Annex 8.1: Navigational Risk Assessment identified that there are 12 main routes operating within the Hornsea Four array area shipping and navigation study area. The busiest routes consist of two to three transits per day and when considered against other routeing within the North Sea are considered moderate use. Although some routes will require deviation not all of these deviations would create unsafe navigation impacts. This is considered within the impact assessment in Section 8.11 .
		The possible cumulative and in combination effects on shipping routes should also be considered, taking into proximity to other windfarm developments and the impact on navigable sea room.	Section 8.12 details the proposed cumulative methodology that will be considered post Section 42 Consultation.
		The proximity of Hornsea Four to other offshore windfarms will also need to be fully considered, with an appropriate assessment of the distances between Offshore Renewable Energy Installation (OREI) boundaries and shipping routes as per MGN 543. MCA would also welcome early discussion on the lighting and marking arrangements.	Hornsea Four commitments (Section 8.8.2) include consideration of MGN 543 and adherence with lighting and marking requirements.
TH	26 November 2018, Scoping Opinion	The possible cumulative and in-combination effects on shipping routes and patterns should be fully assessed, with particular reference to the Hornsea One and Hornsea Two offshore windfarms.	Section 8.12 details the proposed cumulative baseline and methodology that will be considered post Section 42 Consultation.
MCA and TH	27 November 2018, Consultation meeting	Discussion on scoping responses and a review of the proposed developable areas.	No further action required.

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
DFDS Seaways	2 April 2019, Consultation meeting	DFDS Seaways vessels on the Immingham-Esbjerg and Immingham-Gothenburg routes would deviate north of the Hornsea Four array area. A deviation of around 2 nm west of the Hornsea Four array area for the Newcastle-Amsterdam route would not be a concern. The *Finlandia Seaways* and *Jutlandia Seaways* transits shown (from the winter AIS survey data) are likely adverse weather routes and the *Lysvik Seaways* is about to switch to a new west coast route. No new routes are planned in the area.	Route deviations for the post wind farm scenario have accounted for the information provided (see **Section 8.7.3**).
		No DFDS Seaways vessels intend to pass through Hornsea Project One where construction is ongoing and no concerns have been raised. Even with a large spacing between structures DFDS Seaways vessels would not transit through the array.	Route deviations for the post wind farm scenario have accounted for the information provided (see **Section 8.7.3**).
		Cumulatively the Dogger Bank developments will need to be considered as they prevent routeing across the Dogger Bank.	The Dogger Bank developments have been considered in the cumulative impact assessment (see **Section 8.12**).
MCA and TH	23 May 2019, Consultation Meeting	Discussion on proportional approach to be used on the Hornsea Four application. The MCA noted that they would still expect to see all requirements listed under MGN 543.	**Volume 5, Annex 8.1: Navigational Risk Assessment** has followed the standard approach and is compliant with MGN 543.
		Proposed marine traffic survey methodology was discussed, noting that the MGN compliant surveys would not be completed until the application submission.	See **Section 8.6** for further information.
		The reduced array area was discussed.	No comments were raised noting that the layout would be assessed as worst-case as part of the Section 42 Consultation.
		Layout principles were discussed and a review process would be undertaken to see agreement between Hornsea Four and the MCA/TH.	Hornsea Four commitments include to seek agreement with the MCA and TH on the Layout Principles (see **Table 8.9**). (Commitment Co96).

Consultee	Date, Document, Forum	Comment	Where addressed in the PEIR
Hazard Workshop including oil and gas operators, regular vessel operator, MCA, TH, and Chamber of Shipping. Fisheries and recreational representatives were invited but did not attend.	27 June 2019	Discussion on the potential impacts identified for Hornsea Four array area, offshore ECC and High Voltage Alternating Current (HVAC) booster station search area. Impacts identified were deviations (commercial), increased encounters and collision, allision, anchor snagging (limited risk), emergency response and impacts on other installations associated with displaced traffic. Impacts on other installations will be considered in **Volume 2, Chapter 12: infrastructure and Other Users.**	See Appendix B of **Volume 5, Annex 8.1: Navigational Risk Assessment.** It is noted that the hazard log is currently draft and will be finalised post Section 42 Consultation and included within the ES for DCO Application.
VISNED	16 July 2019	Entering the array, whether to fish or transit, is based on the individual skipper's perception of risk. Fishermen are likely to follow the features of the seabed, and if not available, then follow any rows of WTGs.	Layout 18 includes a single line of orientation (see Section 9.1 of **Volume 5, Annex 8.1: Navigational Risk Assessment.**). Hornsea Four commitments (see Section 8.8) include agreement with the MCA and TH on the Layout Principles, which include maintaining at least one line of orientation in the array layout.
		Given the dense perimeter of structures in Layout 18 there will be a perception of higher risk which may lead to fishermen choosing to avoid the array.	No response required.
		The navigational corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three was raised; it was noted that the corridor would be of more benefit for fishing activities in the Silver Pit than navigation.	No response required.

8.5 Study area

8.5.1 Hornsea Four Array Area shipping and navigation study area

8.5.1.1 A ten nautical mile (nm) buffer has been applied around the Hornsea Four array area, as shown in **Figure 8.1**. This study area has been defined in order to provide local context to the analysis of risks by capturing the relevant routes and vessel traffic movements within and in proximity to the proposed Hornsea Four array area. This 10 nm study area has been used

within the majority of United Kingdom (UK) offshore wind farm Navigation Risk Assessments (draft NRAs) including those for the previous Hornsea wind farm projects and has been agreed with the MCA and TH during consultation meetings (see **Section 8.4**).

8.5.2 Hornsea Four offshore ECC shipping and navigation study area

8.5.2.1 A 2 nm buffer has been applied around the Hornsea Four offshore ECC, as shown in **Figure 8.1**. As with the Hornsea Four array area , this study area has been defined in order to capture relevant receptors and their movements within and near the Hornsea Four offshore ECC. The study area runs between the mean Low Water Springs (MLWS) and the boundary of the Hornsea Four array area [and reflects the standard approach taken across the offshore wind industry and agreements with regulators].

8.5.3 Hornsea Four HVAC booster station search area shipping and navigation study area

8.5.3.1 A 10 nm buffer has been applied around the Hornsea Four HVAC booster station search area within the Hornsea Four offshore ECC, as shown in **Figure 8.1**. Again, this study area has been defined in order to capture relevant receptors and their movements within and near the Hornsea Four HVAC booster station search area. This study area reflects the standard approach taken across the offshore wind industry .

8.5.4 Hornsea Four cumulative shipping and navigation study area

8.5.4.1 Changes to routeing at a cumulative level have been assessed in detail within a 10 nm buffer of the Hornsea Four array area, as per the Hornsea Four array area shipping and navigation study area (see **Section 8.5.1**). Details of the methodology used to identify cumulative receptors are given in **Section 8.12**, noting that this extends well beyond the Hornsea Four cumulative shipping and navigation study area. This study area reflects the standard approach taken across the offshore wind industry.

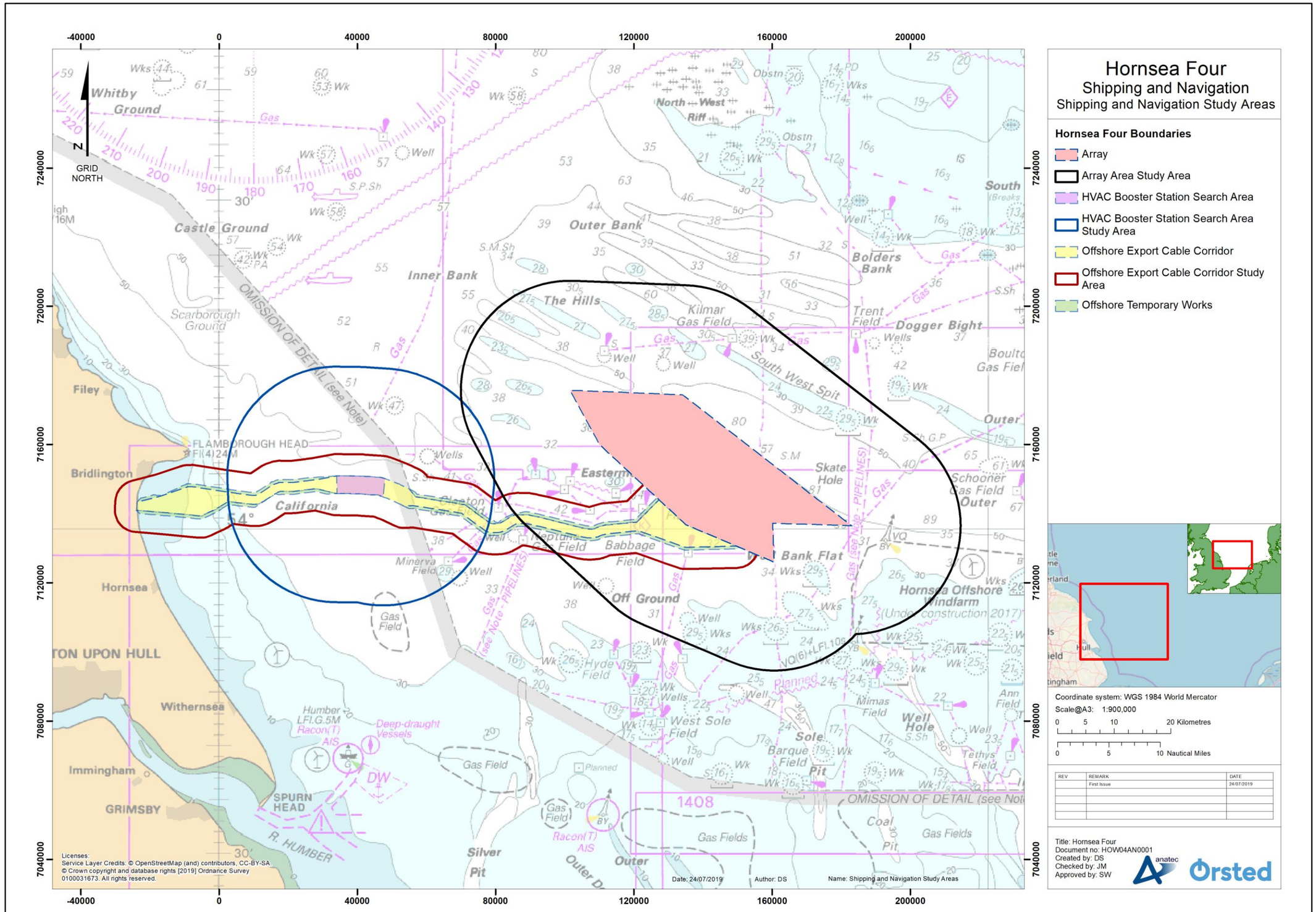

Figure 8.1: Shipping and Navigation study areas (not to scale).

8.6 Methodology to inform baseline

8.6.1 Desktop study

8.6.1.1 A desk study was undertaken to obtain information on shipping and navigation. Data were acquired within each shipping and navigation study area through a detailed desktop review of existing studies and datasets.

8.6.1.2 The following sources of information in Table 8.4 were consulted.

Table 8.4: Key sources of shipping and navigation data.

Source	Summary	Coverage of Hornsea Four PEIR boundary
Vessel traffic	• Automatic Identification System (AIS) summer survey data for the Hornsea Four array area shipping and navigation study area (14 days June 2018); • AIS summer survey data for the Hornsea Four offshore ECC and HVAC booster station search area shipping and navigation study area (14 days June 2018); • AIS, visual and Radio Detecting and Ranging (Radar) winter survey data for the Hornsea Four array area shipping and navigation study area (14 days January/February 2019); and • AIS, visual and Radar winter survey data for the Hornsea Four offshore ECC and HVAC booster station search area shipping and navigation study areas (14 days January/February 2019).	Hornsea Four area array, offshore ECC and HVAC booster search area shipping and navigation study areas.
Anatec ShipRoutes database	• Main shipping routes developed by Anatec to assist in identifying passing vessel movements in proximity to proposed offshore developments.	Hornsea Four area array, offshore ECC and HVAC booster search area shipping and navigation study areas.
Maritime incidents	• Maritime Accident Investigation Branch (MAIB) marine accidents database (2005 to 2014); • Royal National Lifeboat Institution (RNLI) incident data (2008 to 2017); and • Department for Transport (DfT) UK civilian SAR helicopter taskings (2016 to 2018).	Hornsea Four area array, offshore ECC and HVAC booster search area shipping and navigation study areas.
Marine aggregate dredgers	• Marine aggregate dredging areas (licenced and active) (The Crown Estate (TCE), 2019); and • Transit routes (British Marine Aggregate Producers Association (BMAPA), published 2009, downloaded 2019).	Hornsea Four area array, offshore ECC and HVAC booster search area shipping and navigation study areas.

Source	Summary	Coverage of Hornsea Four PEIR boundary
Recreational traffic density and features	• UK Coastal Atlas of Recreational Boating 2.0 (Royal Yachting Association (RYA), 2016).	Hornsea Four area array, offshore ECC and HVAC booster search area shipping and navigation study areas.
Other navigational features	• Admiralty Charts 266, 1187, 1190, 1191 and 2182A (United Kingdom Hydrographic Office (UKHO), 2019).	Hornsea Four area array, offshore ECC and HVAC booster search area shipping and navigation study areas.

8.6.1.3 Fishing vessel navigational activities were assessed using the marine traffic survey data; however the baseline findings of **Volume 2, Chapter 7: Commercial Fisheries** were also used as a secondary source.

8.6.1.4 Offshore oil and gas installations were identified using charted data including positional information on fixed platforms and wellheads. Using these data, possible cumulative effects with other offshore installations, their support vessels and the increased risk associated with the platform locations were identified.

8.6.1.5 Marine aggregate dredging data (licensed areas and active areas) were obtained from TCE. This information was used to identify commercial aggregate dredging activity and transit routes in proximity to the Hornsea Four array area and offshore ECC.

8.6.1.6 Other navigational features such as IMO Routeing measures and Ministry of Defence (MOD) Practice and Exercise Areas (PEXA) have been considered using charted data.

8.6.1.7 Southern North Sea vessel routeing identified by the AIS data (see Table 8.4) is validated using Anatec's ShipRoutes database which has been developed over a number of years using historical AIS data. It is regularly updated to ensure any changes to historical routeing or vessel numbers are reflected.

8.6.2 Site Specific Surveys

8.6.2.1 To inform the EIA, site-specific surveys have been and continue to be undertaken, as agreed with the MCA and TH. A summary of surveys is outlined in **Table 8.5** and to ensure compliance with MGN 543 (MCA, 2018) prior to submission of the application. Currently only the winter survey (January – February 2019) is fully compliant, the summer survey is being undertaken in July – August 2019.

Table 8.5: Summary of site-specific survey data.

Title, Year and Reference	Summary	Coverage of Hornsea Four PEIR boundary
AIS, visual and Radar vessel traffic survey 11 January to 15 February 2019	Vessel based survey for the Hornsea Four array area and HVAC booster station search area determining existing shipping activity in compliance with MGN 543. Fourteen full days of data was recorded at each location.	Hornsea Four area array shipping and navigation study area (14 full days) and Hornsea Four HVAC booster search area shipping and navigation study area (14 full days).
AIS vessel traffic survey 17 June to 30 June 2019	Desk based AIS survey for the Hornsea Four array area and HVAC booster station search area to determine existing shipping activity in partial compliance with MGN 543. Fourteen full days of data was recorded.	Hornsea Four area array shipping and navigation study area and Hornsea Four HVAC booster search area shipping and navigation study area.
AIS vessel traffic survey 17 June to 30 June 2019	Desk based AIS survey for the Hornsea Four offshore ECC to determine existing shipping activity in compliance with MGN 543. Fourteen full days of data was recorded.	Hornsea Four offshore ECC shipping and navigation study area.
AIS, visual and Radar vessel traffic survey To be undertaken summer 2019	Vessel based survey for the Hornsea Four array area and HVAC booster station search area determining existing shipping activity in compliance with MGN 543. Fourteen full days of data to be recorded at each location.	Hornsea Four area array shipping and navigation study area (14 full days) and Hornsea Four HVAC booster search area shipping and navigation study area (14 full days).

8.7 Baseline environment

8.7.1.1 Baseline data has been compiled in line with guidance contained in MGN 543 (MCA, 2018) and following consultation as described in Table 8.4. Full detail can be found in **Volume 5, Annex 8.1: Navigational Risk Assessment**.

8.7.2 Existing baseline

Navigational features

8.7.2.1 A plot of the key navigational features within the Southern North Sea in proximity to Hornsea Four is presented in **Figure 8.2**.

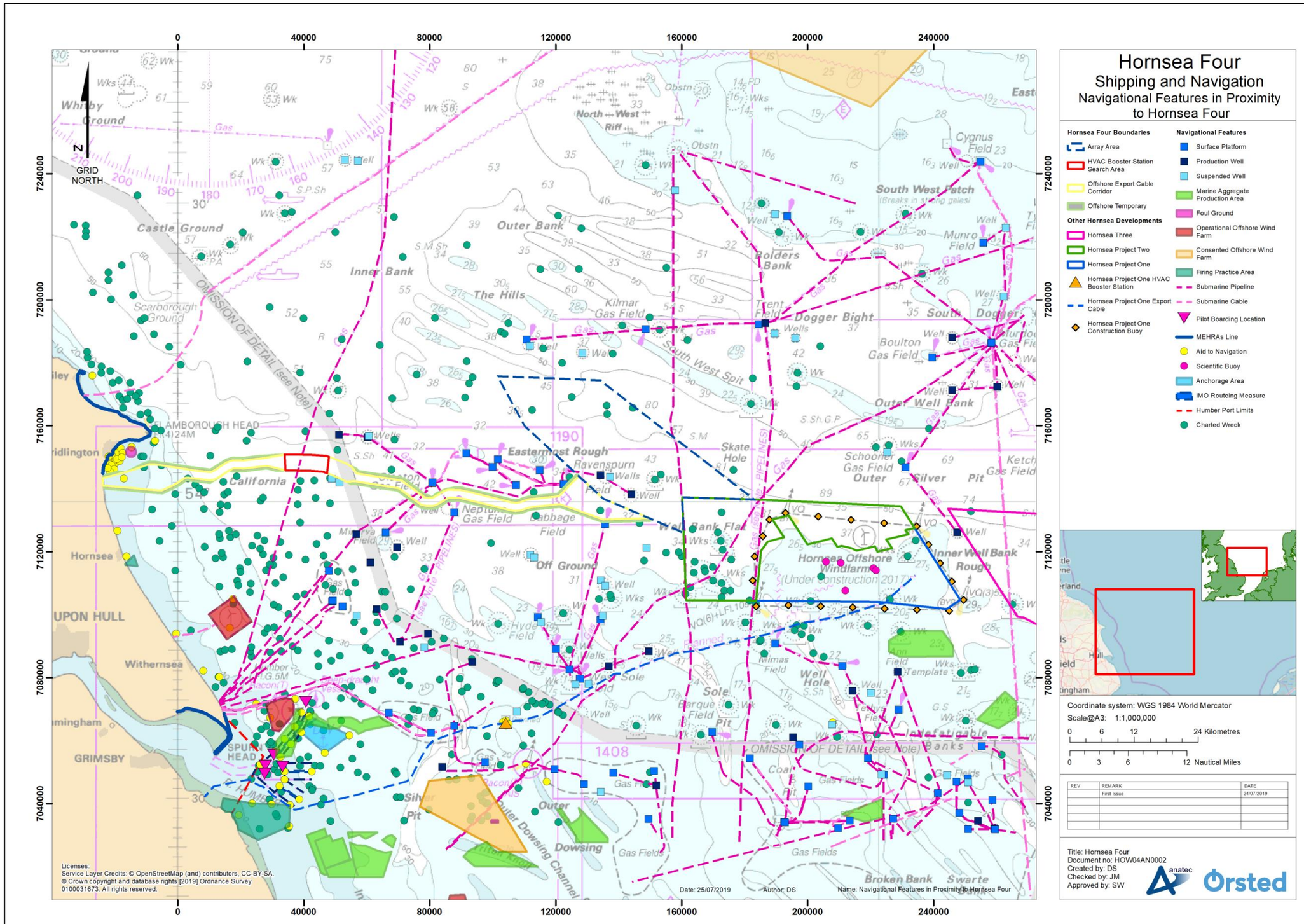

Figure 8.2: Navigational features in proximity to Hornsea Four (not to scale).

8.7.2.2 The key navigational features identified in proximity to the offshore aspects of Hornsea Four are detailed in Table 8.6.

Table 8.6: Details of key navigational features in proximity to Hornsea Four.

Navigational Feature	Details
Other offshore wind farm developments	The Hornsea Four array area shares a section of its boundary with the site boundary for Hornsea Project Two. Hornsea Project One and Hornsea Three are located approximately 2.7 nm and 19.4 nm from the Hornsea Four array area, respectively. Beyond the former Hornsea Zone, there are other Round 3 sites located within the Southern North Sea including the former Dogger Bank Zone and former East Anglia Zone located approximately 36 nm north east and 62 nm south east of the Hornsea Four array area, respectively.
Oil and gas features	There are two production wells connected to the Ravenspurn North CCW platform (part of the Ravenspurn North Central Complex) which are located within the Hornsea Four array area alongside a suspended well. The Ravenspurn North Central Complex platforms are the closest surface platforms to the Hornsea Four array area located approximately 1.6 nm from the western boundary.
Aids to navigation	There are no aids to navigation located within the Hornsea Four array area. The closest aid to navigation is a west cardinal mark located approximately 2.6 nm south east of the Hornsea Four array area. This mark forms part of the construction buoyage for Hornsea Project One and will be removed following the commissioning of the development. There is one aid to navigation located within the Hornsea Four offshore ECC. This is the south west Smithic light buoy, a west cardinal mark designed to assist with entering Bridlington harbour.
Submarine cables and pipelines	There are two submarine pipelines located within the Hornsea Four array area; both are associated with oil and gas features in the Southern North Sea.
Wrecks	There are seven charted wrecks located within the Hornsea Four array area, with the shallowest at 33 m below chart datum. There are three known wrecks located within the Hornsea Four offshore ECC, comprising two wrecks within 10 nm of the landfall site and one approximately 1.2 nm south of the Hornsea Four array area.
IMO Routeing measures	There are no IMO Routeing measures in proximity to the Hornsea Four array area and offshore ECC. However the Inner Approaches Traffic Separation Scheme (TSS) to the Humber, located approximately 32 nm south west of the Hornsea Four site is used by a large number of vessels which transit in proximity to Hornsea Four. Similarly, some vessels passing in proximity to Hornsea Four may use the Off Botney Ground TSS located approximately 51 nm east of the Hornsea Four array area.
Ports	There are a number of ports along the UK east coast with the closest port to the Hornsea Four array area being Bridlington located approximately 39 nm to the west on the east Yorkshire coast.
Marine Environment High Risk Areas (MEHRA)	There are two MEHRAs located in proximity to the Hornsea Four offshore ECC. The Flamborough Head MEHRA is in close proximity (less than 1 nm) to the landfall location while the Spurn Bight MEHRA is located at the Humber.

Vessel traffic in proximity to Hornsea Four array area

8.7.2.3 This section provides an overview of the vessel traffic within the Hornsea Four array area shipping and navigation study area. This includes 28 full days of vessel traffic data over two periods:

- 17 to 30 June 2018 (14 days summer AIS data); and
- 11 January to 2 February 2019 (14 days winter survey data).

8.7.2.4 These survey periods allow for the assessment to account for seasonal variations. The winter survey period was undertaken from a survey vessel located at the Hornsea Four array area and incorporates visual and Radar data in addition to AIS data. A vessel-based survey will be carried out for the summer period in July and August 2019 and included in the final draft NRA as part of the ES. Further information on the marine traffic survey methodology is provided in **Section 7** of **Volume 5, Annex 8.1: Navigational Risk Assessment**.

8.7.2.5 A number of vessel tracks recorded during the Hornsea Four array area survey periods were classified as temporary (non-routine), such as tracks of the survey vessel (winter only) and tracks of vessels associated with the construction of Hornsea Project One. These have therefore been excluded from the analysis. Oil and gas affiliated vessels supporting permanent installations were retained in the analysis.

8.7.2.6 A plot of the vessel tracks recorded during the 28-day survey period, colour-coded by vessel type and excluding temporary traffic, is presented in **Figure 8.3**.

8.7.2.7 For the 14 days' desktop data analysed in the summer survey period, there were an average of 33 unique vessels per day recorded within the study area, recorded on AIS. In terms of vessels intersecting the Hornsea Four array area itself, there was an average of 15 unique vessels per day.

8.7.2.8 For the 14 days' site specific survey data analysed in the winter survey period, there were an average of 23 unique vessels per day recorded within the study area, recorded on AIS, visual and Radar. In terms of vessels intersecting the Hornsea Four array area itself, there was an average of 11 unique vessels per day.

8.7.2.9 Throughout the summer survey period, the main vessel types were cargo vessels (51% within the Hornsea Four array area), tankers (15%) and oil and gas affiliated vessels (15%). Throughout the winter survey period the main vessel types were also cargo vessels (61% within the Hornsea Four array area), tankers (19%) and oil and gas affiliated vessels (13%).

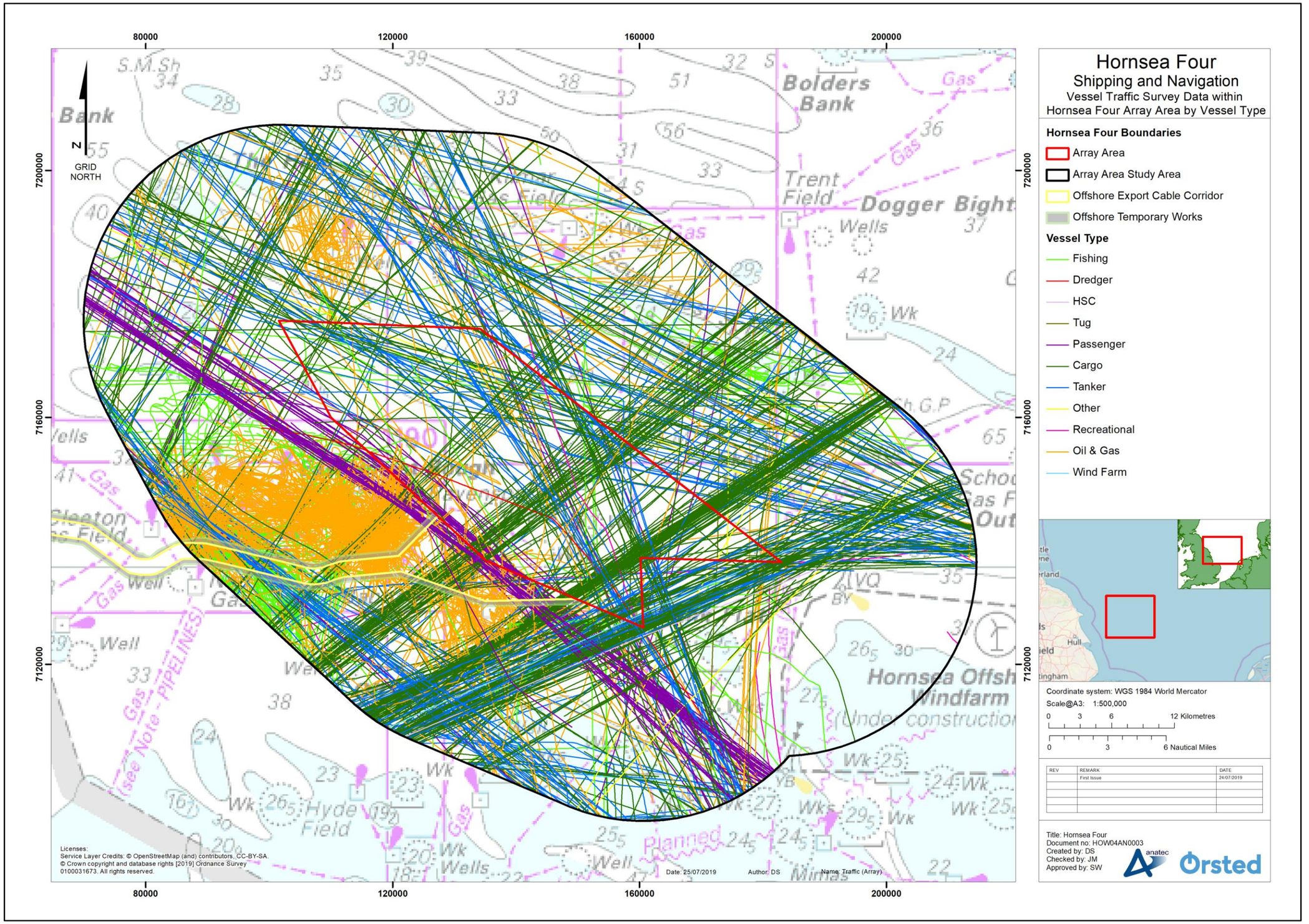

Figure 8.3: Vessel traffic survey data within study area colour-coded by vessel type (28 days summer 2018 (desktop data) and winter 2019 (site specific survey) (not to scale).

8.7.2.10 Vessel lengths overall (LOA) was available for more than 99% of vessels recorded throughout the survey periods and ranged from 7 m for a small yacht to 333 m for a large crude oil tanker. Excluding the small proportion of vessels for which a length was not available the average length of vessels within the study area throughout the summer and winter survey periods were 108 m and 132 m, respectively.

8.7.2.11 Vessel draught was available for approximately 91% of vessel tracks recorded throughout the survey periods and ranged from 1.9 m for a small general cargo vessel to 14.0 m for a large bulk carrier. Excluding those vessels for which a draught was not available the average draught of vessels within the study area throughout the summer and winter survey periods were 5.3 m and 6.0 m, respectively.

8.7.2.12 Main routes have been identified using the principles set out in MGN 543 (MCA, 2016). Vessels transiting at similar headings and locations are identified as a main route and can consist of multiple vessels or a single vessel making the same transit regularly. Twelve main commercial routes were identified as transiting through the study area. Plots of the main routes and corresponding 90th percentiles (areas within which 90% of vessel traffic transiting a route are situated as per MGN 543) within the study area are presented in **Figure 8.4**.

8.7.2.13 Details of the main routes (1 to 12), including the average number of vessels that transit through the study area on each route per day and the main vessel types are provided in **Table 8.7**. It is noted that the main routes reflect key directions of traffic routeing within the Hornsea Four study area, and there are other commercial vessels operating outside of these routes.

Table 8.7: Description of main routes identified within Hornsea Four array area shipping and navigation study area.

Route number	Average transits per day	Description
1	2 to 3	**Immingham (UK) to Esbjerg (Denmark)**. Generally used by cargo vessels (80%) and tankers (20%) and is a DFDS Seaways commercial ferry route. The main vessels operating on this route are the *Ark Dania* and *Ark Germania*.
2	2 to 3	**Immingham to Gothenburg (Sweden)**. Generally used by cargo vessels and is a DFDS Seaways commercial ferry route. The main vessels operating on this route are the *Magnolia Seaways* and *Ficaria Seaways*.
3	2	**Grangemouth (UK) to Rotterdam (Netherlands)**. Generally used by cargo vessels (45%), tankers (30%) and oil and gas affiliated vessels (25%).
4	2	**Newcastle (UK) to Amsterdam (Netherlands)**. Generally used by passenger vessels and is a DFDS passenger ferry route between North Shields (UK) and Ijmuiden (Netherlands).
5	1 to 2	**Immingham to Baltic ports**. Generally used by cargo vessels and is a Finn Lines commercial ferry route between Hull (UK) and Helsinki (Finland).
6	1 to 2	**Tees (UK) to Rotterdam**. Generally used by tankers (55%) and cargo vessels (45%).
7	1 to 2	**Tees to Rotterdam**. Generally used by cargo vessels (50%) and tankers (50%).
8	1 to 2	**Tees to Amsterdam**. Generally used by cargo vessels (50%) and tankers (50%).

Route number	Average transits per day	Description
9	1	**Immingham to Hamburg (Germany)**. Generally used by cargo vessels (50%) and tankers (50%).
10	1	**Immingham to southern Norway ports**. Generally used by cargo vessels (80%) and tankers (20%) and is a Sea-Cargo commercial ferry route between Immingham and Tananger (Norway).
11	1	**Immingham to Baltic ports**. Generally used by cargo vessels.
12	0 to 1	**Great Yarmouth (UK) to Trent gas field**. Generally used by oil and gas affiliated vessels.

8.7.2.14 Throughout the survey periods 18 unique commercial ferries were identified, with 11 undertaking regular routes; each of these is among the main routes identified in **Table 8.7**.

8.7.2.15 For the purposes of the shipping and navigation assessment, recreational activity includes sailing and motor craft (including those undertaking dive and fishing charter trips) of between 2.4 m and 24 m LOA. Throughout the survey periods an average of one unique recreational vessel every two days passed within the Hornsea Four array study area. It is noted that all recreational craft recorded throughout the winter survey period were recorded on AIS, with no recreational craft recorded on Radar.

8.7.2.16 Throughout the survey periods an average of three unique fishing vessels per day passed within the Hornsea Four array study area. It is noted that only fishing vessels was recorded on Radar throughout the winter survey period, with the rest recorded on AIS. Fishing vessel movements were limited within the Hornsea Four array area itself with those tracks recorded characteristic of transiting fishing vessels.

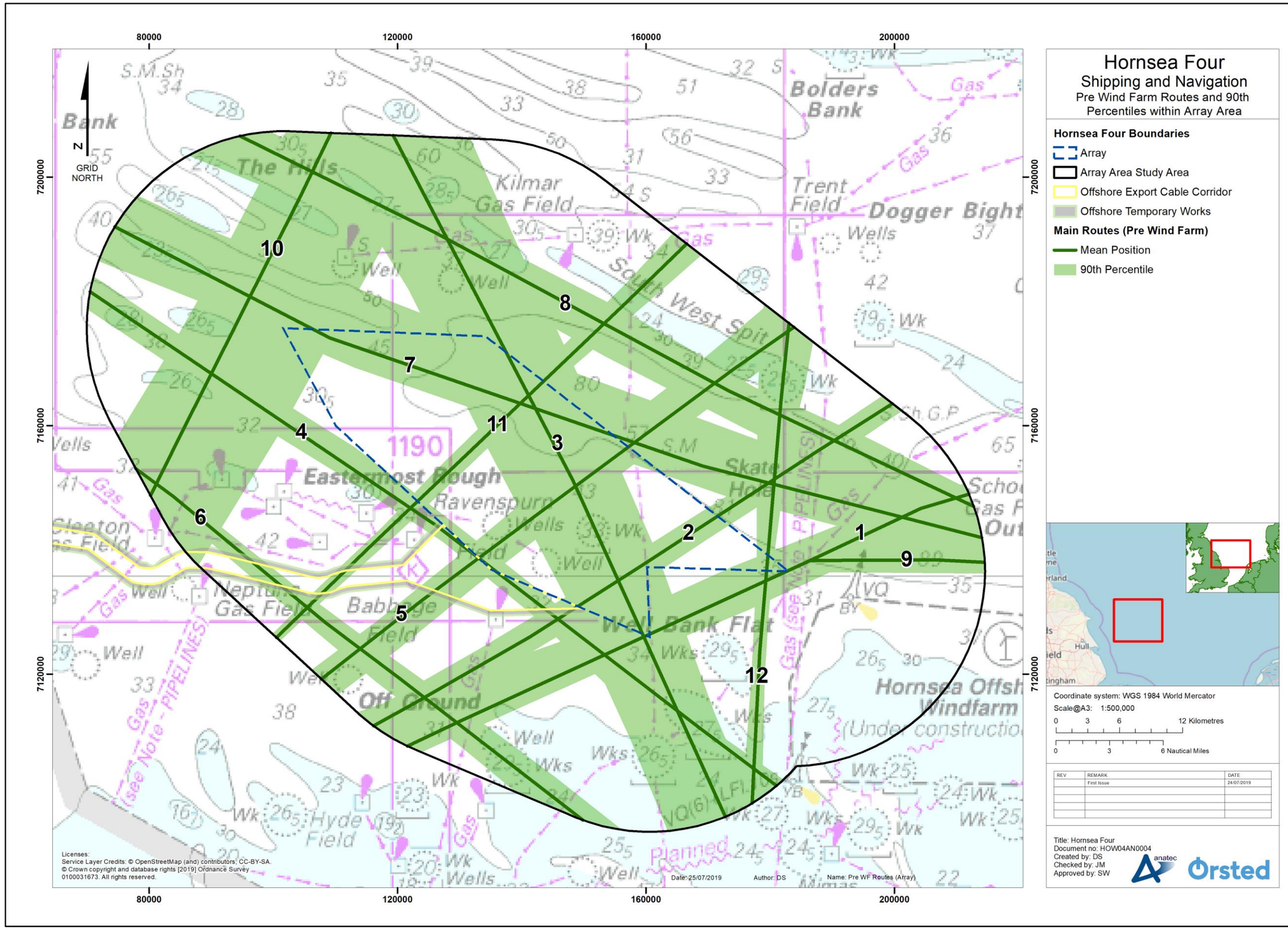

Figure 8.4: Pre-wind farm main routes and 90th percentiles within Hornsea Four array area shipping and navigation study area (not to scale).

8.7.2.17 Although anchored vessels can be identified based upon their navigational status broadcast on AIS, it is common for vessels not to update their navigational status if only at anchor for a short period of time. For this reason, those vessels which travelled at a speed of less than 1 knot (kt) for more than 30 minutes were deemed to be at anchor. After applying these criteria, only one vessel was deemed to be at anchor. This was an offshore supply vessel operating at the Ravenspurn Charlie platform approximately 6.2 nm south west of the Hornsea Four array area.

Maritime incidents in proximity to Hornsea Four array area

8.7.2.18 Detail on maritime incidents can be found in **Section 13** of **Volume 5, Annex 8.1: Navigational Risk Assessment**.

Vessel traffic in proximity to Hornsea Four offshore export cable corridor

8.7.2.19 This section provides an overview of the vessel traffic within the Hornsea Four array area shipping and navigation study area. This includes 28 full days of vessel traffic data over two survey periods:

- 17 to 30 June 2018 (14 days summer AIS data); and
- 13 January to 15 February 2019 (14 days winter AIS data).

8.7.2.20 These variations in survey periods allow for the assessment to account for seasonal variations. The vessel-based winter AIS survey data has been supplemented with AIS data from on-shore sources. Further information on the marine traffic survey methodology is provided in **Section 7** of **Volume 5, Annex 8.1: Navigational Risk Assessment**.

8.7.2.21 A number of tracks recorded during the Hornsea Four array area survey periods were classified as temporary (non-routine), such as tracks of the survey vessel (winter only). These have therefore been excluded from the analysis. Oil and gas affiliated vessels supporting permanent installations were retained in the analysis.

8.7.2.22 A plot of the vessel tracks recorded during the 28-day survey period, colour-coded by vessel type and excluding temporary traffic, is presented in **Figure 8.5**.

8.7.2.23 For the 14 days analysed in the summer survey period, there were an average of 63 unique vessels per day recorded within the Hornsea Four offshore export cable corridor shipping and navigation study area, recorded on AIS. In terms of vessels intersecting the Hornsea Four offshore export cable corridor itself, there was an average of 56 unique vessels per day.

8.7.2.24 For the 14 days analysed in the winter survey period, there were an average of 51 unique vessels per day recorded within the Hornsea Four offshore export cable corridor shipping and navigation study area, recorded on AIS, visual and Radar. In terms of vessels intersecting the Hornsea Four offshore export cable corridor itself, there was an average of 45 unique vessels per day.

8.7.2.25 Throughout the summer survey period, the main vessel types were cargo vessels (35% within the Hornsea Four offshore export cable corridor), fishing vessels (24%) and tankers (20%). Throughout the winter survey period the main vessel types were cargo vessels (35% within the Hornsea Four offshore export cable corridor), tankers (23%) and fishing vessels (18%).

Vessel traffic in proximity to Hornsea Four HVAC booster station search area

8.7.2.26 This section provides an overview of the vessel traffic within the Hornsea Four HVAC booster station search area shipping and navigation study area. This includes 28 full days of vessel traffic data over two survey periods:

- 17 to 30 June 2018 (14 days summer AIS data); and
- 13 January to 15 February 2019 (14 days winter).

8.7.2.27 These variations in survey periods allow for the assessment to account for seasonal variations. The winter survey period was undertaken from a survey vessel located at the Hornsea Four HVAC booster station search area and incorporates visual and Radar data in addition to AIS data. A vessel-based survey will be carried out for the summer period in summer 2019 and included in the final draft NRA as part of the Environmental Statement. Further information on the marine traffic survey methodology is provided in **Section 7** of **Volume 5, Annex 8.1: Navigational Risk Assessment**.

8.7.2.28 A number of tracks recorded during the Hornsea Four HVAC booster station search area survey periods were classified as temporary (non-routine), such as tracks of the survey vessel (winter only). These have therefore been excluded from the analysis. Oil and gas affiliated vessels supporting permanent installations were retained in the analysis.

8.7.2.29 A plot of the vessel tracks recorded during the 28-day survey period, colour-coded by vessel type and excluding temporary traffic, is presented in **Figure 8.6**.

8.7.2.30 For the 14 days' desktop data analysed in the 2018 summer survey period, there were an average of 40 unique vessels per day recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area, recorded on AIS. In terms of vessels intersecting the Hornsea Four HVAC booster station search area itself, there was an average of seven unique vessels per day.

8.7.2.31 For the 14 days' site specific survey data analysed in the 2019 winter survey period, there were an average of 37 unique vessels per day recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area, recorded on AIS, visual and Radar. In terms of vessels intersecting the Hornsea Four HVAC booster station search area itself, there was an average of five unique vessels per day.

8.7.2.32 Throughout the 2018 summer survey period, the main vessel types were tankers (46% within the Hornsea Four HVAC booster station search area) and cargo vessels (33%). Throughout the winter survey period the main vessel types were also tankers (50% within the Hornsea Four HVAC booster station search area) and cargo vessels (35%).

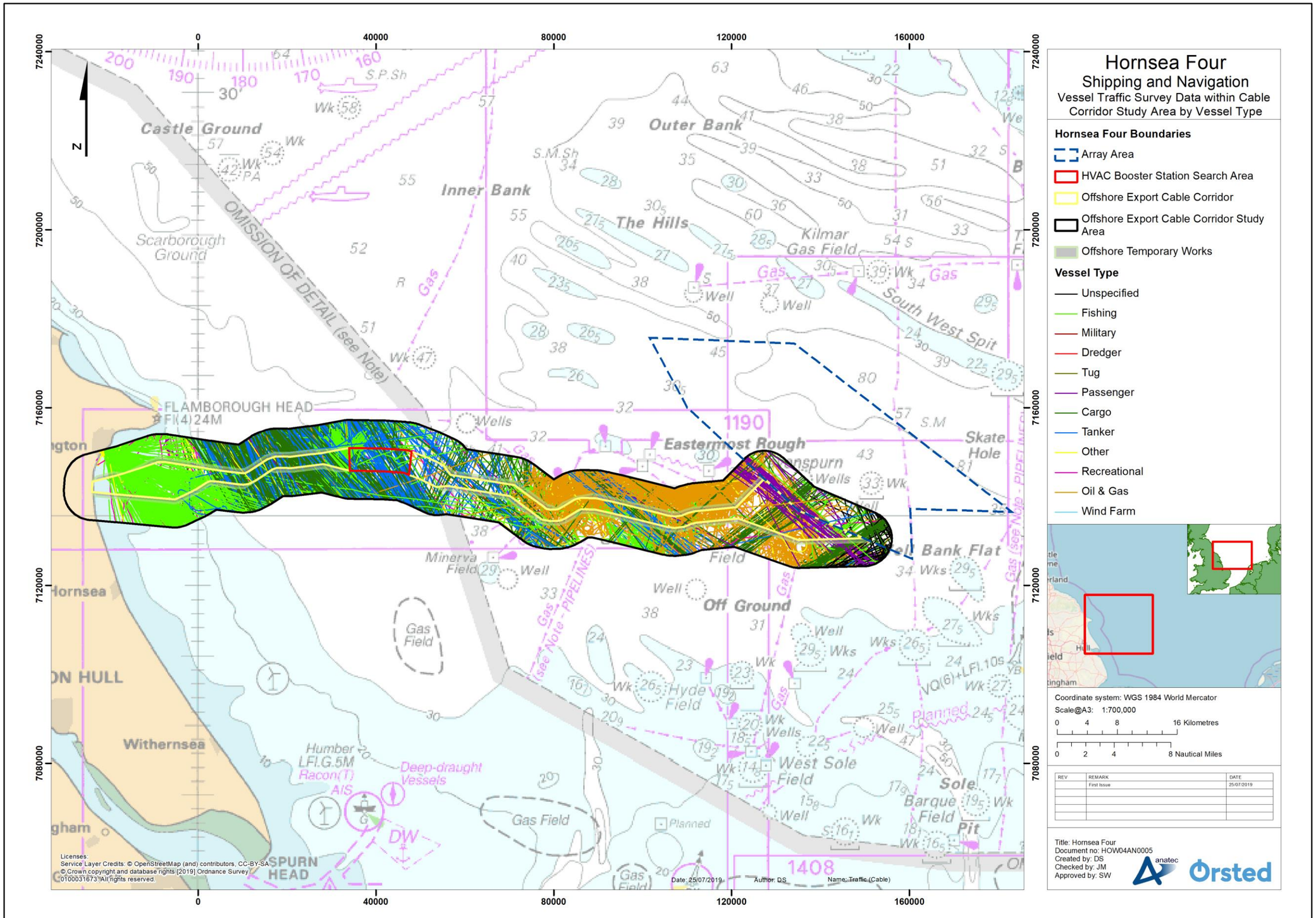

Figure 8.5: Vessel traffic survey data within Hornsea Four offshore ECC shipping and navigation study area colour-coded by vessel type (28 days summer 2018 (desktop data) and winter 2019 (site specific survey)) (not to scale).

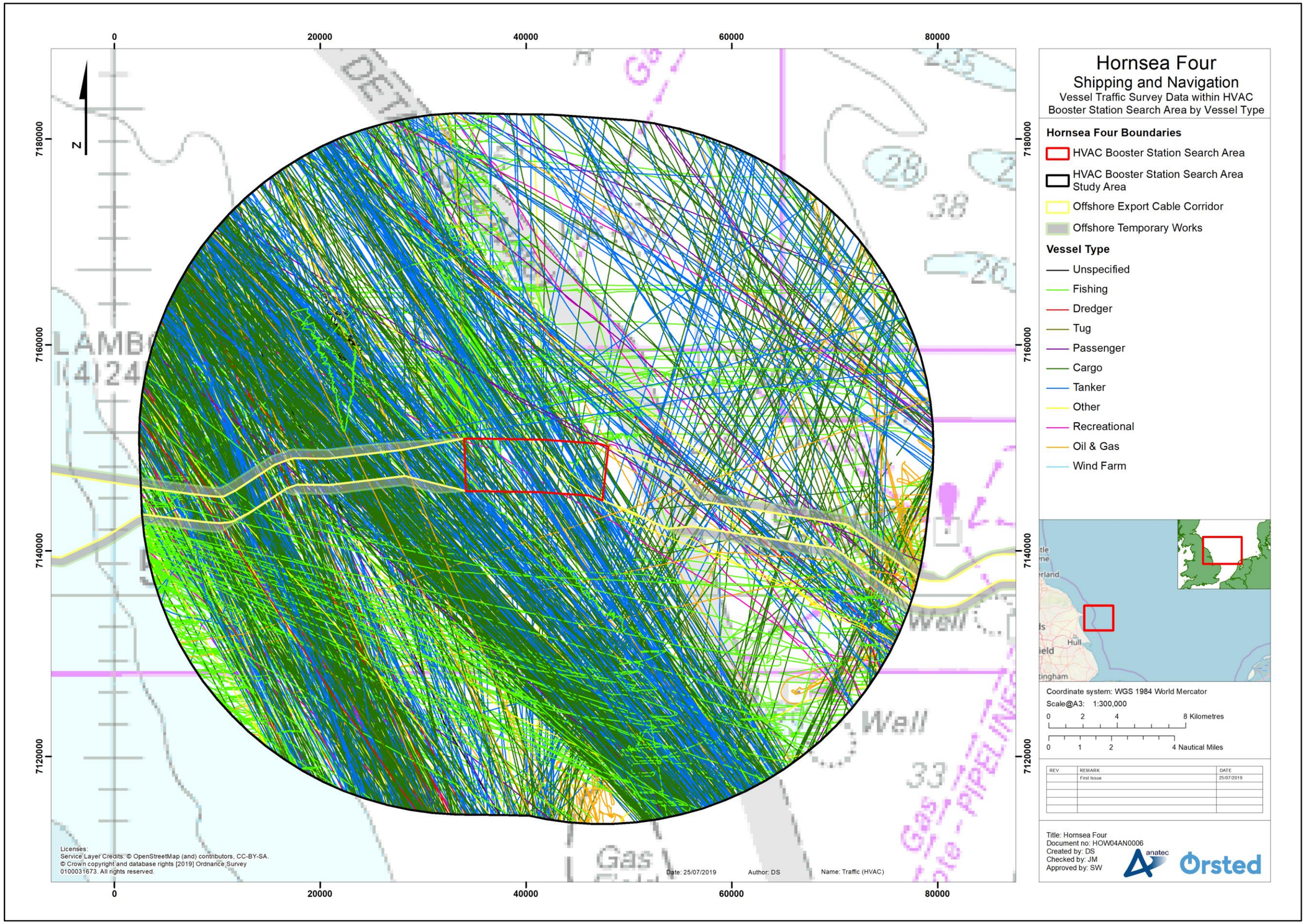

Figure 8.6: Vessel traffic survey data within Hornsea Four HVAC booster station search area shipping and navigation study area colour-coded by vessel type (28 days summer 2018 (desktop data) and winter 2019 (site specific survey)) (not to scale).

8.7.2.33 Vessel LOA was available for more than 99% of vessels recorded throughout the survey periods and ranged from 5 m for a small yacht to 300 m for a large bulk carrier. Excluding the small proportion of vessels for which a length was not available the average length of vessels within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the summer and winter survey periods were 92 m and 109 m, respectively.

8.7.2.34 Vessel draught was available for approximately 82% of vessel tracks recorded throughout the survey periods and ranged from 1.3 m for a catamaran to 14.2 m for a large bulk carrier. Excluding those vessels for which a draught was not available the average draught of vessels within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the summer and winter survey periods were 5.3 m and 4.9 m, respectively.

8.7.2.35 Main routes have been identified using the principles set out in MGN 543 (MCA, 2016) as per the routeing analysis undertaken for the Hornsea Four array area. Ten main commercial routes were identified as transiting through the Hornsea Four HVAC booster station search area shipping and navigation study area. Plots of the main routes and corresponding 90th percentiles within the Hornsea Four HVAC booster station search area shipping and navigation study area are presented in **Figure 8.7**.

8.7.2.36 Details of the main routes (1 to 10), including the average number of vessels that transit through the study area on each route per day and the main vessel types are provided in **Table 8.8**. It is noted that the main routes reflect key directions of traffic routeing within the Hornsea Four array area shipping and navigation study area, and there are other commercial vessels operating outside of these routes.

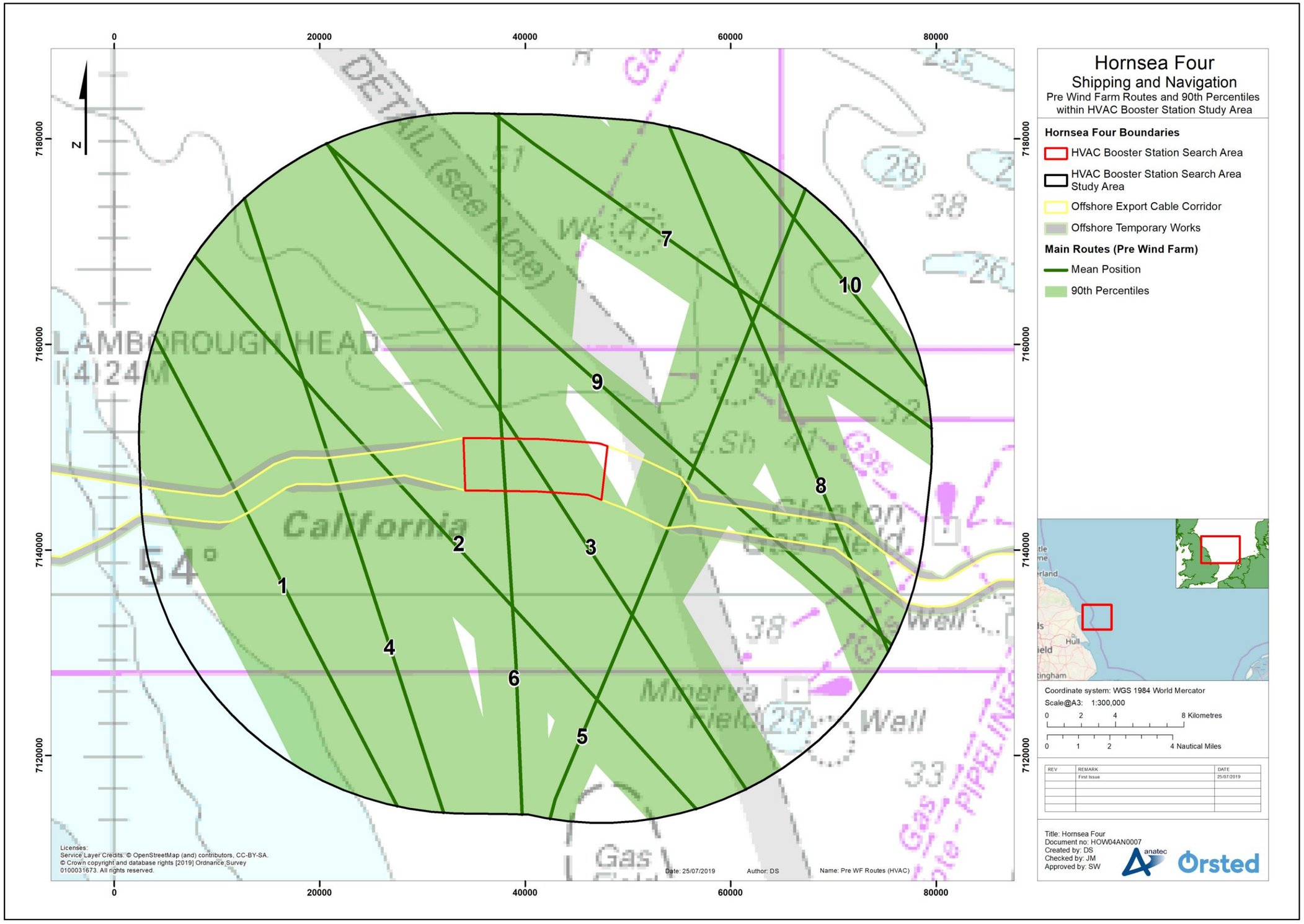

Figure 8.7: Pre wind farm main routes and 90th percentiles within Hornsea Four HVAC booster station search area shipping and navigation study area (not to scale).

Table 8.8: Description of main routes identified within Hornsea Four HVAC booster station search area shipping and navigation study area.

Route Number	Average Transits per Day	Description
1	15	**Tees to Rotterdam**. Generally used by cargo vessels (65%) and tankers (35%).
2	11	**Tees to Rotterdam/Zeebrugge (Belgium)**. Generally used by cargo vessels (65%) and tankers (35%) and is a Bore Lines and P&O Ferries commercial ferry route. The main vessels operating on this route are the *A2B Energy*, *A2B Spirit*, *Bore Song*, *Estraden*, *H&S Bravery*, *Mistral* and *Stena Carrier*.
3	4 to 5	**Grangemouth to Rotterdam**. Generally operated by cargo vessels (65%) and tankers (35%).
4	1 to 2	**Immingham to Moray Firth ports**. Generally operated by cargo vessels (75%) and tankers (25%).
5	1	**Immingham to northern Norway ports**. Generally operated by cargo vessels (60%) and tankers (40%).
6	1	**Immingham to northern Norway ports**. Generally operated by tankers (65%) and cargo vessels (35%).
7	1	**Tees to Rotterdam**. Generally operated by tankers (60%) and cargo vessels (40%).
8	1	**Grangemouth to Rotterdam**. Generally operated by cargo vessels (50%), tankers (25%) and oil and gas support vessels (25%).
9	0 to 1	**Tees to Amsterdam**. Generally operated by cargo vessels (50%) and tankers (50%).
10	0 to 1	**Grangemouth to Ghent (Belgium)**. Generally operated by tankers (65%) and cargo vessels (35%).

8.7.2.37 Throughout the survey periods six unique commercial ferries were identified, with 11 undertaking regular routes; each of these is among the main routes identified in **Table 8.8**. Primarily from the winter survey period, these are considered to be adverse weather transits and are considered further in **Section 16** of **Volume 5, Annex 8.1: Navigational Risk Assessment**.

8.7.2.38 Throughout the survey periods an average of less than one unique recreational vessel per day passed within the Hornsea Four HVAC booster station search area shipping and navigation study area. It is noted that all recreational craft recorded throughout the winter survey period were recorded on AIS, with no recreational craft recorded on Radar.

8.7.2.39 Throughout the survey periods, an average of seven unique fishing vessels per day passed within the Hornsea Four HVAC booster station search area shipping and navigation study area. It is noted that only five fishing vessels were recorded on Radar throughout the winter survey period, with the rest recorded on AIS. Fishing vessel movements were characteristic of both fishing vessels in transit and engaged in fishing activity.

8.7.2.40 Vessels which travelled at a speed of less than 1 kt for more than 30 minutes were deemed to be at anchor. After applying these criteria, five cases of anchored vessels were identified, with the vessel broadcasting an AIS navigational status of "at anchor" in each case. All five cases involved crude oil tankers broadcasting a destination of Flamborough Head.

Maritime incidents in proximity to Hornsea Four HVAC booster station search area

8.7.2.41 Detail on maritime incidents can be found in **Section 13** of **Volume 5, Annex 8.1: Navigational Risk Assessment**.

8.7.3 Predicted future baseline

8.7.3.1 The Infrastructure Planning (EIA) 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.

8.7.3.2 In the event that Hornsea Four does not come forward therefore, an assessment of the future baseline conditions has been carried out and is described in this section.

8.7.3.3 Due to the distance offshore of the Hornsea Four array area, it is not considered likely that any increase in port traffic (i.e. vessels entering and existing ports) would impact on the general traffic levels around the Hornsea Four array area and offshore export cable corridor; therefore a precautionary 10% increase in routeing traffic associated is applied in the future baseline.

8.7.3.4 An indicative 10% increase in commercial fishing vessel transits is applied in the future baseline to demonstrate potential impacts (in line with other renewables assessments). This value is used due to there being limited reliable information on future activity levels upon which any firm assumption could be made. Increases in fishing activities are considered in a separate study of commercial fishing (see **Volume 2, Chapter 7: Commercial Fisheries**).

8.7.3.5 There are no known major developments which will increase the activity of recreational vessels within the Southern North Sea. As with commercial fishing activity, given the lack of reliable information relating to future trends, a 10% increase is considered conservative.

8.7.3.6 During the construction phase there will be up to 3,816 return trips made by vessels involved in the installation of Hornsea Four (see **Table 8.10**). During the operation and maintenance phase there will be up to 3,525 return trips per year made by vessels involved in the operation and maintenance of Hornsea Four. This traffic has been considered in the future baseline.

8.7.3.7 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. Assumptions for re-routeing include:

- All alternative routes maintain a minimum distance of 1 nm from offshore installations and potential Wind Turbine Generator (WTG) boundaries in line with the MGN 543 Shipping Route Template (MCA, 2016). This distance is considered for shipping and navigation from a safety perspective as explained below; and
- All mean routes take into account sandbanks and known routeing preferences.

8.7.3.8 MGN 543 (MCA, 2016) provides guidance to offshore renewable energy developers on both the assessment process and design elements associated with the development of an offshore wind farm. Annex 3 of MGN 543 defines a methodology for assessing passing distances between offshore wind farm boundaries but states that it is "*not a prescriptive tool but needs intelligent application*".

8.7.4 Data Limitations

8.7.4.1 The desk-based data and site specific survey data used in this chapter are detailed in **Table 8.4**. The desk-based data sources used are the most up to date publicly available information. The data are therefore limited by what is available and by what has been made available, at the time of writing the PEIR. Further details on the site-specific data can be obtained in **Volume 2, Chapter 8: Navigational Risk Assessment**.

8.7.4.2 The site-specific data will be in compliance with the requirements of MGN 543 for ES submission and will therefore provide a high level of confidence in the base case that it demonstrates.

8.8 Project basis for assessment

8.8.1 Impact register and impacts "scoped out"

8.8.1.1 Based on the baseline environment, the project description outlined in **Volume 1, Chapter 4: Project Description** and the Commitments outlined in **Volume 4, Annex 5.2: Commitments Register**, no impacts have been proposed to be "scoped out" of the PEIR assessment for shipping and navigation.

8.8.1.2 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 4, Annex 5.1**). This approach is aligned with the Hornsea Four Proportionate approach to EIA (see **Volume 1, Chapter 5: EIA Methodology**).

8.8.2 Commitments

8.8.2.1 Hornsea Four has committed to several Commitments (primary design principles inherent as part of the project, installation techniques and engineering designs/modifications as part of their pre-application phase, to avoid a number of impacts or reduce impacts as far as

reasonably practicable). Further Commitments (adoption of best practice guidance) are embedded as an inherent aspect of the EIA process.

8.8.2.2 The commitments adopted by Hornsea Four in relation to shipping and navigation are presented in **Table 8.9**. Full details of the Commitments are presented within the Commitment Register (see **Volume 4, Annex 5.2**). The method by which Co177 and Co179 are secured shall be confirmed post-PEIR via consultation.

Table 8.9: Relevant shipping and navigation commitments.

Commitment ID	Measure Proposed	How the Measure will be Secured
Co81	Where scour protection is required, MGN 543 (or latest relevant available guidance) will be adhered to with respect to changes greater than 5% to the under keel clearance.	DCO Schedule 11, Part 2 - Condition 14 and; DCO Schedule 12, Part 2 - Condition 14 (Offshore safety management)
Co83	Where possible, cable burial will be the preferred option for cable protection.	DCO Schedule 11, Part 2 - Condition 12(1)(h) and; DCO Schedule 12, Part 2 - Condition 12(1)(h) (Cable specification and installation plan)
Co89	Advance warning and accurate location details of construction, maintenance and decommissioning operations, associated Safety Zones and advisory passing distances will be given via Notices to Mariners and Kingfisher Bulletins.	DCO Schedule 11, Part 2 - Condition 6(8) and; DCO Schedule 12, Part 2 - Condition 6(8) (Notifications and inspections)
Co93	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 and Civil Aviation Authority (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 7 and; DCO Schedule 12, Part 2 - Condition 7 (Aids to navigation) DCO Schedule 11, Part 2 - Condition 12(1)(j) and; DCO Schedule 12, Part 2 - Condition 14(1)(j) (Aid to navigation management plan)
Co94	The United Kingdom Hydrographic Office 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 6(10) and; DCO Schedule 12, Part 2 - Condition 6(10) (Notifications and inspections)

Commitment ID	Measure Proposed	How the Measure will be Secured
Co96	The project commits to agreeing layout principles with MCA, which will include maintaining at least one line of symmetry/ orientation in turbine layout.	DCO Schedule 11, Part 2 - Condition 12(1)(a) and; DCO Schedule 12, Part 2 - Condition 12(1)(a) (Pre-construction plans and documentation)
Co98	Monitoring of vessel traffic for the duration of the construction period.	DCO Schedule 11, Part 2 - Condition 17(2)(b) and; DCO Schedule 12, Part 2 - Condition 17(2) (Construction Monitoring)
Co99	Hornsea Four will ensure compliance with MGN 543 where appropriate.	DCO Schedule 11, Part 2 - Condition 14 and; DCO Schedule 12, Part 2 - Condition 14 (Offshore safety management)
Co139	Safety zones of up to 500m will be applied during construction, maintenance and decommissioning phases. Where appropriate, guard vessels will also be used to ensure adherence with Safety Zones or advisory passing distances, as defined by risk assessment, to mitigate any impact which poses a risk to surface navigation during construction, maintenance and decommissioning phases. Such impacts may include partially installed structures or cables, extinguished navigation lights or other unmarked hazards.	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 the Project Description.
Co176	A Cable Specification and Installation Plan will be produced prior to construction of the offshore export cable which will include; details of cable burial depths; a detailed cable laying plan which ensures safe navigation is not compromised; details of cable protection for each cable crossing; and proposals for monitoring of offshore cable.	DCO Schedule 11, Part 2 - Condition 12(1)(h) and; DCO Schedule 12, Part 2 - Condition 12(1)(h) (Cable specification and installation plan)
Co177	Hornsea Four vessels will comply with MGN 372 (Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2008) or the latest relevant available guidance where appropriate.	N/A

Commitment ID	Measure Proposed	How the Measure will be Secured
Co178	Hornsea Four will undertake further consultation with Regular Operators as part of the formal consultation process	N/A
Co179	Hornsea Four will ensure marine coordination with the Marine Helicopter Coordination Centre (MHCC).	N/A
Co181	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)

8.9 Maximum Design Scenario

8.9.1.1 Table 8.10 describes the parameters upon which the impact assessment of significance effects for shipping and navigation has been undertaken. The maximum design scenario (MDS) for shipping and navigation has been determined from a review of the Project Description for Hornsea Four (Volume 1 Chapter 4: Project Description). Effects of greater adverse significance are not predicted to arise should any other development scenario (based on the design parameters within the project description) be taken forward in the final design of the scheme.

Table 8.10: Maximum design scenario for impacts on shipping and navigation.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
Construction			
Construction activities associated with the Hornsea Four array area, offshore export cable corridor and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-C-1).	Secondary: Co139 Co179 Tertiary: Co89 Co93 Co99 Co177	**Construction Timeline:** • Single phase of offshore construction over approximately three years. **Buoyed Construction Areas:** • Buoyed construction area deployed around the maximum extent of the Hornsea Four array area including 500 m construction Safety Zones and 50 m pre-commissioning Safety Zones; and • Buoyed construction area deployed around the HVAC booster stations including 500 m construction Safety Zones. **Construction Vessels:** • Up to 60 construction vessels for the WTG foundations engaged at any given time with up to 810 return trips; • Up to 38 construction vessels for the WTGs engaged at any given time with up to 900 return trips; • Up to 36 construction vessels for substation and accommodation platform foundations engaged at any given time with up to 210 return trips; • Up to 18 construction vessels for the inter-array and interconnector cables engaged at any one time with up to 1,488 return trips; • Up to 24 construction vessels for the export cables engaged at any given time with up to 408 return trips; and • Up to 18 construction vessels for the HVAC booster stations engaged at any given time with up to 90 return trips.	Largest extent and maximum number of construction vessels over the longest construction period with highest level of vessel activity.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
Pre-commissioned structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (SN-C-2).	Secondary: Co139 Tertiary: Co89 Co93 Co94 Co99 Co177	**Construction Timeline:** • Single phase of offshore construction over approximately three years. **Wind Turbines (Suction Caisson Jacket or Piled Jacket Foundations):** • Up to 180 pre-commissioned WTGs on suction caisson jacket or piled jacket foundations (foundation with largest surface area at sea level). **OSS and HVAC Booster Stations (GBS Foundations):** • Up to six pre-commissioned offshore transformer substations on GBS foundations (foundation with largest surface area at sea level); • Up to three pre-commissioned offshore High Voltage Direct Current (HVDC) converter substations on GBS (foundation with largest surface area at sea level); • Up to one pre-commissioned offshore accommodation platform on GBS (foundation with largest surface area at sea level); and • Up to three pre-commissioned HVAC booster stations on GBS foundations with minimum spacing of 100 m (foundation with largest surface area at sea level).	Largest extent and maximum number of structures over the longest construction period.
Pre-commissioned cables associated with the Hornsea Four array area and offshore export cable corridor may increase anchor snagging risk for all vessels (SN-C-3).	Primary: Co83 Secondary: Co139 Tertiary: Co81 Co89 Co99 Co176	**Construction Timeline:** • Single phase of offshore construction over approximately three years. **Export Cables:** • Maximum installation export cable length of approximately 654 kilometres (km) (six cables of 109 km) each, including within the Hornsea Four array area. **Inter Array and Interconnector Cables:** • Maximum installation length of array cables, up to 600 km; and • Up to six pre-commissioned interconnector cables linking the offshore substations, up to 90 km (15 km in total length each).	Largest extent and maximum number of structures over the longest construction period.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
Construction activities associated with the Hornsea Four array area and offshore export cable corridor may restrict the emergency response capability of existing resources (SN-C-4).	Secondary: Co179 Tertiary: Co89	**Construction Vessels and Helicopters:** • Up to 60 construction vessels for the WTG foundations engaged at any given time with up to 810 return trips and up to 180 helicopter return trips; • Up to 38 construction vessels for the WTGs engaged at any given time with up to 900 return trips and up to 135 helicopter return trips; • Up to 36 construction vessels for substation and accommodation platform foundations engaged at any given time with up to 210 return trips and up to 70 helicopter return trips; • Up to 18 construction vessels for the inter-array and interconnector cables engaged at any one time with up to 1,488 return trips and up to 396 helicopter return trips; • Up to 18 construction vessels for the HVAC booster stations engaged at any given time with up to 90 return trips and up to 21 helicopter return trips; and • Up to 24 construction vessels for the export cables engaged at any given time with up to 408 return trips and up to 800 helicopter return trips.	Maximum number of construction vessels over the longest construction period.

Operation and Maintenance

Presence of structures within the Hornsea Four array area, offshore export cable corridor and HVAC booster station search area and activities associated with the Hornsea Four array area, offshore export cable corridor and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore increased vessel to vessel collision risk for all vessel in all weather conditions (SN-O-5).	Secondary: Co178 Tertiary: Co89 Co94 Co99 Co177	**Operational Life:** • Operational life of 35 years. **Development Area:** • Structure deployment across full developable area; and • Maintenance Safety Zones of up to 500 m. **Operation and Maintenance Vessels:** • Up to 3,525 return trips by operation and maintenance vessels operational 24/7.	Largest extent over the longest operational period with most operational activity.

Operational structures within the Hornsea Four array area and HVAC booster station search area may create powered and drifting allision risk for all vessels (SN-O-6).	Secondary: Co179 Tertiary: Co89 Co93 Co94 Co96 Co99 Co177	**Operational Life:** • Operational life of 35 years; **Development Area and Wind Turbines (Suction Caisson Jacket or Piled Jacket Foundations):** • Up to 180 WTGs on suction caisson jacket or piled jacket foundations (foundation with largest surface area at sea level); • Minimum spacing of 810 m between structures within Hornsea Four array area; • Minimum spacing of 100 m between offshore HVAC booster stations; and • Maintenance Safety Zones of up to 500 m. **OSS and HVAC Booster Stations (GBS Foundations):** • Up to six offshore transformer substations on GBS foundations (foundation with largest surface area at sea level); • Up to three offshore HDVC converter substations on GBS foundations (foundation with largest surface area at sea level); • Up to one offshore accommodation platform on GBS foundations (foundation with largest surface area at sea level); and • Up to three HVAC booster stations on GBS foundations (foundation with largest surface area at sea level).	Largest extent and maximum number of operation and maintenance vessels over the longest operational period
Operational cables within the Hornsea Four array area and offshore export cable corridor may increase anchor snagging risk for all vessels and cable protection used may reduce navigable water depths for all vessels (SN-O-7).	Primary: Co83 Secondary: Co139 Tertiary: Co81 Co89 Co99 Co176	**Operational Life:** • Operational life of 35 years. **Export Cables:** • Maximum export cable length of approximately 654 km (six cables of 109 km each), including within the Hornsea Four array area. **Inter Array and Interconnector Cables:** • Maximum length of array cables, up to 600 km; and • Up to six interconnector cables linking the offshore substations, up to 90 km (15 km in total length each).	Largest extent and maximum number of structures over the longest operational period with use of cable burial protection.

Operation and maintenance activities associated with the Hornsea Four array area and offshore export cable corridor may restrict the emergency response capability of existing resources (SN-O-8).	Secondary: Co179 Tertiary: Co96 Co99	**Operational Life:** • Operational life of 35 years. **Operation and maintenance vessels:** • Up to 3,525 return trips by operation and maintenance vessels and/or helicopters operational 24/7.	Maximum number of operation and maintenance vessels over the longest operational period
Operational structures within the Hornsea Four array area and offshore export cable corridor may impact a vessel's use of its Radar, communications and navigation equipment during navigational transits (SN-O-9).	Tertiary: Co99	**Operational Life:** • Operational life of 35 years. **Array Area and Wind Turbines (Suction Caisson Jacket or Piled Jacket Foundations):** • Maximum WTG deployment (up to 180) on suction caisson jacket or piled jacket foundations covering maximum sea area over a 35 year operational life; • Minimum spacing of 810 m between structures within Hornsea Four array area. • Minimum spacing of 100 m between HVAC booster stations; and • Maintenance Safety Zones of up to 500 m. **OSS/HVAC Booster Stations (GBS Foundations):** • Up to six offshore transformer substations on GBS foundations (foundation with largest surface area at sea level); • Up to three offshore HDVC converter substations on GBS (foundation with largest surface area at sea level; • Up to one offshore accommodation platform on GBS (foundation with largest surface area at sea level); and • Up to three HVAC booster stations on GBS foundations.	Largest extent and maximum number of structures over the longest operational period

Decommissioning

Decommissioning activities associated with the Hornsea Four array area and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore increased vessel to vessel collision risk for all vessels in all weather conditions (SN-D-10).	Secondary: Co139 Co179 Tertiary: Co89 Co93 Co99 Co177 Co181	**Decommissioning Timeline:** • Single phase of offshore decommissioning over approximately three years. **Buoyed Decommissioning Area:** • Buoyed decommissioning area deployed around the maximum extent of the Hornsea Four array area including 500 m decommissioning Safety Zones; and • Buoyed decommissioning area deployed around the HVAC booster stations including 500 m decommissioning Safety Zones.	Largest extent over the longest decommissioning period
Decommissioning structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (SN-D-11).	Secondary: Co139 Tertiary: Co89 Co93 Co94 Co99 Co177 Co181	**Decommissioning Timeline:** • One phase of offshore decommissioning over approximately three years. **Decommissioning Structures:** • Up to 180 pre-decommissioned WTGs on suction caisson jacket or piled jacket foundations (foundation with largest surface area at sea level); • Up to six pre-decommissioned offshore transformer substations on GBS foundations (foundation with largest surface area at sea level); • Up to three pre-decommissioned offshore HVDC converter substations on GBS (foundation with largest surface area at sea level); • Up to one pre-decommissioned offshore accommodation platform on GBS (foundation with largest surface area at sea level); and • Up to three pre-decommissioned HVAC booster stations on GBS foundations with minimum spacing of 100 m (foundation with largest surface area at sea level).	Largest extent and maximum number of structures over the longest decommissioning period

Decommissioned cables left in situ within the Hornsea Four array area and offshore export cable corridor may increase anchor snagging risk for all vessels (SN-D-12).	Primary: Co83 Tertiary: Co81 Co89 Co99 Co176 Co181 Secondary: Co139	**Decommissioning Timeline:** • Single phase of offshore decommissioning over approximately three years. **Export cable, Inter Array and Interconnector Cables:** • Maximum export cable length of approximately 654 km (six cables of 109 km each, including within the Hornsea Four array area) left in situ. **Inter Array and Interconnector Cables:** • Maximum length of array cables, up to 600 km left in situ; and • Up to six interconnector cables linking the offshore substations, up to 90 km (15 km in total length each) left in situ.	Largest extent and maximum number of structures over the longest decommissioning period. Cables left in situ.
Decommissioning activities associated with the Hornsea Four array area and offshore export cable corridor may restrict the emergency response capability of existing resources (SN-D-13).	Secondary: Co179 Tertiary: Co99 Co181	**Decommissioning Timeline:** • Single phase of offshore decommissioning over approximately three years. **Decommissioning Vessels:** • Up to 60 decommissioning vessels for the WTG foundations engaged at any given time with up to 810 return trips and up to 180 helicopter return trips; • Up to 38 decommissioning vessels for the WTGs engaged at any given time with up to 900 return trips and up to 135 helicopter return trips; • Up to 36 decommissioning vessels for substation and accommodation platform foundations engaged at any given time with up to 1`0 return trips and up to 70 helicopter return trips; • Up to 18 decommissioning vessels for the inter-array and interconnector cables engaged at any one time with up to 1,488 return trips and up to 396 helicopter return trips; • Up to 18 decommissioning vessels for the HVAC booster stations engaged at any given time with up to 90 return trips and up to 21 helicopter return trips; and • Up to 24 decommissioning vessels for the export cables engaged at any given time with up to 408 return trips and up to 800 helicopter return trips.	Maximum number of construction vessels over the longest decommissioning period.

8.10 Assessment methodology

8.10.1.1 The assessment methodology for shipping and navigation is consistent with that presented in Annex C of the Scoping Report and Volume 1, Chapter 5 Environmental Impact Assessment Methodology where possible; however, this topic is also assessed in accordance with guidance provided by the key regulator, the MCA. The primary guidance documents used when assessing impacts are listed in **Section 2** of **Volume 5, Annex 8.1: Navigational Risk Assessment**. In order to undertake a proportional assessment, the regulator required FSA approach is built into the definition for the magnitude of impact defined in **Table 8.12.**

8.10.1.2 The MCA require that their methodology is used as a template for undertaking impact assessments (MCA, 2015). This template is based on the IMO FSA process. The FSA centres on risk management and requires that any application demonstrates that sufficient controls are, or will be, in place in order for the assessed risk (base case and future case) to be judged as broadly acceptable or tolerable.

8.10.2 Hazard Workshop

8.10.2.1 In order to gather expert opinion and local knowledge, a Hazard Workshop was undertaken during which a project and site-specific hazard log was prepared (see **Appendix A** of **Volume 5, Annex 8.1: Navigational Risk Assessment**). The draft hazard log identified hazards relating to Hornsea Four, the level of risk associated with the hazards, the controls to be put in place and the tolerability of the residual risks.

8.10.2.2 The draft hazard log will also identify any commitments required to show that the hazards associated with Hornsea Four are broadly acceptable or tolerable in line with FSA and ALARP declarations, in line with regulatory requirements. This information was then fed into the assessment of significance of effect process (see **Table 8.13**) to aid identification of impacts associated with the development and the assessment of the significance of effects arising from those impacts.

8.10.3 Impact assessment criteria

8.10.3.1 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. They also reference a consequence level in line with the FSA methodology required by the MCA.

8.10.3.2 The sensitivity of the receptor is defined by the:

- Vulnerability;
- Recoverability; and
- Value/importance of that receptor.

8.10.3.3 For the shipping and navigation assessment the following factors were also taken into consideration:

- Consultation feedback from stakeholders and regular operators;
- Outputs of the Hazard Workshop;
- Lessons learned and research from previous developments, especially impacts associated with navigation and communication, where physical modelling is not available;
- Analysis of baseline data; and
- Clear evidence of impact (i.e. deviations).

8.10.3.4 Following Section 42 Consultation results of collision and allision risk modelling (including comparison with average risk levels in the UK) will also be used to define sensitivity.

Table 8.11: Definition of terms relating to receptor sensitivity.

Sensitivity	Definition used in this Chapter
Very High	Receptor is of critical value to the local, regional or national economy and/or the receptor is highly vulnerable to impacts with regard to navigational safety that may arise from Hornsea Four and/or recoverability is long term or not possible. Major severity of consequence under FSA assessment.
High	Receptor is of high value to the local, regional or national economy and/or the receptor is generally vulnerable to impacts with regard to navigational safety that may arise from Hornsea Four and/or recoverability is slow or costly. Serious severity of consequence under FSA assessment.
Medium	Receptor is of medium value to the local, regional or national economy and/or the receptor is somewhat vulnerable to impacts with regard to navigational safety that may arise from Hornsea Four and/or has good levels of recoverability. Moderate severity of consequence under FSA assessment.
Low	Receptor is of low value to the local, regional or national economy and/or the receptor is not or generally not vulnerable to impacts with regard to navigational safety that may arise from Hornsea Four and/or has very good recoverability. Minor severity of consequence under FSA assessment.

8.10.3.5 The magnitude of an impact is defined by the:

- Spatial extent;
- Duration (long, medium or short term);
- Frequency or risk of occurrence; and
- Reversibility of the effect.

8.10.3.6 The criteria for defining magnitude in this chapter are outlined in **Table 8.12** below. They also reference a frequency level in line with the FSA methodology required by the MCA.

Table 8.12: Definition of terms relating to magnitude of an impact.

Magnitude of Impact	Definition used in this Chapter
Major	• The receptor is of international extent;

Magnitude of Impact	Definition used in this Chapter
	• The impact would be of long-term duration and continuous throughout all phases; • The impact would not be reversible throughout all phases; • The impact will be reversible post decommissioning; and • Frequent occurrence under FSA assessment.
Moderate	• The receptor is of national extent; • The impact would be of medium duration but continuous throughout a phase; • The impact would not be reversible throughout all phases; • The impact will be reversible post decommissioning; and • Reasonably probable occurrence under FSA assessment.
Minor	• The receptor is of local or national extent. • The impact would be of medium duration but continuous throughout a phase; • The impact could be reversible dependant on phase; • The impact will be reversible post decommissioning; and • Remote occurrence under FSA assessment.
Negligible	• The receptor is of local extent; • The impact would be of short duration but intermittent throughout a phase; • The impact could be reversible dependant on phase; • The impact will be reversible post decommissioning; and • Negligible or extremely unlikely occurrence under FSA assessment.

8.10.3.7 The significance of the effect upon shipping and navigation is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The significance of effect has also been aligned with FSA rankings. The method employed for this assessment is presented in **Table 8.13.** Where a range of significance of effect is presented in **Table 8.13**, the final assessment for each effect is based upon expert judgement.

8.10.3.8 For the purposes of this assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of the EIA Regulations. Under FSA regulations impacts that are broadly acceptable or tolerable with mitigation are considered to be ALARP.

Table 8.13: Matrix used for the assessment of the significance of the effect.

		Magnitude of Impact/Degree of Change			
		Negligible	**Minor**	**Moderate**	**Major**
Value, Importance, Sensitivity	**Low**	Not Significant	Not Significant or Minor (Not Significant)	Minor (Not Significant)	Minor (Not Significant) or Moderate (Significant)
	Medium	Not Significant	Minor (Not Significant)	Moderate (Significant)	Moderate (Significant) or Major (Significant)
	High	Not Significant	Minor (Not Significant) or Moderate (Significant)	Moderate (Significant) or Major (Significant)	Major (Significant) or Substantial (Significant)
	Very High	Not Significant	Moderate (Significant) or Major (Significant)	Major (Significant) or Substantial (Significant)	Substantial (Significant)

8.11 Impact assessment

8.11.1 Construction

8.11.1.1 The impacts of the offshore construction of Hornsea Four have been assessed on shipping and navigation. The environmental impacts arising from the construction of Hornsea Four are listed in Table 8.10 along with the maximum design scenario against which each construction phase impact has been assessed.

8.11.1.2 A description of the potential effect on shipping and navigation receptors caused by each identified impact is given below; these impacts will be reassessed following section 42 consultation, further discussions with stakeholders, outputs of the hazard log and completion of the MGN 543.

8.11.1.3 It is noted that the scope and assessment of impacts associated with oil and gas assets (as identified by the Hazard Workshop) will be developed post Section 42 Consultation in consultation with relevant operators and with due regard to the specific characteristics of their operations and assets.

Construction activities associated with the Hornsea Four array area, ECC and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-C-1).

8.11.1.4 Vessel traffic movements around the Hornsea Four array area, offshore export cable corridor and HVAC booster station search area have been captured through dedicated vessel traffic surveys and AIS surveys as noted in Section 8.6.2. Vessel traffic survey data assessments are considered alongside historical data (including the Anatec ShipRoutes

database) so that a detailed overview of vessel movements has been defined (see Section 8.7.2).

8.11.1.5 Deviations would be required for nine out of the 12 main routes identified within the Hornsea Four array area shipping and navigation study area in the existing baseline, with the level of deviation varying between -1.7 nm for Route 9 (i.e. a decrease in total route length) and 30.9 nm for Route 12.

8.11.1.6 For the displaced routes, the increase in distance and percentage change from the existing baseline are presented in Table 8.14. It is noted that increases in route length are based upon indicative final destinations and percentage changes are based upon the full route length. An illustration of the anticipated shift in the mean positions of the main commercial routes within the study area is presented in Figure 8.8.

Table 8.14: Summary of future baseline main route deviations within Hornsea Four array area shipping and navigation study area.

Route Number	Average Transits per Day	Increase in Route Length (nm)	Increase in Total Route Length (%)
1	2 to 3	15.3	4.7
2	2 to 3	11.1	2.9
3	2	4.4	1.2
4	2	0.4	0.2
5	1 to 2	9.9	2.6
7	1 to 2	0.1	<0.1
9	1	No increase	N/A
11	1	5.4	1.5
12	O to 1	30.9	22.6

8.11.1.7 During consultation undertaken with DFDS Seaways the potential effect on adverse weather routeing was raised. Adverse weather includes wind, wave and tidal conditions as well as reduced visibility due to fog that can hinder a vessel's standard route and/or speed of navigation. Adverse weather routes are assessed to be significant course adjustments to mitigate vessel movement in adverse weather conditions. When transiting in adverse weather conditions, a vessel is likely to encounter various types of weather and tidal phenomena, which may lead to severe roll motions, potentially causing damage to cargo, equipment and/or danger to persons on board. The sensitivity of a vessel to these phenomena will depend upon the actual stability parameters, hull geometry, vessel type, vessel size and speed.

8.11.1.8 The adverse weather routeing used by DFDS Seaways vessels which pass through the Hornsea Four array study area has been considered and is based upon the vessel traffic survey data and information provided by DFDS Seaways during consultation. The findings are provided in Table 8.15.

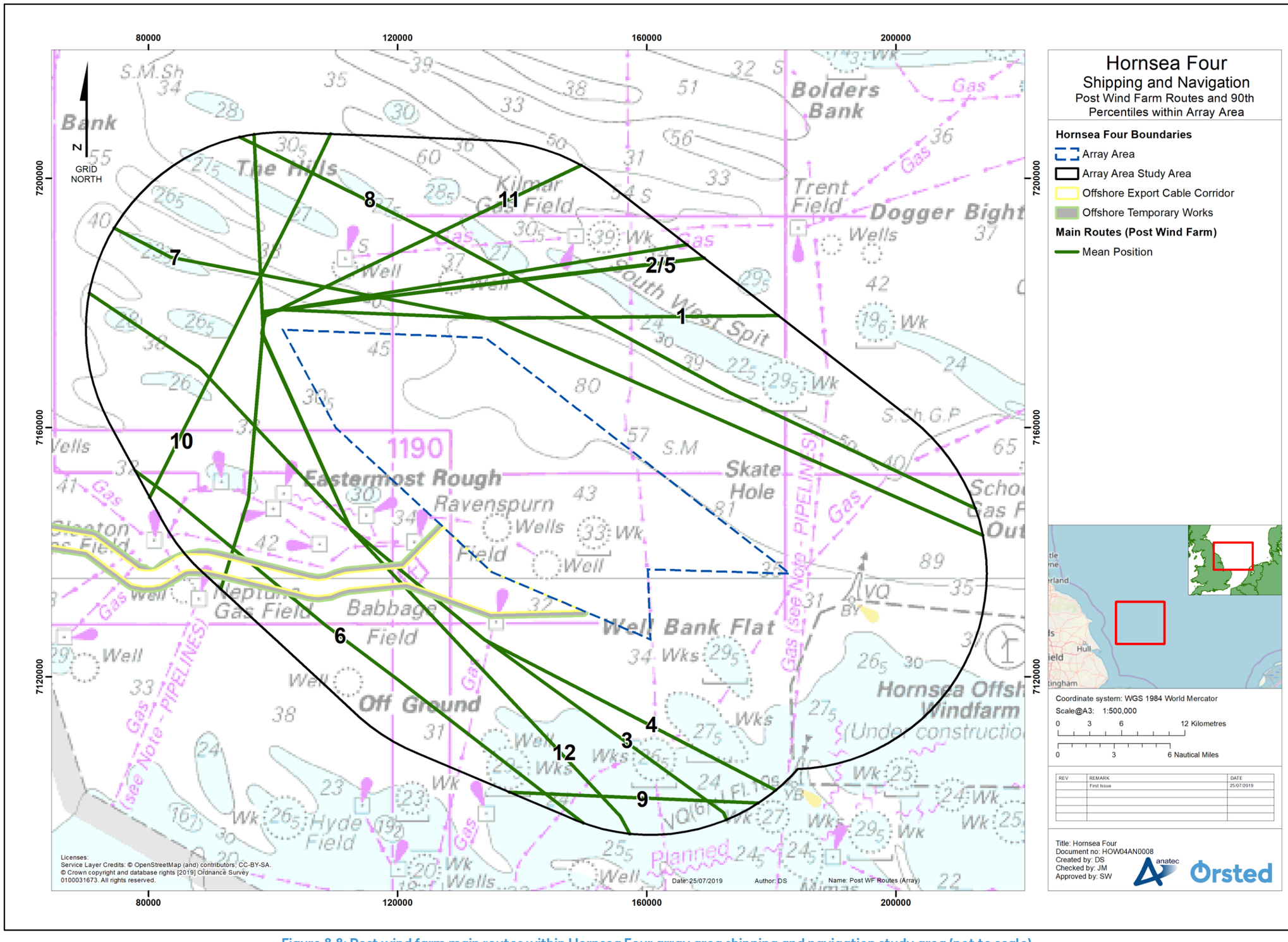

Figure 8.8: Post wind farm main routes within Hornsea Four array area shipping and navigation study area (not to scale).

Table 8.15: Summary of DFDS Seaways commercial ferry route changes in adverse weather conditions.

DFDS Seaways Commercial Ferry Route	Changes in Adverse Weather Conditions
Immingham to Esbjerg	During adverse weather this route passes south of Hornsea Project One rather than north thus increasing the passing distance from the Hornsea Four array area. Therefore this adverse weather route is not anticipated to be impacted by the presence of Hornsea Four.
Immingham to Gothenburg	During adverse weather this route avoids the Dogger Bank which is regarded as particularly susceptible to adverse weather conditions. The route has two alternatives: • North of the Dogger Bank: Passes west of Hornsea Four in a north-south direction. Given that the route no longer passes through the Hornsea Four array area, this adverse weather route is not anticipated to be impacted by the presence of Hornsea Four; and • South of the Dogger Bank: Passes south of Hornsea Four in a south west-north east direction. It is noted that the presence of Hornsea Project One is not taken into consideration by this alternative route and the route would likely pass further north, possibly intersecting the Hornsea Four array area. With the Hornsea developments in place, this route would be able to shift south of the Hornsea developments, noting that this would place it on a similar passage to the already in use adverse weather route between Immingham and Esbjerg, i.e. a route known to be considered safe for DFDS Seaways vessels operating in adverse weather. Therefore this adverse weather route is not anticipated to be impacted by the presence of Hornsea Four.
North Shields to Ijmuiden	During adverse weather this route shifts significantly towards the UK east coast thus passing a large distance clear of the Hornsea Four array area. Although the adverse weather route does pass in proximity to the Hornsea Four HVAC booster station search area it follows a similar pathway to a number of existing commercial ferry routes and is not anticipated to be impacted by the presence of the HVAC booster stations.

8.11.1.9 Deviations would be required for two out of the ten main routes identified within the Hornsea Four HVAC booster station search area shipping and navigation study area in the existing baseline, with the deviation 1.0 nm for Route 6 and 1.7 nm for Route 3.

8.11.1.10 For the displaced routes, the increase in distance and percentage change from the existing baseline are presented in **Table 8.16**. An illustration of the anticipated shift in the mean positions of the main commercial routes within the Hornsea Four HVAC booster station search area shipping and navigation study area is presented in **Figure 8.9**. It can be seen that the area with the greatest number of encounters produced is to the west of the Hornsea Four HVAC booster station search area where there is already a relatively high density of vessel traffic in the existing baseline.

Table 8.16: Summary of future baseline main route deviations within Hornsea Four HVAC booster station search area shipping and navigation study area.

Route Number	Increase in Route Length (nm)	Increase in Total Route Length (%)
3	1.7	0.5
6	1.0	0.2

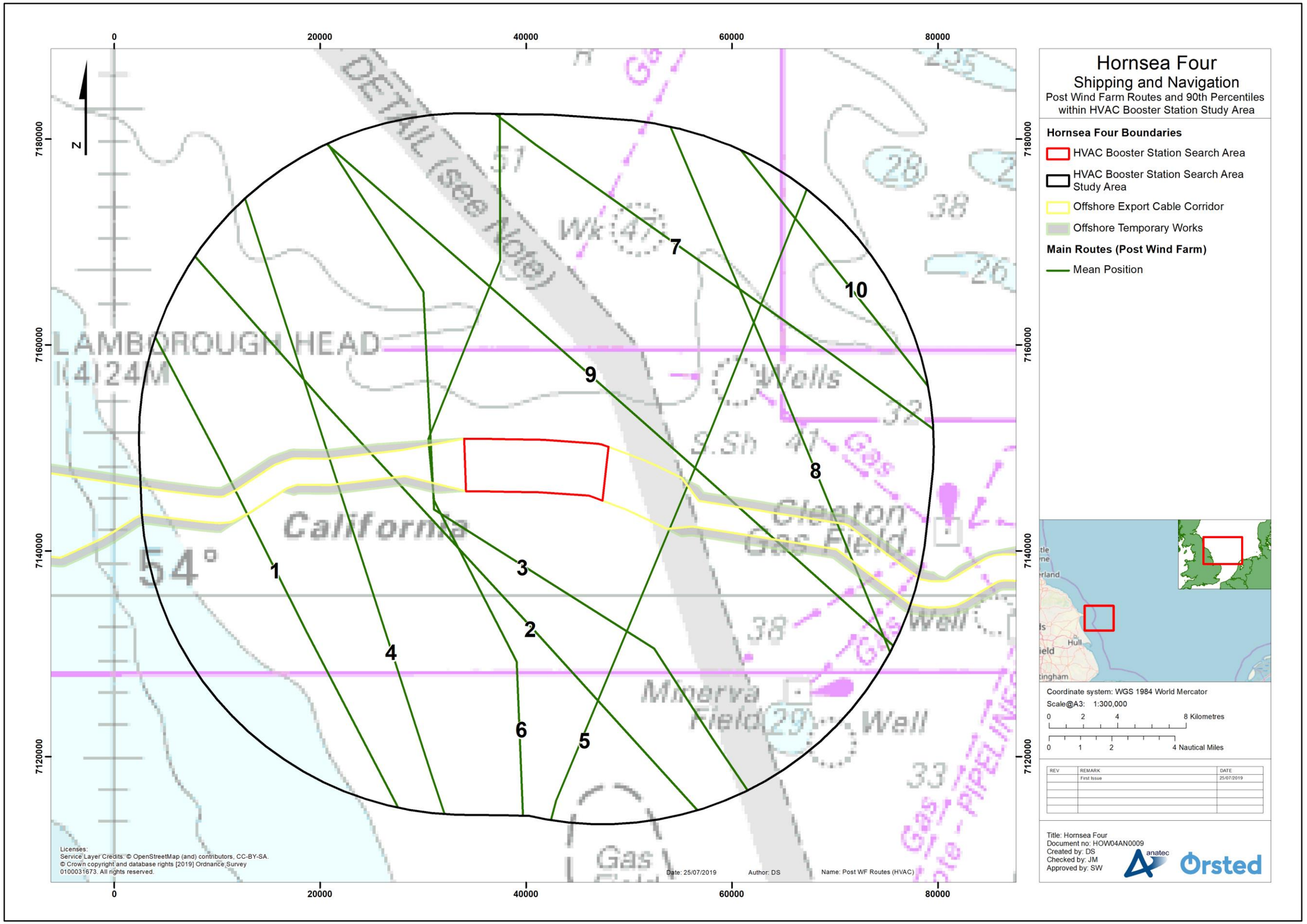

Figure 8.9: Post wind farm main routes within Hornsea Four HVAC booster station search area shipping and navigation study area (not to scale).

Magnitude of impact

8.11.1.11 Deviations for vessels routeing within the Hornsea Four array area and HVAC booster station search area would be frequent and continuous throughout the construction phase due to the buoyed constructions areas.

8.11.1.12 Impacts on adverse weather routeing are expected to be infrequent given the limited occurrence of adverse weather routeing in the area and that the majority of vessels are non-passenger[1] carrying (which are more sensitive to adverse weather and require specific routeing to mitigate impacts).

8.11.1.13 Deviations associated with the Hornsea Four offshore ECC (installation vessels) would be reasonably probable to occur but of a limited duration given that no overarching restrictions on vessel routeing would be in place other than compliance with the International Regulations for the Prevention of Collisions at Sea (COLREGS) (IMO, 1972/77).

8.11.1.14 Deviations associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area may lead to increased encounters by creating areas with denser activity levels with consequently an additional collision risk. However given the short duration of the single construction phase (three years) and based on experience of existing projects (constructing or constructed) it is anticipated that the vessels will safely adjust passage plans and deviate around the buoyed construction areas .Given the sea room available there is not expected to be any significant increase in risk when considered alongside the commitments described in **Table 8.9**.

8.11.1.15 When considering experience at other wind farms in construction it is identified that third-party vessels do consider notices to mariners during passage planning and avoid construction areas. It is likely that vessels will pass more than 1 nm off the buoyed construction area (based on experience at existing sites) to keep clear of any ongoing construction activity.

8.11.1.16 There have not been any recorded incidents within a buoyed construction area whereby a third-party vessel has collided within a construction vessel (see **Section 8.7.2**).

8.11.1.17 Considering that project vessels will be managed by the MHCC to minimise interactions with third-party vessels and the presence of existing regulations such as COLREGS (IMO, 1972/77) and guidance such as MGN 372 (MCA, 2008), there is considered to be a low increase in encounters (and overall frequency) and therefore remote occurrence of increased collision risk.

8.11.1.18 Overall this impact is predicted to be of local spatial extent given that encounters are predicted to increase in close proximity to the buoyed construction areas, short term duration given that it is related to the presence of the buoyed construction area or cable installation activities, continuous through the construction phase and reversible once the buoyed area is removed. It is predicted that the impact will affect the receptor directly. The

[1] Passenger carrying vessels are defined as those vessels that carry more than 12 non crew members.

magnitude is therefore, considered to be **minor** when considering the different variations in anticipated deviations.

Sensitivity of the receptor

8.11.1.19 When commitments adopted as part of Hornsea Four are considered against the high probability of deviations in normal conditions, the very low probability of adverse weather deviations, the varying types of vessel operating in the area and the available sea room, the most likely consequence (under FSA) for any vessel is predicted to be of low severity given that they are impacts not related to navigational safety. It is noted that there can be more severe consequences for adverse weather routeing; however no vessels were identified within the Hornsea Four array area or HVAC booster station search area as being sensitive to changes in adverse weather routeing (non-passenger carrying). It is understood that the worst-case consequences of any collision incident can be severe including damage to vessels and fatality to crew; however when considered against incident statistics (see **Section 13** of **Volume 5, Annex 8.1: Navigational Risk Assessment**) it is noted that in reality the most likely consequences are more moderate.

8.11.1.20 Vessels are generally important to the regional and national economy but, given the open sea area available in which vessels can navigate and the commitments included as part of Hornsea Four it is not expected that significant hot spots reflecting increased vessel encounters will be created even with the deviations expected, therefore mitigating the potential for collision risk.

8.11.1.21 The receptor is deemed to be somewhat vulnerable, have good recoverability after the construction phase and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

8.11.1.23 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **minor.** The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Pre-commissioned structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (SN-C-2).

8.11.1.24 Presence of pre-commissioned structures on the perimeter of, or within, the Hornsea Four array area or HVAC booster station search area may increase vessel to structure allision risk for powered and drifting vessels in an emergency situation (including machinery related problems or navigational system errors).

8.11.1.25 During the construction phase commitments included as part of Hornsea Four will be in place to ensure that allision risk is maintained within ALARP parameters. Commitments are described in **Table 8.9.**

8.11.1.26 Experience to date shows that the offshore wind farm industry's standard commitments (such as coordination of construction vessels, buoyed construction areas and safety zones, see **Table 8.9**) are tested and effective at mitigating risk to third-party vessels who typically adhere to buoyed construction areas and stay well clear of ongoing construction activity, thus reducing the potential for an allision incident. As per the maximum design scenario (see **Table 8.10**) for this impact, both the Hornsea Four array area and HVAC booster station search area will have buoyed areas around them (likely to be a combination of cardinal marks and special marks) which will help vessels to remain a safe distance from pre commissioned infrastructure. It is likely that vessels will pass more than 1 nm off the buoyed construction area based on experience at existing sites. Safety Zones will also be in place around active construction areas or pre-commissioned structures to ensure that those vessels (such as fishing vessels) that do choose to navigate through the Hornsea Four array area are aware of safe passing distances. Guard vessels will also be present to offer local advice to mariners as required.

8.11.1.27 There have been no recorded incidents, within UK waters, associated with third-party vessels (powered) alliding with a pre-commissioned offshore wind farm structure and, although there have been incidents with construction vessels manoeuvring and alliding with a structure within a construction area, experience in the industry for developers, contractors and the vessel operators has and continues to increase operational procedures adapted as lessons are learnt.

8.11.1.28 For drifting vessels Not Under Command (NUC) incident statistics (see **Section 13** of **Volume 5, Annex 8.1: Navigational Risk Assessment**) and lessons learnt from other offshore wind farms all confirm that the frequency of machinery related failures in the area is very low and therefore the probability of a vessel being NUC in the area is therefore also anticipated to be very low. This impact will therefore only be present for a limited time (the

construction period) and only during periods of adverse weather when the direction of the wind or tide could cause the vessel to drift within the array.

8.11.1.29 During the construction phase, Hornsea Four construction areas shall be monitored by the MHCC located in Grimsby via Very High Frequency (VHF) radio and AIS but also through the presence of on site construction vessels. The Hornsea Four array area is in the majority out with the Global Maritime Distress and Safety System (GMDSS) sea area A1 and the presence of the MHCC, offshore VHF aerials, AIS receivers and the presence of on site construction vessels will mean a positive impact for communication, monitoring and SAR.

8.11.1.30 Should a vessel on site require assistance, then Hornsea Four, including under Safety of Life at Sea Convention (SOLAS) (IMO, 1974) obligations, are beneficially placed to provide assets including navigational information (including weather forecasting) and safety support.

Magnitude of impact

8.11.1.31 The impact is predicted to be of local spatial extent given that it can only occur in close proximity to the pre-commissioned structures, short term duration given that it is restricted to the construction phase, continuous for the duration of construction (apart from adverse weather or drifting given that they are extremely unlikely to occur) following installation of the first pre commissioned structure and reversible given that the structures will have operational aids to navigation post commissioning and that vessels will become familiar with their presence. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor.**

Sensitivity of receptor

8.11.1.32 Under the FSA, allision risk (powered and drifting) associated with navigating externally to or internally within the array is considered to be tolerable with mitigation given the low frequency of third-party vessels (small craft such as fishing vessels and recreational vessels) likely to navigate within the Hornsea Four array area and the commitments in place to manage passing traffic. Hornsea Four construction vessels within the area will be mitigated by their own operational procedures including high standards of maintenance and regulation.

8.11.1.33 As well as allision incidents being of low frequency, how much damage a vessel sustains in the event that an allision with a structure does occur will depend upon the energy of impact, as well as the size and structural integrity of the vessel and the sea state at the time. As fishing vessels and recreational vessels are smaller and can be of non-steel construction they are likely to be most vulnerable to the impact.

8.11.1.34 Vessels are only considered sensitive to this impact when they are within the Hornsea Four array area or HVAC booster station search area. This impact represents a new risk of allision in a previously open sea area. The receptor is deemed to be of low vulnerability given the limited exposure and low potential for significant damage due to vessel size and type,

good recoverability and low value due to the highest risk of effect being on small craft/vessels. The sensitivity of the receptor is therefore, considered to be **low** (given the lower percentage of small craft predicted to be operating in the area).

Significance of effect

8.11.1.35 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Pre-commissioned cables associated with the Hornsea Four array area and offshore export cable corridor may increase anchor snagging risk for all vessels (SN-C-3).

8.11.1.36 The presence of pre-commissioned cables could create an increased snagging risk for vessels navigating within the Hornsea Four array area and offshore export cable corridor.

8.11.1.37 From the vessel traffic survey data, there were no vessels anchoring within the Hornsea Four array area during the vessel traffic surveys; therefore given that the potential for a vessel to anchor in the Hornsea Four array area is low, impacts on vessel's anchoring in proximity to the Hornsea Four array area are expected to be negligible.

8.11.1.38 From the vessel traffic survey data, five vessels were recorded anchoring within the Hornsea Four offshore export cable corridor with none in proximity to the Hornsea Four HVAC booster station search area.

8.11.1.39 For the Hornsea Four offshore export cable corridor, lessons learnt [from other offshore wind farm projects] show that anchoring has the potential to damage a subsea cable if a vessel drops its anchor on the cable or drags anchor over the cable. The damage caused depends on the penetration depth of the anchor (which itself depends on vessel size and type of anchor), the type of seabed and the cable burial depth or protection method.

8.11.1.40 "Planned" anchoring can take place for a number of reasons including adverse weather anchoring (e.g. seeking refuge in a safe haven), machinery failure (e.g. to slow drift speed/stop and/or to carry out repairs (e.g. loss of steering)) and subsea operations/survey vessels. It is noted that when the cable is being installed the probability of planned anchoring in close proximity is limited given that vessels will be aware (through notice to mariners etc.) of the operations occurring.

8.11.1.41 Anchoring in an emergency (e.g. during steering failure) will be very low frequency; however it is noted that vessels may have limited time in which to decide to release and anchor if drifting towards a hazard. Promulgation methods will provide vessels with adequate information to make a decision and guard vessels will protect particularly vulnerable sections of cable or installation operations (following risk assessment).

8.11.1.42 Any impacts associated with partially installed cables are expected to be mitigated by commitments included as part of Hornsea Four. Commitments are described in **Table 8.9**.

8.11.1.43 There are not expected to be any effects on recreational vessels or smaller commercial fishing vessels given the water depths and penetration depths of their anchors which would limit the ability for them to snag an export, inter array or interconnector cable. Guard vessels monitoring vulnerable sections or operations are also able to assist small craft under SOLAS (IMO, 1974) obligations.

Magnitude of impact

8.11.1.44 Given commitments included as part of Hornsea Four and the low frequency of anchoring within the Hornsea Four array area and offshore export cable corridor (including the near shore area) the impact is assessed to be broadly acceptable under the FSA.

8.11.1.45 The impact is predicted to be of local spatial extent given that it can only occur in very close proximity to the pre-commissioned cables, short term duration given that it is restricted to the construction phase, continuous for the duration of construction (apart from emergency anchoring which is extremely unlikely to occur) and reversible given that following installation that the cables will be adequately buried or protected during the operational phase. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

8.11.1.46 Vessels are only considered sensitive to this impact when they are in very close proximity to an export cable; inter array cable or interconnector cable. The receptor is deemed to be of low vulnerability and value given low severity of consequence with very good recoverability given the commitments in place (promulgation of information and use of guard vessels). The sensitivity of the receptor is therefore, considered to be **low.**

Significance of effect

8.11.1.47 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **negligible**. The effect will, therefore **not significant** in EIA terms (and broadly acceptable under FSA).

Construction activities associated with the Hornsea Four array area and offshore export cable corridor may restrict the emergency response capability of existing resources (SN-C-4).

8.11.1.48 The construction of Hornsea Four, including the increased presence of vessels and people within the Hornsea Four array area and offshore ECC may impact upon the ability of emergency responders to respond to incidents. The MDS for the total number of vessel movements during the construction phase is predicted to be 122 at any given time with up to 3,906 return trips for the duration of the construction phase.

8.11.1.49 From SAR helicopter taskings data (2016-2018), the frequency of SAR operations in proximity to the Hornsea Four array area is moderate and in proximity to the Hornsea Four HVAC booster station search area is low.

8.11.1.50 Under national and international law, the operators of Hornsea Four would be required to comply with existing emergency response requirements (SOLAS (IMO, 1974)) as well as give consideration to other response groups within the area (MCA). Owing to the increased level of activity relating to Hornsea Four there would be expected to be some increased demands on SAR facilities within the area; however this would likely be mitigated by the presence of new on site resources (associated with the construction activities) that will be able to respond in an emergency (either related to Hornsea Four or a third-party) under SOLAS (IMO, 1974) obligations.

8.11.1.51 Commitments included as part of Hornsea Four, which will help mitigate impact on emergency response capability, are described in **Table 8.9**.

8.11.1.52 There are not expected to be any perceptible impacts associated with the Hornsea Four offshore ECC given the low level of personnel and vessels (and generally shorter transit times) working on the installation of the cables.

Magnitude of impact

8.11.1.53 The consequences of this impact on emergency response capability could be significant but it is noted that this is considered to be an extremely unlikely occurrence given the commitments in place to provide self-help capability, i.e. project emergency response planning, the presence of support vessels to respond and adherence (where appropriate) with MGN 543 (MCA, 2016).

8.11.1.54 The impact is predicted to be of national spatial extent given the location of emergency response resources, short term duration given that it is restricted to the construction phase, intermittent for the duration of construction given the low frequency of occurrence and reversible after the construction activities have ceased. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

8.11.1.55 Due to the increased level of personnel and vessels on site during the construction phase there would be a small increase in the frequency of an incident occurring, thus diminishing the overall ability of the current level of emergency response provision, including pollution response. However, this sensitivity is mitigated by the presence of on site resources providing additional emergency response resources (including self-help capability) not previously present in the area.

8.11.1.56 Vessels are only considered sensitive to this impact when an emergency response event occurs. The receptor is therefore deemed to be of low vulnerability but high value given the severity of consequence with good recoverability due to the reduced level of personnel and vessels on site during the construction phase. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

8.11.1.57 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. The effect will, therefore, be of **minor adverse** significance, which is **not significant** in EIA terms (and broadly acceptable under FSA).

Future monitoring

8.11.1.58 The following monitoring requirements have been identified for the construction phase in relation to shipping and navigation:

- As per Co98 in Table 8.9 the DCO and DML will require monitoring of vessel traffic for the duration of the construction period.

8.11.2 Operation and Maintenance

8.11.2.1 The impacts of the offshore operation and maintenance of Hornsea Four have been assessed on shipping and navigation and are listed in Table 8.10 along with the maximum design scenario against which each impact has been assessed.

Presence of structures within the Hornsea Four array area, offshore export cable corridor and HVAC booster station search area and activities associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore increased vessel to vessel collision risk for all vessels in all weather conditions (SN-O-5).

8.11.2.2 Further assessment including details of vessel to vessel encounters and vessel to vessel collision modelling will be undertaken following Section 42 Consultation as part of the draft NRA and ES submissions.

Deviations for Regular Operators

8.11.2.3 DFDS Seaways is the predominant Regular Operator within the Hornsea Four array area, operating three main routes. Deviations would be required for each of these routes, with the increase in distance and percentage change from the existing baseline presented in **Table 8.17**.

Table 8.17: Summary of future baseline main route deviations for DFDS Seaways operated routes within Hornsea Four array area shipping and navigation study area.

Route Number (Destinations)	Increase in Route Length (nm)	Increase in Total Route Length (%)
1 (Immingham to Esbjerg)	15.3	4.7
2 (Immingham to Gothenburg)	11.1	2.9
4 (North Shields to Ijmuiden)	0.4	0.2

Encounters and collision risk between third-party vessels

8.11.2.4 Deviations would be required for nine out of the 12 main routes identified within the study area in the existing baseline, with the level of deviation varying between no increase for Route 9 and 30.9 nm for Route 12.

8.11.2.5 For the displaced routes, the increase in distance, both in terms of distance and percentage change, are presented in **Table 8.14**. An illustration of the anticipated shift in the mean positions of the main commercial routes within the Hornsea Four array area shipping and navigation study area is presented in **Figure 8.8**.

8.11.2.6 Commitments included as part of Hornsea Four will mitigate increased traffic levels and encounters between third-party vessels. Although collision risk modelling will not be undertaken until after Section 42 Consultation, levels of traffic and open sea room within the area indicate that encounters will not increase significantly during the operation and maintenance phase. This qualification is also supported by [evidence] that to date there have been no recorded collision incidents between third-party vessels attributed to the operation of an offshore wind farm.

8.11.2.7 As with the construction phase, adverse weather is expected to be infrequent, with no notable adverse weather routes (those associated with passenger carrying vessels) impacted by the development.

Encounters and collision risk associated with third-party vessels exiting the Hornsea Four array area

8.11.2.8 During consultation DFDS Seaways and oil and gas operators noted that their vessels would not transit through the array. There remains a possibility that recreational vessels and fishing vessels may do so; however, given that only on average one unique recreational vessel every two days and three unique fishing vessels per day passed within the Hornsea Four

array area shipping and navigation study area, the likelihood of a small craft exiting the Hornsea Four array area in a scenario which would create a collision risk is low.

8.11.2.9 MGN 543 (MCA, 2016) identifies the potential for visual navigation to be impaired by the location of offshore wind farm structures by decreasing vessels' ability to sight each other, i.e. when obscured behind structures. However given the levels of expected vessel traffic and the spacing of structures (810 m) this effect is expected to be infrequent. It is noted that during any instance of restricted visibility COLREGS (IMO, 1972/77) applies and will mitigate this impact by regulating all vessels to operate at a safe speed and use sound signals (when required) to notify others of their presence.

8.11.2.10 Due to the low levels of small craft likely to be operating within the array or in proximity to the main commercial vessel routes, the frequency of encounters and thus collision risk involving displaced third-party vessels passing or exiting the Hornsea Four array area is likely to be very low.

8.11.2.11 Given the distance offshore, the level of small craft activity is anticipated to be very low in adverse weather conditions. In particular, the winter vessel traffic survey (which included visual and Radar data) returned only one recreational vessel track and on average less than one unique fishing vessel per day within the Hornsea Four shipping and navigation study area.

Visual interference (navigational aids and/or landmarks)

8.11.2.12 Due to the distance offshore of Hornsea Four it is predicted there will be no impacts on existing aids to navigation and/or landmarks. Indeed, it is likely to become a key navigational aid in an area previously devoid of lights and marks to assist passing vessels. This could be of particular benefit to the small number of recreational craft who frequent the area and may lack advanced navigational technology due to cost and available bridge space.

Encounters and collision risk associated with operations and maintenance vessels

8.11.2.13 It is anticipated that up to 3,525 return trips per year by operation and maintenance vessels will be made between the Hornsea Four array area or HVAC booster stations and base ports during the operation and maintenance of Hornsea Four.

8.11.2.14 As with the construction phase, vessel to vessel encounters between operation and maintenance vessels and third-party vessels are expected to be of a low frequency given the commitments described in **Table 8.9**.

8.11.2.15 Impacts relating to operation and maintenance vessel visits to the Hornsea Four offshore export corridor are expected to be negligible over the operational life of Hornsea Four and therefore no significant impacts are expected.

Hornsea Four HVAC booster stations

8.11.2.16 It is assumed that there is no maximum spacing required by the regulators given that each HVAC booster station, as with oil and gas surface platforms, can be marked as an isolated structure. Given the limited number of HVAC booster stations (three) possible within the Hornsea Four HVAC booster station search area, deviations are not expected to be significant when considering worst-case as shown in **Table 8.18**. In reality, vessels would be able to navigate much closer to the final locations with relatively small footprints.

8.11.2.17 **Table 8.18** presents the increase in route length associated with main route deviations around the Hornsea Four HVAC booster station search area.

Table 8.18: Summary of future baseline main route deviations within Hornsea Four HVAC booster station search area.

Route Number	Increase in Route Length (nm)	Increase in Total Route Length (%)
3	1.7	0.5
6	1.0	0.2

8.11.2.18 An illustration of the anticipated shift in the mean positions of the main commercial routes within the Hornsea Four HVAC booster station shipping and navigation study area is presented in **Figure 8.9.** It can be seen that the area of highest potential for increased encounters produced is west of the Hornsea Four HVAC booster station search area.

8.11.2.19 Further modelling and location refinement will be undertaken following Section 42 Consultation as part of the draft NRA and ES submission.

8.11.2.20 Consultation responses from regular operators, recreational users and commercial fishing stakeholders did not identify any concern associated with collision with operations and maintenance vessels for vessels operating in or near the Hornsea Four array area.

Magnitude of impact

8.11.2.21 The impact is predicted to be of regional spatial extent given the routes of the commercial vessels within the southern North Sea, medium term duration given that it is in relation to the operation and maintenance phase, intermittent (noting that collision risk modelling is yet to be undertaken) and not reversible due to the permanent presence of the structures during the 35-year operational life. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **moderate.**

Sensitivity of the receptor

8.11.2.22 When commitments included as part of Hornsea Four are considered against the high probability of deviations in normal conditions, the very low probability of adverse weather deviations, the varying types of vessels operating in the area and the available sea room, the most likely consequence (under FSA) for most vessels is predicted to be of low severity

given that they are impacts not related to navigational safety. As with the construction phase, it is noted that there can be more severe consequences for adverse weather routeing; however no vessels were identified within the Hornsea Four array area or HVAC booster station search area as being sensitive to changes in adverse weather routeing (non-passenger carrying). It is understood that the worst-case consequences of any collision incident can be severe resulting in damage to vessels and fatality to crew; however when considered against incident statistics (see **Section 13** of **Volume 5, Annex 8.1: Navigational Risk Assessment**) it is noted that in reality most likely consequences are more moderate.

8.11.2.23 Vessels are generally important to the regional and national economy but, given the open sea area available in which vessels can navigate and the commitments included as part of Hornsea Four it is not expected that significant hot spots reflecting increased vessel encounters will be created even with the deviations expected, therefore mitigating the potential for collision risk.

8.11.2.24 The receptor is deemed to be of somewhat vulnerable, have good recoverability once vessels are familiar with the new routes and high value. However given the impact on high value regular routes which could have commercial consequences for the operators the sensitivity of the receptor is considered to be **medium** until further consultation can be undertaken as part of the Section 42 Consultation process.

Significance of the effect

8.11.2.25 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **moderate**. The effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms (and tolerable with mitigation under FSA).

Further mitigation

8.11.2.26 Further consultation will be required to mitigate impacts for Regular Operators noting that the impacts are commercial in nature and **Volume 5, Annex 8.1: Navigational Risk Assessment** demonstrates that the vessels still have safe operational routes. Following this further consultation the impact is anticipated to be of **minor adverse** significance.

Operational structures within the Hornsea Four array area and HVAC booster station search area may create powered and drifting allision risk for all vessels (SN-O-6).

8.11.2.27 Allision risk modelling (powered and drifting) will be undertaken following the Section 42 Consultation.

8.11.2.28 Commitments included as part of Hornsea Four will reduce the allision risk to vessels passing externally to the array so that it is an extremely unlikely occurrence. These commitments are described in **Table 8.9**.

8.11.2.29 It is noted that Hornsea Four will potentially be the fourth offshore wind farm within the former Hornsea Zone to be consented (noting Hornsea Three is currently within its determination phase); when considering this along with the other constructing and operational wind farms within the UK Renewable Energy Zone (REZ) it is noted that vessels are familiar with navigation in proximity to WTGs.

8.11.2.30 To date there has only been one incident of a third-party vessel alliding with an operational WTG. In this case a crew member on a fishing vessel left the autopilot on, resulting in an allision incident which was attended by an RNLI lifeboat.

Offshore transformer substations, offshore HVDC converter substations and accommodation platform

8.11.2.31 Indicative locations for offshore transformer substations, offshore HVDC converter substations and the accommodation platform are provided in the array layout (see **Figure 9.2** in **Volume 5, Annex 8.1: Navigational Risk Assessment**), although specific worst-case locations for this infrastructure will not be defined until after the Section 42 Consultation. Although these structures may not be placed on the extreme periphery of the Hornsea Four array (and therefore in proximity to passing traffic routes) they do present an increased allision risk for vessels due to the size of the structure and potential consequences due to the resistant force of the structure compared to the energy of the impact. This will be taken into consideration as part of the final layout design, however if they are placed on the periphery it is not anticipated that they will increase allision return periods to intolerable severity levels and can be mitigated with effective lighting and marking (marking and lighting in accordance with standard industry guidance and regulatory requirements).

Allision risk associated with drifting vessels

8.11.2.32 Presence of infrastructure within the Hornsea Four array area or HVAC booster station search area may increase the vessel to structure allision risk external to the array for NUC vessels in an emergency situation (including machinery related problems or navigational system errors). Modelling will be undertaken post Section 42 Consultation; however given incident statistics (see **Section 13** of **Volume 5, Annex 8.1: Navigational Risk Assessment**) and lessons learnt from other offshore wind farms, the frequency of occurrence is considered to be very low.

8.11.2.33 As with the construction phase should a vessel within the Hornsea Four array area or the HVAC booster station search area require assistance, then Hornsea Four assets, including under SOLAS obligations, are beneficially placed to provide assistance including navigational information (including weather forecasting) and safety support. This support would be particularly beneficial to small craft that may choose to navigate through the array.

8.11.2.34 As vessels NUC are considered to be at drift, they are typically travelling at low speeds which will reduce the consequence of an encounter with a WTG or associated infrastructure. A large NUC vessel is less sensitive to a collision with infrastructure than a smaller vessel due

to the relative structural strength of the vessel compared with the structure. How much damage a vessel sustains upon allision with a structure will depend upon the energy of impact, including the size and structural integrity of the vessel and the sea state at the time.

8.11.2.35 It is noted that in order to prevent an allision vessels may use anchors or bow thrusters to prevent drifting towards a structure.

Allision risk for vessels navigating internally within the array

8.11.2.36 The presence of infrastructure within the Hornsea Four array area may also cause increased vessel to structure allision risk internally within the array, most notably for recreational vessels and fishing vessels who are expected to be the predominate users. The level of small craft within the area is very low and not expected to increase significantly in a future case scenario.

8.11.2.37 Based on consultation feedback it is not considered likely that larger commercial vessel will navigate within the array.

8.11.2.38 MCA guidance (MGN 543 (MCA, 2016)) states that a UK developer can seek to demonstrate that fewer than two lines of orientation in the array layout are acceptable. As per Commitment Co96 layout Principles will be agreed with the key regulators (MCA and TH) to ensure that the final layout is within parameters considered safe for surface navigation (see **Volume 4, Annex 4.7: Layout Principles**). Experience shows that vessels do not navigate within rows when transiting internally and will often take the shortest route. As with any passage this will depend upon the prevailing conditions and vessels are expected to passage plan accordingly in line with Chapter V of SOLAS (IMO, 1974).

HVAC booster stations

8.11.2.39 Presence of HVAC booster stations with the Hornsea Four HVAC booster station search area may increase vessel to structure allision risk for all vessels.

8.11.2.40 As with vessel to vessel collision risk, vessel to structure allision risk associated with the HVAC booster stations would be acceptable assuming they are located away from key navigational routes – locations will be identified post Section 42 Consultation and modelled as part of the final submission.

8.11.2.41 Based on the vessel routeing identified for the anticipated change in routeing due to the HVAC booster stations, and assumptions that the commitments are in place, the frequency of an errant vessel under power deviating from its route to the extent that it comes into proximity with a Hornsea Four HVAC booster station is not considered to be a probable occurrence.

8.11.2.42 Fishing and recreational users had no concerns in relation to the HVAC booster stations.

Magnitude of impact

8.11.2.43 The impact is predicted to be of local spatial extent given that it can only occur in proximity to structures, medium term duration given that it is in relation to the operation and maintenance phase, intermittent (noting that allision risk modelling is yet to be undertaken) and not reversible due to the permanent presence of the structures during the 35-year operational life. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor.**

Sensitivity of receptor

8.11.2.44 The worst-case consequences could give a very high severity; however when considered against the commitments included as part of the Hornsea the most likely consequences are medium, should an allision occur.

8.11.2.45 Vessels are only considered sensitive to this impact when they are in proximity to the edge of the Hornsea Four array, navigating within the Hornsea Four array or in close proximity to the HVAC booster stations; however it is a new risk of allision in a previously open sea area. The receptor is deemed to be of low vulnerability given the limited potential for significant damage, have a good level of recoverability as vessels will become familiar with the development and be of high value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of effect

8.11.2.46 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **minor**. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms (and broadly acceptable under FSA), noting that Hornsea Four commits to agreeing Layout Principles with MCA (Co96), which will include maintaining at least one line of symmetry/orientation in the array layout.

Operational cables within the Hornsea Four array area and offshore export cable corridor may increase anchor snagging risk for all vessels and cable protection used may reduce navigable water depths for all vessels (SN-O-7).

8.11.2.47 Anchoring activity within the Hornsea Four array area shipping and navigation study area was minimal in the vessel traffic surveys, with only one vessel deemed to be at anchor, this being an offshore supply vessel operating at a nearby gas platform.

8.11.2.48 There were five cases of anchoring activity identified within the Hornsea Four offshore ECC study area, with two of these cases occurring within the offshore ECC itself. All five cases involved a tanker anchoring off the east Yorkshire coast in water depths between 20 m and 22 m.

8.11.2.49 Given that any cable (export, inter array and interconnector) will be buried and/or protected as well as charted there are not anticipated to be any perceptible effects on vessels during the operation and maintenance phase.

8.11.2.50 Commitments included are described in **Table 8.9**.

8.11.2.51 As with the construction phase, lessons learnt show that anchoring has the potential to damage a subsea cable if a vessel drops its anchor on the cable or drags anchor over the cable. Anchoring in an emergency will be very low frequency; however it is noted that vessels may have limited time in which to decide to release and anchor if drifting towards a surface or shore line hazard. Therefore the Cable specification, installation and monitoring plan will also set out burial depths or protection methods used to mitigate any risk with unexpected anchor releases. It is noted that consequences for anchor snagging are most likely minor.

Under keel clearance

8.11.2.52 Guidance noted within MGN 543 (See commitment Co81) states that where protection is used it should not change the chartered water depth by more than 5%; RYA guidance (RYA, 2015) states that clearance distances of over 4 m are not a concern. Should either of these parameters not be achieved further assessment and consultation may be required as part of the post consent process. Consequences for under keel allision can be significant but Hornsea Four is committed to compliance with relevant guidance as part of the Cable specification, installation and monitoring plan.

Magnitude of impact

8.11.2.53 Given commitments made by Hornsea Four (including commitment to burying cables) the observed low frequency of anchoring within the Hornsea Four array area, offshore ECC and the near shore area, the impact is assessed to be extremely unlikely to occur.

8.11.2.54 The impact is predicted to be of local spatial extent given that it can only occur in very close proximity to the cables, medium term duration given that it is in relation to the operation and maintenance phase, intermittent and reversible for the duration of the operation given that following installation the cables will be adequately buried or protected. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible.**

Sensitivity of receptor

8.11.2.55 Vessels are only considered sensitive to this impact when they are within very close proximity to an export cable; inter array cable or interconnector cable. The receptor is deemed to be of low vulnerability and value given negligible severity of consequence with very good recoverability given the operational burial and protection method proposed. The sensitivity of the receptor is therefore, considered to be **low.**

Significance of effect

8.11.2.56 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **negligible**. The effect will, therefore be **not significant** in EIA terms (and broadly acceptable under FSA).

Operation and maintenance activities associated with the Hornsea Four array area and offshore export cable corridor may restrict the emergency response capability of existing resources (SN-O-8).

8.11.2.57 Given that vessel, aircraft and personnel numbers will be significantly reduced during the operation and maintenance phase (compared to the construction phase) there are not anticipated to be any significant impacts on emergency response resources during the operation and maintenance phase given that all offshore operations will have their own self-help capability as part of their emergency response plans.

8.11.2.58 It is of note that Hornsea Four on site facilities will have beneficial impacts on emergency response provision for all users.

8.11.2.59 Commitments included as part of Hornsea Four which include consideration of air and surface craft and their access to the array using a guaranteed single line of orientation. Commitments are described in Table 8.9.

8.11.2.60 An average of four to five SAR helicopter taskings per year were undertaken for incidents within the Hornsea Four array area shipping and navigation study area; this is considered a moderate frequency although the majority of incidents occurred land side of the Hornsea Four array area and none occurred within the Hornsea Four array area itself. The frequency of SAR helicopter taskings is not expected to change markedly given the self-help capabilities and emergency response which will be provided by Hornsea Four.

Magnitude of Impact

8.11.2.61 The consequences of impact on emergency response capability could be significant but it is noted that this is considered to be an extremely unlikely occurrence given the limited number of vessels and personnel on site during the operation and maintenance phase and commitments in place to provide self-help capability, i.e. project emergency response planning and presence of support vessels to respond.

8.11.2.62 The impact is predicted to be of national spatial extent given the location of emergency response resources, medium term duration given that it is in relation to the operation and maintenance phase, intermittent given the low frequency of occurrence and not reversible due to the permanent presence of the structures during the 35-year operational life. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible.**

Sensitivity of receptor

8.11.2.63 Due to the limited number of personnel and vessels on site during the operation and maintenance phase there would be a small increased risk of an incident occurring, thus diminishing the overall ability of the current level of emergency response facilities, including pollution response. However, it is noted that there is a relatively low frequency of occurrence demonstrated by the incident and SAR statistics (see **Section 13** of **Volume 5, Annex 8.1: Navigational Risk Assessment**) and the presence of on-site resources will increase the mitigation by providing its own self-help capability as well as adding to the risk.

8.11.2.64 Vessels are only considered sensitive to this impact when an emergency response event occurs. The receptor is therefore deemed to be of low vulnerability but high value given the severity of consequence with good recoverability due to the reduced level of personnel and vessels on site during the operation and maintenance phase. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

8.11.2.65 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **negligible**. The effect will, therefore not significant in EIA terms (and broadly acceptable under FSA).

Operational structures within the Hornsea Four array area and offshore export cable corridor may impact a vessel's use of its Radar, communications and navigation equipment during navigational transits (SN-O-9).

8.11.2.66 **Volume 5, Annex 8.1: Navigational Risk Assessment** includes a technical assessment of effects associated with the impact on communication and position fixing equipment associated with the operation of the Hornsea Four array area, offshore export cable corridor and HVAC booster station search area. The results are summarised in **Table 8.19**.

Table 8.19: Summary of significance and magnitude by type of communication or navigation equipment.

Topic		Sensitivity	Magnitude
Type	Specific		
Communication	VHF	Low	Negligible
Communication	VHF direction finding	Low	Negligible
Communication	AIS	Low	Negligible
Communication	Navigational Telex (NAVTEX)	Low	Negligible
Communication	Global Positioning System (GPS)	Low	Negligible

Topic		Sensitivity	Magnitude
Type	Specific		
Electromagnetic Field (EMF)	Cables	Low	Negligible
EMF	WTGs	Negligible	Negligible
Marine Radar	Use of marine Radar	Medium – vessels have sufficient sea room to distance themselves from the Hornsea Four array area, in line with the shipping template (MCA, 2016) and experience shows that careful adjustment of controls/compliance with COLREGS (IMO, 1972/77) mitigates any impacts for those navigating in close proximity or internally within the array.	Negligible
Noise	WTG generated noise	Low	Negligible
Noise	Sound Navigation Ranging (SONAR)	Low	Negligible

8.11.2.67 Given the experience gained from offshore wind farms being constructed in close proximity to shipping activity all effects are considered to be ALARP and no further commitments are required.

Significance of effect

8.11.2.68 Overall, it is predicted that the sensitivity of the receptor to effects on communication and positioning fixing equipment is considered to be **low** and the magnitude is deemed to be **negligible**. The effect will, therefore be **not significant** in EIA terms (and broadly acceptable under FSA).

8.11.3 Decommissioning

Decommissioning activities associated with the Hornsea Four array area and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-D-10).

8.11.3.1 Export cables within the offshore ECC are assumed to remain in situ and therefore there will not be any associated decommissioning activities. Consequently there is no increase in encounters or collision risk associated with the export cables.

8.11.3.2 Vessel traffic movements around the Hornsea Four array area and HVAC booster station search area during the decommissioning phase are expected to reflect the construction phase scenario provided in **Section 8.11.1**.

Magnitude of impact

8.11.3.3 Deviations for vessels routeing within the Hornsea Four array area and HVAC booster station search area would be frequent and continuous throughout the decommissioning phase due to the buoyed decommissioning areas.

8.11.3.4 As with the construction phase, impacts on adverse weather routeing are expected to be infrequent given the limited occurrence of adverse weather routeing in the area and that the majority of vessels are non-passenger carrying (which are more sensitive to adverse weather and require specific routeing to mitigate impacts).

8.11.3.5 Deviations associated with the Hornsea Four array area and HVAC booster station search area may lead to increased encounters by creating areas of denser activity levels with consequently an additional collision risk. However given the likely short duration of the decommissioning phase (three years) and the sea room available there is not expected to be any significant increase in risk when considered alongside the Hornsea Four commitments described in **Table 8.9**.

8.11.3.6 Commitments included as part of Hornsea Four are in place to manage increased traffic levels and encounters (and therefore collision risk) between decommissioning and third-party vessels (see **Table 8.9**).

8.11.3.7 When considering experience at other wind farms it is identified that third-party vessels do consider notices to mariners during passage planning and avoid current constructing areas, which are likely to be similar in nature to decommissioning areas. It is likely that vessels will pass more than the 1 nm off the buoyed decommissioning area (based on experience at existing sites) to keep clear of any ongoing decommissioning activity.

8.11.3.8 Considering that project vessels will be managed by the MHCC to minimise interactions with third-party vessels and the presence of existing regulations such as COLREGS (IMO, 1972/77) and guidance such as MGN 372 (MCA, 2008), there is considered to be a low increase in encounters (and overall frequency) and therefore remote occurrence of increased collision risk.

8.11.3.9 Overall this impact is predicted to be of local spatial extent given that encounters are predicted to increase within close proximity to the buoyed decommissioning areas, short term duration given that it is related to the presence of the buoyed decommissioning area, continuous through the decommissioning phase and reversible given all structures will be removed. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

8.11.3.10 When commitments adopted as part of Hornsea Four are considered against the high probability of deviations in normal conditions, the very low probability of adverse weather deviations, the varying types of vessels operating in the area and the available sea room the most likely consequence (under FSA) for any vessel is predicted to be of low severity given that they are impacts not related to navigational safety. It is noted that there can be more severe consequences for adverse weather routeing however no vessels were identified within the Hornsea Four array area or HVAC booster station search area as being sensitive to changes in adverse weather routeing (non-passenger carrying).It is understood that the worst-case consequences of any collision incident can be severe including damage to vessels and fatality to crew; however when considered against incident statistics (see **Section 13** of **Volume 5, Annex 8.1: Navigational Risk Assessment**) it is noted that in reality the most likely consequences are more moderate.

8.11.3.11 Vessels are generally important to the regional and national economy but, given the open sea area available in which vessels can navigate and the commitments included as part of Hornsea Four it is not expected that significant hot spots reflecting increased vessel encounters will be created even with the deviations expected, therefore mitigating the potential for collision risk.

8.11.3.12 The receptor is deemed to be somewhat vulnerable, have good recoverability after the decommissioning phase and high value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of the effect

8.11.3.13 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **minor.** The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Decommissioning structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (SN-D-11).

8.11.3.14 During the decommissioning phase commitments included as part of Hornsea Four will be in place to ensure that allision risk is maintained within ALARP parameters. Commitments are described in **Table 8.9.**

8.11.3.15 Experience to date shows that vessels typically adhere to buoyed construction areas and generally keeping well clear of ongoing construction activity, thus reducing the potential for an allision incident. Buoyed decommissioning areas are expected to be treated by vessels similarly to buoyed construction areas. As per the maximum design scenario (see **Table 8.10**) for this impact, both the Hornsea Four array area and HVAC booster station search area will have buoyed areas around them (likely to be a combination of cardinal marks and special marks) which will help to ensure that vessels remain a safe distance from decommissioning infrastructure, it is likely that vessels will pass more than the 1 nm off the buoyed

decommissioning area based on experience at existing sites. Safety Zones will also be in place around active decommissioning areas or decommissioning structures to ensure that those vessels (such as fishing vessels) that do decide to navigate through the Hornsea Four array area are aware of safe passing distances. Guard vessels will also be present to offer local advice to mariners as required.

8.11.3.16 For drifting vessels NUC incident statistics (see **Section 13** of **Volume 5, Annex 8.1: Navigational Risk Assessment**) and lessons learnt from other offshore wind farms all confirm that the frequency of machinery related failures in the area is very low and therefore the probability of a vessel being NUC in the area is therefore also anticipated to be very low. This impact will therefore only be present for a limited time (the decommissioning period) and only during periods of adverse weather when the direction of the wind or tide could cause the vessel to drift within the array.

8.11.3.17 During the decommissioning phase, Hornsea Four decommissioning areas shall be monitored by the MHCC located in Grimsby via VHF radio and AIS but also through the presence of on site decommissioning vessels. As with the construction phase the presence of on site decommissioning vessels will mean a positive impact for communication, monitoring and SAR.

8.11.3.18 Should a vessel on site require assistance, then Hornsea Four, including under SOLAS obligations, are beneficially placed to provide assets including navigational information (including weather forecasting) and safety support.

Magnitude of impact

8.11.3.19 The impact is predicted to be of local spatial extent (given that it can only occur in close proximity to the decommissioning structures, short term duration given that it is restricted to the decommissioning phase, continuous for the duration of decommissioning (apart from adverse weather or drifting given that they are extremely unlikely to occur) and reversible given that all structures will be removed. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

8.11.3.20 Under the FSA, allision risk (powered and drifting) associated with navigating externally to or internally within the array is considered to be tolerable with mitigation given the low frequency of third-party vessels (small craft such as fishing vessels and recreational vessels) likely to navigate within the Hornsea Four array area and the commitments in place to manage passing traffic. Hornsea Four decommissioning vessels within the area will be mitigated by their own operational procedures including high standards of maintenance and regulation.

8.11.3.21 As well as allision incidents being low frequency how much damage a vessel actually sustains in the event that an allision with a structure does occur will depend upon the energy of impact, as well as the size and structural integrity of the vessel and the sea state at the

time. As fishing vessels and recreational vessels are smaller and can be of non-steel construction they are likely to be vulnerable to the impact.

8.11.3.22 Vessels are only considered sensitive to this impact when they are within the Hornsea Four array area or HVAC booster station search area. This impact does not represent a new risk of allision given vessels will be familiar with navigation around the operational array. The receptor is deemed to be of low vulnerability given limited exposure and low potential for significant damage due to vessel size and type, good recoverability and low value due to highest risk of effect being on small craft/vessels. The sensitivity of the receptor is therefore, considered to be **low** (given the lower percentage of small craft predicted to be operating in the area).

Significance of effect

8.11.3.23 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Decommissioned cables left in situ within the Hornsea Four array area and offshore export cable corridor may increase anchor snagging risk for all vessels (SN-D-12).

8.11.3.24 Vessel anchoring activity is considered within **Section 8.7.2**.

8.11.3.25 As part of the decommissioning phase cables will be subject to a risk assessment and monitoring procedures. By this phase of the development, vessels will be familiar with the locations of the charted cable.

8.11.3.26 Anchoring in an emergency (e.g. during steering failure) will be very low frequency; however it is noted that vessels may have limited time in which to decide to release and anchor if drifting towards a hazard.

8.11.3.27 Any impacts associated with the in situ decommissioned cables are expected to be mitigated by commitments included as part of Hornsea Four. Commitments are described in **Table 8.9**.

8.11.3.28 There are not expected to be any effects on recreational vessels or smaller commercial fishing vessels given the water depths and penetration depths of their anchors which would limit the ability for them to snag an export, inter array or interconnector cable. Guard vessels monitoring vulnerable sections or operations are also able to assist small craft under SOLAS (IMO, 1974) obligations.

Magnitude of impact

8.11.3.29 Given commitments included as part of Hornsea Four and the low frequency of anchoring within the Hornsea Four array area and offshore export cable corridor (including the near shore area) the impact is assessed to be broadly acceptable under the FSA.

8.11.3.30 The impact is predicted to be of local spatial extent given that it can only occur in very close proximity to the in situ decommissioned cables, long term duration given that it relates to post decommissioning, continuous and not reversible. It is predicted that the impact will affect the receptor directly. When considered against the extremely unlikely occurrence the magnitude is therefore, considered to be **moderate**.

Sensitivity of receptor

8.11.3.31 Vessels are only considered sensitive to this impact when they are in very close proximity to an export cable; inter array cables or interconnector cable. The receptor is deemed to be of low vulnerability and value (given the cables are decommissioned) with very good recoverability given the commitment in place (promulgation of information and use of guard vessels during the decommissioning phase). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

8.11.3.32 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **moderate**. The effect will, therefore, be of **minor adverse significance**, which is not significant in EIA terms (and broadly acceptable under FSA).

Decommissioning activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources SN-D-13).

8.11.3.33 Given that the decommissioning phase will occur after three years of construction and 35 years of operational life of the Hornsea Four array area and offshore ECC even with the increase in activity there are not expected to be any perceptible effects on the emergency response capability of existing resources.

8.11.3.34 Commitments included as part of Hornsea Four, which will help mitigate impact on emergency response capability, are described in **Table 8.9.**

Magnitude of impact

8.11.3.35 The consequences of this impact on emergency response capability are not expected to be significant given the experience of operating in the area by the time of the decommissioning phase and the continued commitments in place to provide self-help capability, i.e. project emergency response planning, the presence of support vessels to respond and adherence (where appropriate) with MGN 543 (MCA, 2016).

8.11.3.36 The impact is predicted to be of local spatial extent given the familiarity with Hornsea Four resources, short term duration given that it is restricted to the decommissioning phase, intermittent throughout the phase given the low frequency of occurrence and reversible after the decommissioning activities have ceased. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

8.11.3.37 Due to the increased level of personnel and vessels on site during the decommissioning phase there would be a small increase in the frequency of an incident occurring, thus diminishing the overall ability of the current level of emergency response provision, including pollution response. However this sensitivity is mitigated by the presence of on site resources providing additional emergency response resources (including self-help capability) not previously present in the area (during the operation and maintenance phase).

8.11.3.38 The receptor is therefore deemed to be of negligible vulnerability but high value given the severity of consequence with very good recoverability due to the structures being removed. The sensitivity of the receptor is therefore, considered to be **low.**

Significance of effect

8.11.3.39 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **negligible**. The effect will, therefore be **not significant** in EIA terms (and broadly acceptable under FSA).

8.12 Cumulative effect assessment (CEA)

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

8.12.1.2 A screening process has identified a number of reasonably foreseeable projects and developments which may act cumulatively with Hornsea Four. The full list of such projects that have been identified in relation to the offshore environment are set out in set out in **Volume 4, Annex 5.3: Offshore Cumulative Effects** and are presented in a series of maps within **Volume 4, Annex 5.4: Location of Offshore Cumulative Schemes**.

8.12.1.3 In assessing the potential cumulative impacts for Hornsea Four in relation to shipping and navigation it is important to note 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 maximum design scenario. There is therefore a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which may 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.

8.12.1.4 Given that the key receptors within the shipping and navigation chapter are vessels which route internationally the tiers selected consider both project status and distance from Hornsea Four. The tiers applied in the shipping and navigation CEA are summarised in **Table 8.20**, with the level of assessment undertaken for each tier included.

Table 8.20: Tiered cumulative approach.

Tier	Project Status	Description	Data Confidence	Level of CEA
1	Operational, under construction or consented or under determination	• May impact a main route passing within 1 nm of the Hornsea Four array area or HVAC booster station search area and/or interacts with traffic which may be directly displaced by the Hornsea Four array area or HVAC booster station search area. **Offshore wind farms** • Up to 50 km from the Hornsea Four array area, offshore export cable corridor or HVAC booster station search area. **Oil and gas infrastructure** • Up to 10 km from the Hornsea Four array area or HVAC booster station search area; or • Up to 5 km from the Hornsea Four offshore export cable corridor.	High or medium	Quantitative cumulative re-routeing of main routes
2	Operational, under construction, consented or under determination	• May impact a main route passing within 1 nm of the Hornsea Four array area or HVAC booster station search area and/or interacts with traffic which may be directly displaced by the Hornsea Four array area or HVAC booster station search area. **Offshore wind farms** • Between 50 km and 100 km from the Hornsea Four array area, offshore export cable corridor or HVAC booster station search area. **Oil and gas infrastructure** • Between 10 km and 20 km from the Hornsea Four array area or HVAC booster station search area; or • Between 5 km and 10 km from the Hornsea Four offshore export cable corridor.	High or medium	Qualitative cumulative re-routeing of main routes

Tier	Project Status	Description	Data Confidence	Level of CEA
3	Scoped or under examination	• Does not impact a main route passing within 1 nm of the Hornsea Four array area or HVAC booster station search area and does not interact with traffic which may be directly displaced by the Hornsea Four array area or HVAC booster station search area. **Offshore wind farms** • Up to 100 km from the Hornsea Four array area, offshore export cable corridor or HVAC booster station search area. **Oil and gas infrastructure** • Up to 20 km from the Hornsea Four array area or HVAC booster station search area; or • Up to 10 km from the Hornsea Four offshore export cable corridor.	Low	Qualitative assumptions of routeing only

8.12.1.5 Offshore wind farm developments are screened out if they are over 100 km from Hornsea Four or within 100 km of Hornsea Four but not yet scoped.

8.12.1.6 Similarly, oil and gas infrastructure is screened out if over 20 km from the Hornsea Four array area or HVAC booster station search area or over 10 km from the Hornsea Four offshore export cable corridor or within these parameters but does not impact a main route passing within 1 nm of the Hornsea Four array area or HVAC booster station search area or interact with traffic that may be directly displaced by the Hornsea Four array area or HVAC booster station search area.

8.12.1.7 The specific projects scoped into the CEA for shipping and navigation as well as the tiers into which they have been allocated are presented in **Table 20.1** and **Figure 20.1** in **Volume 5, Annex 8.1: Navigational Risk Assessment**. The operational projects included are due to their completion/commissioning subsequent to the data collection process for Hornsea Four and as such not included within the baseline characterisation. Note that only projects screened into the assessment for shipping and navigation based on the criteria outlined in **Table 8.20** have been assigned to tiers. For the full list of projects considered, including those screened out see **Volume 4, Annex 5.3: Offshore Cumulative Effects** and presented in a series of maps within **Volume 4, Annex 5.4: Location of Offshore Cumulative Schemes**.

8.12.1.8 The CEA will be undertaken following Section 42 Consultation and in developing the final assessment that will be presented in the ES to accompany the DCO application and will consider the following impacts:

- Hornsea Four array area, offshore export cable corridor and HVAC booster station search area cumulative with the projects identified within the cumulative screening may cause vessels to be deviated leading to increased vessel to vessel encounters and

therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions; and
- Structures within the Hornsea Four array area with projects identified within the cumulative screening will create powered and drifting allision risk for all vessels.

8.12.1.9 Impacts that will not be considered within the CEA, due to the localised nature of the impact, include:

- Anchor snagging associated with export cables;
- Allision risk associated within the structures within the HVAC booster station search area;
- Impacts on a vessel's use of Radar, communications and navigation equipment during navigational transits; and
- Impacts on emergency response resources (given that each project will be expected to mitigate its own impact through emergency response capability and planning).

8.12.1.10 A cumulative maximum design scenario will also be developed following the completion of Section 42 Consultation and will be presented in the ES to accompany the final DCO application.

8.13 Transboundary effects

8.13.1.1 Transboundary impacts relate to impacts that may occur from an activity within one European Economic Area (EEA) state on the environment or interests of another.

8.13.1.2 It was identified that transboundary issues could arise from Hornsea Four on commercial shipping routes transiting between the UK and other EEA ports. This could also include impacts upon international ports, shipping routes and/or routes affected by other international offshore renewable energy developments. The potentially affected areas include ports within the Southern North Sea (as per **Section 10.7** of **Volume 5, Annex 8.1: Navigational Risk Assessment**). The development of Hornsea Four could affect routes operating between the UK and ports located in the Netherlands, Denmark, Belgium and Germany. The results of the vessel deviation assessments in the draft NRA identified some deviations for routes; some deviations identified (see **Section 8.11.1**) were found to be significant at this stage, and require further consultation as parts of the post Section 42 Consultation process (see commitments presented in **Table 8.9**).

8.13.1.3 All EEA states that are likely to be significantly affected by Hornsea Four will be consulted as part of the formal phases of consultation. Dialogue with these authorities will continue to take place throughout the development of Hornsea Four in relation to potential transboundary impacts.

8.14 Inter-related effects

8.14.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, operation and maintenance, decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages (e.g. impacts on routeing and allision risk);
- Receptor-led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on shipping and navigation, such as deviated vessels, may interact to produce a different or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects.

8.14.1.2 Inter-related effects will be considered project wide for shipping and navigation following the completion of Section 42 Consultation and will be presented in the ES to accompany the final DCO application.

8.15 Conclusion and summary

8.15.1.1 For the construction phase, a total of four impacts were assessed, with the highest significance of effect determined to be minor adverse for impacts relating to increased vessel to vessel collision risk due to deviations and resulting increased vessel to vessel encounters, powered and drifting allision risk and restricted emergency response capability. No additional commitments are considered for these impacts, and therefore the residual impacts are also minor adverse.

8.15.1.2 For the operation and maintenance phase, a total of five impacts were assessed, with the highest significance of effect determined to be moderate adverse for an impact relating to increased vessel to vessel collision risk due to deviations and resulting increased vessel to vessel encounters. For this impact, additional consultation is considered as an additional commitment, and therefore the residual impact is minor adverse, noting that the impact is commercial in nature and **Volume 2, Chapter 8: Shipping and Navigation** demonstrates that vessels can still operate safely.

8.15.1.3 For the decommissioning phase, a total of four impacts were assessed, with the highest significance of effect determined to be minor adverse for impacts relating to increased vessel to vessel collision risk due to deviations and resulting increased vessel to vessel encounters and powered and drifting allision risk. No additional commitments are considered for these impacts, and therefore the residual impacts are also minor adverse.

8.15.1.4 **Table 8.21** presents a summary of the significant impacts assessed within this PEIR, any commitments and the residual effects.

Table 8.21: Summary of potential impacts assessed for shipping and navigation.

Impact and Phase	Receptor and Sensitivity	Magnitude and Significance	Mitigation	Residual Impact
Construction				
Construction activities associated with the Hornsea Four array area, offshore export cable corridor and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-C-1).	All vessels Medium	Minor Minor adverse	None proposed beyond existing commitments in **Table 8.9**	Minor adverse
Pre commissioned structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (CN-C-2).	All vessels Low	Minor Minor adverse	None proposed beyond existing commitments in **Table 8.9**	Minor adverse
Pre commissioned cables associated with the Hornsea Four array area and offshore export cable corridor may increase anchor snagging risk for all vessels (SN-C-3).	All vessels Low	Negligible Not Significant	None proposed beyond existing commitments in **Table 8.9**	Not Significant
Construction activities associated with the Hornsea Four array area and offshore export cable corridor may restrict the emergency response capability of existing resources (SN-C-4).	All vessels Low	Minor Minor adverse	None proposed beyond existing commitments in **Table 8.9**	Minor adverse
Operation				
Presence of structures within the Hornsea Four array area, offshore export cable corridor and HVAC booster station search area and activities associated with the Hornsea Four array area, offshore export cable corridor and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore increased vessel to vessel collision risk for all vessels in all weather conditions (SN-O-5).	All vessels Medium	Moderate Moderate adverse	Further consultation will be required to mitigate impacts for regular operators noting that the impacts are commercial in nature and **Volume 2, Chapter 8: Navigational Risk Assessment** demonstrates that the vessels can still operate safely.	Minor adverse

Impact and Phase	Receptor and Sensitivity	Magnitude and Significance	Mitigation	Residual Impact
Operational structures within the Hornsea Four array area and HVAC booster station search area may create powered and drifting allision risk for all vessels (SN-O-6).	All vessels Medium	Minor Minor adverse	None proposed beyond existing commitments in Table 8.9	Minor adverse
Operational cables within the Hornsea Four array area and offshore export cable corridor may increase anchor snagging risk for all vessels and cable protection used may reduce navigable water depths for all vessels (SN-O-7).	All vessels Low	Negligible Not Significant	None proposed beyond existing commitments in Table 8.9	Not Significant
Operation and maintenance activities associated with the Hornsea Four array area and offshore export cable corridor may restrict the emergency response capability of existing resources (SN-O-8).	All vessels Low	Negligible Not Significant	None proposed beyond existing commitments in Table 8.9	Not Significant
Operational structures within the Hornsea Four array area and offshore export cable corridor may impact a vessel's use of its Radar, communications and navigation equipment during navigational transits (SN-0-9).	All vessels Low	Negligible Not Significant	None proposed beyond existing commitments in Table 8.9	Not Significant
Decommissioning				
Decommissioning activities associated with the Hornsea Four array area and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-D-10).	All vessel Medium	Minor Minor adverse	None proposed beyond existing commitments in Table 8.9	Minor adverse
Decommissioning structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (SN-D-11).	All vessels Low	Minor Minor adverse	None proposed beyond existing commitments in Table 8.9	Minor adverse
Decommissioned cables left in situ within the Hornsea Four array area and offshore export cable corridor may increase anchor snagging risk for all vessels (SN-D-12).	All vessels Low	Moderate Minor Adverse	None proposed beyond existing commitments in Table 8.9	Minor Adverse
Decommissioning activities associated with the Hornsea Four array area and offshore export cable corridor may restrict the emergency response capability of existing resources (SN-D-13).	All vessels Low	Negligible Not Significant	None proposed beyond existing commitments in Table 8.9	Not significant

8.16 References

DECC (2011). *NPS for Renewable Energy Infrastructure*. London: DECC.

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