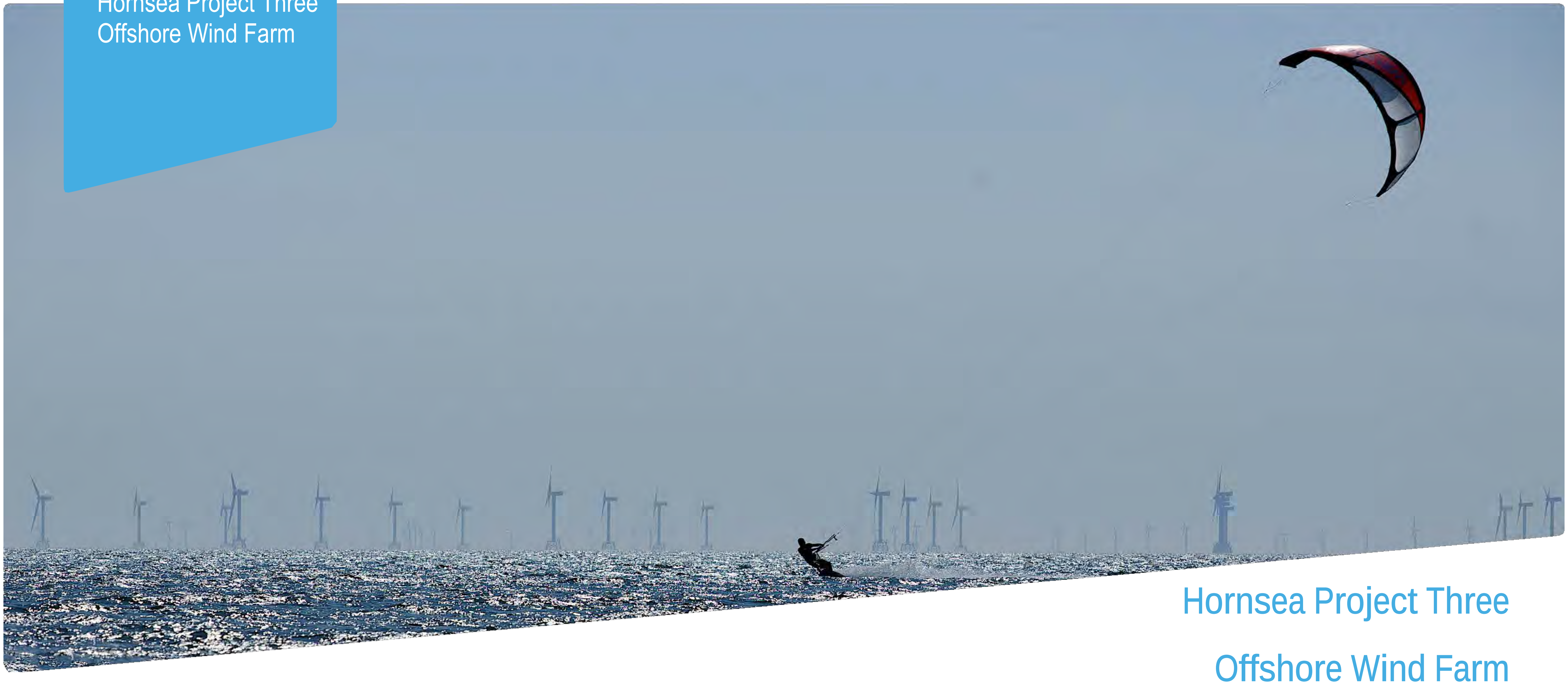
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Preliminary Environmental Information Report:
Annex 7.1 – Navigational Risk Assessment (Part 1)

Date: July 2017

Hornsea 3
Offshore Wind Farm

DONG energy

Environmental Impact Assessment

Preliminary Environmental Information Report

Volume 5 – Offshore

Annex 7.1 – Navigational Risk Assessment

Report Number: P6.5.7.1

Version: Final

Date: July 2017

This report is also downloadable from the Hornsea Project Three offshore wind farm website at: www.dongenergy.co.uk/hornseaproject3

DONG Energy Power (UK) Ltd.

5 Howick Place,

London, SW1P 1WG

Front cover picture: Kite surfer near one of DONG Energy's UK offshore wind farms © DONG Energy Hornsea Project Three (UK) Ltd., 2016.

Liability

This report has been prepared by Anatec, with all reasonable skill, care and diligence within the terms of their contract with DONG Energy Power (UK) Ltd

Prepared by Anatec

Contributors: ASC Ltd.

Checked by: Hywel Roberts and Kieran Bell.

Accepted by: Sophie Banham

Approved by: Stuart Livesey

Table of Contents

List of Tables

List of Figures

Glossary

Term	Definition
Allision	The act of striking or collision of a moving vessel against a stationary object.
Area To Be Avoided (ATBA)	An area within defined limits in which either navigation is particularly hazardous or it is exceptionally important to avoid casualties and which should be avoided by all ships, or by certain classes of ships.
Automatic Identification System (AIS)	Automatic Identification System. A system by which vessels automatically broadcast their identity, key statistics e.g. length, brief navigation details e.g. location, destination, speed and current status e.g. survey. Most commercial vessels and EU fishing vessels over 15m are required to have 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.
COLLRISK	Anatec Collision Risk Modelling Software.
Cloud Base	The lowest altitude of the visible portion of the cloud.
Deep Water Route (DWR)	A route in a designated area within defined limits which has been accurately surveyed for clearance of sea bottom and submerged articles. They are of particular use to vessels restricted in their ability to manoeuvre due to their draught size.
Design Envelope	A description of the range of possible elements which make up the project design options under consideration, as set out in detail in the project description. This envelope is used to define the project 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	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
Emergency Position Indicating Radio Beacon	An EPIRB is used to alert search and rescue services in the event of an emergency. It does this by transmitting a coded message on the 406 MegaHertz (MHz) distress frequency via satellite and earth stations to the nearest rescue co-ordination centre. EPIRBs are registered to a vessel or aircraft and some also transmit on 121.5MHz which allows a SAR aircraft to home in on them.
Entonox	A ready-to-use medical gas mixture of 50% nitrous oxide and 50% oxygen used for short-term pain relief.
Flotel	A portmanteau of the terms floating hotel, refers to the installation of living quarters on top of rafts or semi-submersible platforms.
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.

Term	Definition
Global Maritime Distress and Safety System (GMDSS) Sea Area A2	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). Hornsea Three array area is within Sea Area A2 which is within the radiotelephone coverage of at least one medium frequency coast station in which continuous Digital Selective Calling (2187.5 kilohertz) alerting and radiotelephony services are available. For planning purposes, this area typically extends to up to 180 nautical miles (330 kilometres) offshore during daylight hours, but would exclude any A1 designated areas. In practice, satisfactory coverage may often be achieved out to around 150 nautical miles (280 kilometres) offshore during night time.
IMO Routeing	Predetermined shipping routes established by the International Maritime Organization. Referred to as international sea lanes in EN-3 para 2.6.155.
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 which provide significant advice relating to the improvement of the safety of shipping and of life at sea, and to prevent or minimise pollution from shipping.
Medrescue	Transfer of sick or injured persons(s) from a hostile environment to a recognised medical facility (e.g., hospital or chamber).
Meteorological Mast	A met mast or tower structure, on which meteorological observation and recording equipment is mounted.
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 Cable Corridor	The specific corridor of seabed from Hornsea Three to the Norwich Main National Grid substation, within which the cables will be located.
Offshore Renewable Energy Infrastructure (OREI)	Offshore Renewable Energy Installations (OREIs) as defined by Guidance on UK Navigational Practice, Safety and Emergency Response Issues, MGN 543. For the purpose of this report and in keeping with the consistency of the Environmental Impact Assessment, OREI can mean offshore wind turbines and the associated electrical infrastructures such as offshore HVAC collector substations, offshore HVDC converter stations, accommodation platforms and offshore HVAC reactive compensation stations.
Personel Locator Beacon (PLB)	A PLB works in exactly the same way as an EPIRB by sending a coded message on the 406 MHz distress frequency which is relayed via the Cospas-Sarsat global satellite system. PLBs are typically carried on the person and are registered to the owner and may also transmit on 121.5MHz.
Radar	Radio Detection And Ranging – an object-detection system which uses radio waves to determine the range, altitude, direction, or speed of objects.
Safety Zone	A statutory marine zone demarcated for the purposes of safety around a possibly hazardous installation or works/ construction area.
Traffic Separation Scheme	A Traffic Separation Scheme (TSS) is a traffic-management route-system ruled by the International Maritime Organization. The traffic-lanes (or clearways) indicate the general direction of the ships in that zone; ships 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.

Term	Definition
Vessel Traffic Services	A service implemented by a Competent Authority designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the VTS area.
Zone Appraisal and Planning (ZAP)	A framework intended to rationalise and balance the commercial aim of maximising development capacity aspirations with practicalities of deliverability.

Acronyms

Acronym	Description
AC	Alternating Current
AfL	Agreement for Lease
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ALBs	All-Weather Lifeboats
AM	Amplitude Modulation (radio)
ARPA	Automatic Radar Plotting Aid
ATBA	Area To Be Avoided
AtoN	Aids to Navigation
BEIS	Department for Business, Energy and Industrial Strategy
BMAPA	British Marine Aggregate Producers Association
BWEA	British Wind Energy Association
CA	Cruising Association
CAA	Civil Aviation Authority
CBA	Cost Benefit Analysis
CGOC	Coastguard Operations Centres
COLREGs	The International Regulations for Preventing Collisions at Sea 1972
CoS	Chamber of Shipping
CROs	Coastguard Rescue Officers
CRT	Coastguard Rescue Teams
CTV	Crew Transfer Vessel
DC	Direct Current
DCO	Development Consent Order
DfT	Department for Transport
DSC	Digital Selective Calling
DWR	Deep Water Route
E	East
EASA	European Aviation Safety Agency
EIA	Environmental Impact Assessment
ELT	Emergency Locator Transmittor
EPIRB	Emergency Position Indicating Radio Beacon
ERCoP	Emergency Response and Cooperation Plan
ERRV	Emergency Response and Rescue Vessels
EU	European Union
FLIR	Forward looking infra-red
FM	Frequency Modultation
FMS	Flight management system
FOV	Field of view
FSA	Formal Safety Assessment
GCAF	Gross Cost of Averting a Fatality
GIS	Geographical Information System
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
HAT	Highest Astronomical Tide
HF	High Frequency
HMCG	Her Majesty's Coastguard
HSE	Health, Safety and Environment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current

Acronym	Description
IALA	International Association of Lighthouse Authorities
IFSD	InFlight Shut Down
ILBs	Inshore Lifeboats
ILO	International Labour Organisation
ILS	Instrument Landing System
IMC	Intrusment Meteorological Conditions
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
IPS	Intermediate Peripheral Structures
IR	Infrared
IRC	International Rating Certificate
ITOPF	International Tanker Owners Pollution Federation Limited
LAT	Lowest Astronomical Tide
LKP	Last Known Position
LOA	Lengths Overall
LOFT	Line Oriented Flying Training
MAIB	Maritime and Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MEHRA	Marine Environmental High Risk Area
MetOcean	Meteorological Ocean
MF	Medium Frequency
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
MOD	Ministry of Defence
MPCP	Marine Pollution Contingency Plan
MSC	Maritime Safety Council
MSI	Maritime Safety Information
N	North

Acronym	Description
NAVTEX	Navigational Telex
NE	Northeast
NOREL	Nautical Offshore Renewable Energy Liaison
NRA	Navigational Risk Assessment
NUC	Not Under Command
NVG	Night Vision Googles
NW	Northwest
OOW	Officer of the Watch
OREI	Offshore Renewable Energy Installation
OSV	Offshore Support Vessel
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Areas
PINS	Planning Inspectorate
PLA	Port of London Authority
PLB	Personal Locator Beacons
PLL	Potential Loss of Life
PLN	Port Letter Number
POB	Persons On Board
POD	Probablity of Detection
PPE	Personal Protective Equipment
QHSE	Quality, Health, Safety and Environment
Radar	Radio Detecting and Ranging
RAF	Royal Air Force
REZ	Renewable Energy Zones
RIB	Rigid-Hulled Inflatable Boat
RNLI	Royal National Lifeboat Institute
Ro Ro	Roll on roll off
RV	Research Vessel
RYA	Royal Yachting Association

Acronym	Description
SAR	Search and Rescue
SAROPS	Search and rescue operations
SCADA	Supervisory Control and Data Acquisition
SE	Southeast
SMS	Safety Management System
SNSOWF	Southern North Sea Offshore Windfarm Forum
SOLAS	Safety of Life at Sea
SPS	Significant Peripheral Structures
SW	Southwest
TCE	The Crown Estate
TH	Trinity House
TI	Thermal imaging
TSS	Traffic Separation Scheme
TV	Television
UHF	Ultra High Freqeuncy
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency
VMC	Visual meteorological conditions
VTS	Vessel Traffic Services
WGS	World Geodetic System
ZAP	Zone Appraisal and Planning

Units

Unit	Description
£	Great British pound (currency)
dB	Decibel (sound)
Ft	Feet (distance)
GRT	Gross Registered Tonne (volume)
GW	Gigawatt (power)
km	Kilometre (distance)
kn	Knot (speed)
m	Metre (distance)
MHz	MegaHertz (frequency)
mi.	Miles
mph	Miles per Hour (speed)
MW	Megawatt (power)
nm	Nautical Mile (distance)
Pa	Pascal (pressure)
yds	Yards (distance)

1. Introduction

1.1 Background

1.1.1.1 Anatec were commissioned by DONG Energy Hornsea Project Three (UK) Ltd to undertake an NRA for the proposed Hornsea Three array area (located within the former Hornsea Zone), the Hornsea Three offshore cable corridor and the Hornsea Three offshore HVAC booster station search area. This NRA report presents information on the proposed development relative to the existing and future case navigational activity and forms an annex to the Preliminary Environmental Information Report (PEIR).

1.2 Navigational risk assessment

1.2.1.1 An Environmental Impact Assessment (EIA) is a process which identifies the environmental effects of a project, both negative and positive, in accordance with European Union (EU) Directives. An important requirement of the EIA for offshore projects is the NRA. Following the MCA methodology (MCA, 2015) and MGN 543 (MCA, 2016), an NRA for Hornsea Three has been undertaken and includes:

- Overview of base-case environment;
- Marine traffic survey;
- Implications of offshore wind farms including position of turbines;
- Assessment of navigational risk pre- and post-development of Hornsea Three;
- Formal Safety Assessment (FSA);
- Implications for marine navigation and communication equipment;
- Identification of mitigation measures;
- Emergency response; and
- Any required monitoring.

1.2.1.2 Assessments will be undertaken for each development phase as follows:

- Construction;
- Operation and maintenance; and
- Decommissioning.

1.2.1.3 The assessment of Hornsea Three is based on a Design Envelope which includes conservative assumptions that have been considered and assessed for all impacts; except external visual navigation which is assessed against Layout B. Only Layout A has been modelled for the NRA given it represents the maximum scenario for allision risk. Further details of the Hornsea Three Design Envelope are outlined in volume 1, chapter 3: Project Description.

2. Guidance and Legislation

2.1 Primary guidance

2.1.1.1 The primary guidance documents used during the assessment are listed below:

- MCA MGN 543 (Merchant and Fishing) Safety of Navigation Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response (MCA, 2016);
- MCA Methodology for Assessing Marine Navigational Safety Risks of Offshore Wind Farms (2015); and
- Guidelines for FSA – Maritime Safety Council (MSC)/Circular 1023/MEPC/Circular 392 (International Maritime Organization, 2002).

2.1.1.2 MGN 543 highlights issues that shall be taken into consideration when assessing the effect on navigational safety from offshore renewable energy developments, proposed in UK internal waters, territorial sea or Renewable Energy Zones (REZ).

2.1.1.3 The MCA require that their methodology is used as a template for preparing NRA's. It is centred on risk management and requires a submission that shows that sufficient controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with mitigation. The NRA will identify both base case and future case levels of risk and what measures are required to ensure the future case remains broadly acceptable or tolerable.

2.2 Other guidance

2.2.1.1 Other guidance documents used during the assessment are listed below:

- MCA Marine Guidance Note 372 (MGN 372 merchant and fishing) Offshore Renewable Energy Installations (OREIs) Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2008b);
- International Association of Marine Aids to Navigation (AtoN) and Lighthouse Authorities (IALA) Recommendation 0-139 on The Marking of Man-Made Offshore Structures, Edition 2 (IALA, 2013);
- Royal Yachting Association (RYA) – The RYA's Position on Offshore Renewable Energy Developments Paper 1 – Wind Energy (RYA, 2015); and
- Department for Business, Energy and Industrial Strategy (BEIS) Standard Marking Schedule for Offshore Installations (2011).

3. Navigational Risk Assessment Methodology

3.1 Formal safety assessment methodology

3.1.1.1 A shipping and navigation receptor can only be affected by an impact if there is a pathway through which an impact can be transmitted between the source activity and the receptor. In cases where a receptor is exposed to an impact, the overall severity of consequence to the receptor is determined. This process incorporates a degree of subjectivity. Assessments for shipping and navigation receptors used the following criteria, to assess:

- Baseline data and assessment;
- Expert opinion;
- Outputs of the Hazard Workshop (see appendix B);
- Level of stakeholder concern;
- Time and/or distance of any deviation;
- Number of transits of specific vessel and/or vessel type; and
- Lessons learnt from existing offshore developments.

3.2 Formal safety assessment process

3.2.1.1 The Internal Maritime Organization (IMO) FSA process (IMO, 2002) approved by the IMO in 2002 under MSC/Circ.1023/MEPC/Circ.392 has been applied within this study. This is a structured and systematic methodology based on risk analysis and cost benefit analysis (if applicable).There are five basic steps within this process:

- Step 1 – Identification of hazards (a list of all relevant accident scenarios with potential causes and outcomes);
- Step 2 – Assessment of risks (evaluation of risk factors);
- Step 3 – Risk control options (devising measures to control and reduce the identified risks);
- Step 4 – Cost benefit analysis (determining cost effectiveness of risk control measures); and
- Step 5 – Recommendations for decision-making (information about the hazards, their associated risks and the cost effectiveness of alternative risk control measures).

3.2.1.2 A criterion in assessing risk is the Hazard Workshop. The following tables (Table 3.1 and Table 3.2) identify how the severity of consequence and the frequency of occurrence are defined within the hazard log; these rankings are the same rankings used for Hornsea Project One and Hornsea Project Two so that cross comparison is possible. The rankings for severity of consequence are shown in Table 3.1.

Table 3.1: Severity of consequences.

Rank	Description	Definition			
		People	Property	Environment	Business
1	Negligible	No Perceptible Impact	No Perceptible Impact	No Perceptible Impact	No Perceptible Impact
2	Minor	Slight injury(s)	£10,000-£100,000	Tier 1 Local assistance required	£10,000-£100,000
3	Moderate	Multiple minor or single serious injury	£100,000-£1million	Tier 2 Limited external assistance required	£100,000-£1million Local publicity
4	Serious	Multiple serious injury or single fatality	£1million-£10million	Tier 2 Regional assistance required	£1million-£10million National publicity
5	Major	More than one fatality	>£10million	Tier 3 National assistance required	>£10million International publicity

3.2.1.3 The rankings for frequency of occurrence are shown in Table 3.2.

Table 3.2: Frequency of occurrence.

Rank	Description	Definition
1	Negligible	<1 occurrence per 10,000 years
2	Extremely unlikely	1 per 100 – 10,000 years
3	Remote	1 per 10 – 100 years
4	Reasonably probable	1 per 1 – 10 years
5	Frequent	Yearly

3.2.1.4 The severity of consequences is then assessed against the frequency of occurrence to provide the level of tolerability of the impact. This tolerability matrix is shown in Table 3.3. The tolerability of the impact is defined as Broadly Acceptable (low risk), Tolerable (intermediate risk) or Unacceptable (high risk).

3.2.1.5 Once identified, the impact will then be assessed to ensure it is ALARP. Further risk control measures may be required to further mitigate the impact in accordance with ALARP principles. Unaccpetable risks are considered not to be ALARP.

Table 3.3: Tolerability matrix and risk rankings.

Severity of consequences	5 (Major)					
	4 (Serious)					
	3 (Moderate)					
	2 (Minor)					
	1 (Negligible)					
		1	2	3	4	5
		Frequency of occurrences				

	Broadly Acceptable (low risk)
	Tolerable (intermediate risk)
	Unacceptable (high risk)

3.3 Methodology for assessing cumulative effects

3.3.1.1 The assessment of cumulative effects includes considering the impacts arising from other offshore wind farms and development activities within the southern North Sea.

3.3.1.2 Cumulative issues on a zonal development plan basis were assessed as part of the Southern North Sea Offshore Wind Forum (SNSOWF) remit in 2013. It was recognised that, due to the scale and location of Round 3 zones in the southern North Sea (Dogger Bank, the former Hornsea Zone and the former East Anglia zone), coordination was required between zones in order for the developers of these zones to successfully undertake their respective Zone Appraisal and Planning (ZAP) process. Therefore, the developers of the three zones established the SNSOWF to extend the principles of ZAP beyond the boundaries of their respective zones and to help manage wider cumulative issues between these zones. An overview of this work is detailed in section 21.3. Although the work has not been refreshed since 2013, the routes identified have been validated against the surveys undertaken for Hornsea Three.

3.3.1.3 The following methods have been used to assess these effects identified as part of the baseline study:

- Stakeholder consultation and expert opinion;
- Lessons learned;
- Desktop study;
- Collision and allision risk modelling; and
- Regular operator feedback.

3.4 Assumptions

3.4.1.1 The shipping and navigation baseline and impact assessment has been carried out based on the information available and responses received at the time of preparation. It has assessed a conservative scenario noting the final locations of structures will not be finalised until post consent.

4. Consultation

4.1 Stakeholder types

4.1.1.1 There are a variety of stakeholder types:

- “Risk imposer” includes those whose actions or policies result in a risk and need action;
- “Risk taker” includes those whose action or inaction results in a risk;
- “Risk beneficiary” benefits from imposing or taking a risk;
- “Risk payer” pays for the management of a risk;
- “Risk sufferer” suffers the consequence of a risk; and
- “Risk observer” is aware of a risk but it does not affect them directly.

4.1.1.2 In order to ensure that all stakeholders and their interested users were included within the NRA process, a review of stakeholder types was undertaken in line with the baseline study. Stakeholders have been represented by organisations who have different roles including:

- Proposers who are proposing the development;
- Approvers who are responsible for giving a development consent;
- Advisors who are formally consulted by the approvers;
- Users who are not formally consulted by the approvers but who may wish to provide input to them; and
- Observers.

4.2 Stakeholders consulted as part of navigational risk assessment (NRA) process

4.2.1.1 Key marine and navigation stakeholders have been consulted as part of the NRA. The following stakeholders have been consulted via dedicated meetings:

- MCA;
- TH;
- Chamber of Shipping (CoS);
- RYA; and
- Cruising Association (CA).

4.2.1.2 Consultation with regular operators was also undertaken including through the Hazard Workshop.

4.2.1.3 A summary of the key consultation for Hornsea Three is included in section 14.

5. Data sources

5.1 Summary of data sources

5.1.1.1 This section summarises the main data sources used in assessing the baseline shipping activities relative to Hornsea Three. The main data sources used in this assessment are listed below:

- Maritime traffic survey – AIS, visual and Radio Detecting and Ranging (Radar) survey data (26 days throughout June and July 2016 and 14 days throughout November and December 2016) for the Hornsea Three array area collected from two survey vessels. Further detail is given in section 15;
- Maritime traffic survey – AIS, visual and Radar survey data (14 days throughout September 2016 and 14 days throughout November and December 2016) for the Hornsea Three offshore HVAC booster station search area collected from two survey vessels. Further detail is given in section 15.4;
- Shore based AIS survey data Hornsea Three offshore cable corridor search area combined with Hornsea Three array area data (period coinciding with the maritime traffic survey being undertaken in the Hornsea Three array area). This data is collected using shore based receivers and not a marine traffic vessel survey;
- AIS fishing and recreational survey data (365 days throughout March 2016 to February 2017) for the London Array offshore wind farm site. Further detail is given in section 22.13;
- Fishing surveillance satellite data (2009) and observation data (2005 to 2009) which was validated against data in volume 2, chapter 6: Commercial Fisheries;
- Maritime incident data from the Maritime Accident Investigation Branch (MAIB) (2005 to 2014) and Royal National Lifeboat Institute (RNLI) (2005 to 2014);
- Marine aggregate dredging data (licence areas and active areas) and transit routes from The Crown Estate (TCE) and British Marine Aggregates and Producers Association (BMAPA) (2016);
- Admiralty Sailing Direction – North Sea (West) Pilot NP 54 United Kingdom Hydrographic Office (UKHO) (UKHO, 2016);
- UKHO Admiralty Charts 1187, 1503, 2182a and 4140; and
- RYA UK Coastal Atlas of Recreational Boating (2009) and Geographic Information System (GIS) Shape Files (2016).

5.1.1.2 The marine traffic survey data used in the NRA is summarised in section 7 and Table 5.1 below.

5.2 Study Areas

5.2.1 Hornsea Three array area shipping and navigation study area

5.2.1.1 A 10 nautical mile (nm) buffer was applied around the Hornsea Three array area. This study area has been defined in order to provide local context to the analysis of risks by capturing the relevant routes and traffic movements within and near the proposed Hornsea Three array area. This 10 nm study area has been used within the majority of UK wind farm NRAs including Hornsea Project One and Hornsea Project Two.

5.2.2 Hornsea Three offshore cable corridor shipping and navigation study area

5.2.2.1 AIS survey data has been sourced for the Hornsea Three offshore cable corridor; however in order to provide local context a minimum 2 nm buffer has been applied to either side of the offshore cable corridor (dependant on where data was available) in order to capture relevant receptors and their movements within and near the Hornsea Three offshore cable corridor. The Hornsea Three offshore cable corridor shipping and navigation study area runs between the low water mark and the edge of the Hornsea Three array area.

5.2.3 Hornsea Three offshore HVAC booster station search area shipping and navigation study area

5.2.3.1 A 5 nm buffer has been applied around the Hornsea Three offshore HVAC booster station search area shipping and navigation study area. This extent is based on routeing of vessels and the likely size of deviations required. This search area overlaps with the Hornsea Three offshore cable corridor because of a regulator requirement for a marine traffic survey (Automatic Identification System (AIS) data and Radar) to be undertaken where surface structures are proposed and to identify relevant receptors that may be affected.

5.2.4 Hornsea Three cumulative shipping and navigation study area

5.2.4.1 It should be noted that, due to the national and international nature of shipping and navigation, risks have been considered within a wider southern North Sea perspective (where relevant) for vessels routeing as per section 21 and Table 21.1. Changes to routeing have been shown in detail within a 10 nm buffer around the Hornsea Project One, Hornsea Project Two and the Hornsea Three array areas.

Table 5.1: Summary of marine traffic survey data.

Survey period	Survey location	Data type	Data capture (full days)	Vessel	AIS System Type	Radar System Type	Personnel
6–18 June & 22 June–4 July 2016	Hornsea Three array area	AIS, visual and Radar	26 days	Neptune Research / survey vessel Flagged Iceland	JRC 182 JHS	JRC JMA 531	FLO/bridge crew & dedicated surveyor
16–29 September 2016	Hornsea Three offshore HVAC booster station search area	AIS, visual and Radar	14 days	Willing Lad Survey vessel Flagged UK	Koden AIS, Type KAT-100	JRC JMA 3210-6	Bridge crew (dedicated)
10–16 November & 26 November–3 December 2016	Hornsea Three array area	AIS, visual and Radar	14 days	Research Vessel (RV) Aora Research / survey vessel Flagged UK	Furuno FA100	Decca Bridgemaster E	Bridge crew (dedicated)
17–19 November & 4–15 December 2016	Hornsea Three offshore HVAC booster station search area	AIS, visual and Radar	14 days	RV Aora Research / survey vessel Flagged UK	Furuno FA100	Decca Bridgemaster E	Bridge crew (dedicated)

6. Lessons Learnt

6.1.1.1 There is considerable benefit for the Applicant in the sharing of lessons learnt within the offshore industry. The NRA and in particular the hazard assessment, includes general consideration for lessons learnt and expert opinion from previous offshore wind farm developments and other sea users.

6.1.1.2 Lessons learnt data sources include:

- RYA and CA (2004) Sharing the Wind – Identification of recreational boating interests in the Thames Estuary, Greater Wash and North West (Liverpool Bay), Southampton, RYA;
- Department for Transport (DfT) (2004) Results of the electromagnetic investigations 2nd edition, Southampton, MCA and QinetiQ;
- Renewables UK (RUK) (2014 issue 2) Guidelines for Health and Safety in the Wind Energy Industry;
- MCA (2005) Offshore Wind Farm Helicopter Search and Rescue – Trials Undertaken at the North Hoyle Wind Farm Report of helicopter Search and Rescue (SAR) trials undertaken with Royal Air Force Valley "C" Flight 22 Squadron on March 22 2005, Southampton, MCA;
- Nautical Offshore Renewable Energy Liaison (NOREL Group) (unknown) A Report compiled by the Port of London Authority based on experience of the Kentish Flats Wind Farm Development, NOREL Work Paper, WP4 (2nd NOREL);
- SMart Wind (2014) Hornsea Project Two Environment Statement Volume 2, Chapter 7: Shipping and Navigation; and
- TCE and Anatec (2012) Strategic Assessment of Impacts on Navigation of Shipping and Related Effects on Other Marine Activities Arising from the Development of Offshore Wind Farms in the UK REZ.

7. Marine Traffic Survey Methodology

7.1 Introduction

7.1.1.1 This section describes the survey methodology used when recording marine traffic survey data for the Hornsea Three array shipping and navigation study area and the Hornsea Three offshore HVAC booster station search area shipping and navigation study area.

7.2 Baseline survey methodology

7.2.1.1 Baseline shipping activity was assessed using AIS, visual and Radar track data. The period of data collection encompassed seasonal fluctuations in shipping activity (i.e. summer/winter), and also accounted for a range of tidal conditions. For the Hornsea Three offshore cable corridor shipping and navigation study area this data was supplemented with data from shore based AIS stations. For the Hornsea Three array area shipping and navigation study area, the quality of coverage of such shore based survey data was insufficient to further enhance the vessel based survey data. As agreed with the MCA, and in line with standard best practice, a vessel-based marine traffic survey of the sections of the export cable corridor that lie beyond the Hornsea Three offshore HVAC booster station shipping and navigation search area is not required.

7.2.1.2 The operational areas targeted by the survey vessels throughout the summer and winter survey periods at the Hornsea Three array area shipping and navigation study area are presented in Figure 7.1 and Figure 7.2 respectively. The survey vessels used were the *Neptune* (summer) and *RV Aora* (winter).

7.2.1.3 The operational areas targeted by the survey vessels throughout the summer and winter survey periods at the Hornsea Three offshore HVAC booster station shipping and navigation search area are presented in Figure 7.3 and Figure 7.4 respectively. The survey vessels used were the *Willing Lad* (summer) and *RV Aora* (winter).

7.2.1.4 In all surveys the vessels remained within the central area of the study area in order to provide the best coverage of AIS transmission, Radar returns and v

7.3 AIS and Radar coverage

7.3.1.1 AIS is required on board all vessels of more than 300 Gross Register Tonnes (GRT) engaged on international voyages, cargo vessels of more than 500 GRT not engaged on international voyages, passenger vessels irrespective of size built on or after 1 July 2002, and fishing vessels over 15 m in length.

7.3.1.2 Therefore, larger vessels were recorded on AIS, while smaller vessels without AIS installed (i.e. fishing vessels under 15 m and recreational craft) were recorded, where possible, on the Automatic Radar Plotting Aid (ARPA) on board the survey vessel. A proportion of smaller vessels also carry AIS voluntarily.

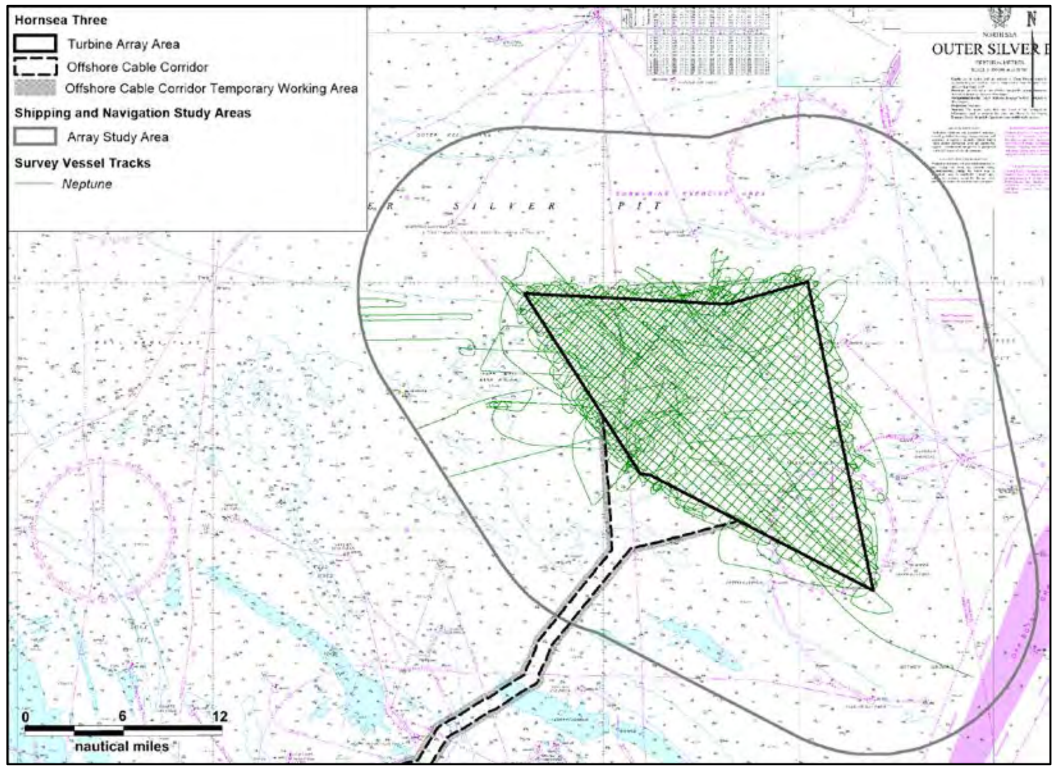


Figure 7.1: Summer (June to July 2016) Hornsea Three array area survey vessel AIS tracks.

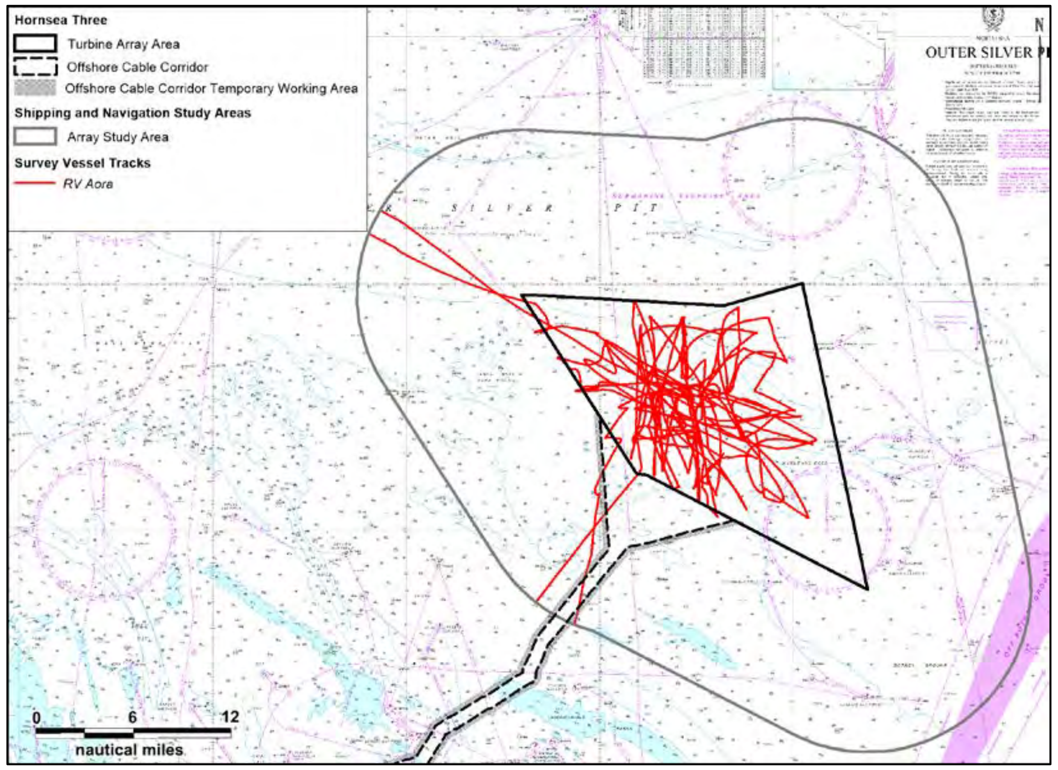


Figure 7.2: Winter (November to December 2016) Hornsea Three array area survey vessel AIS tracks.

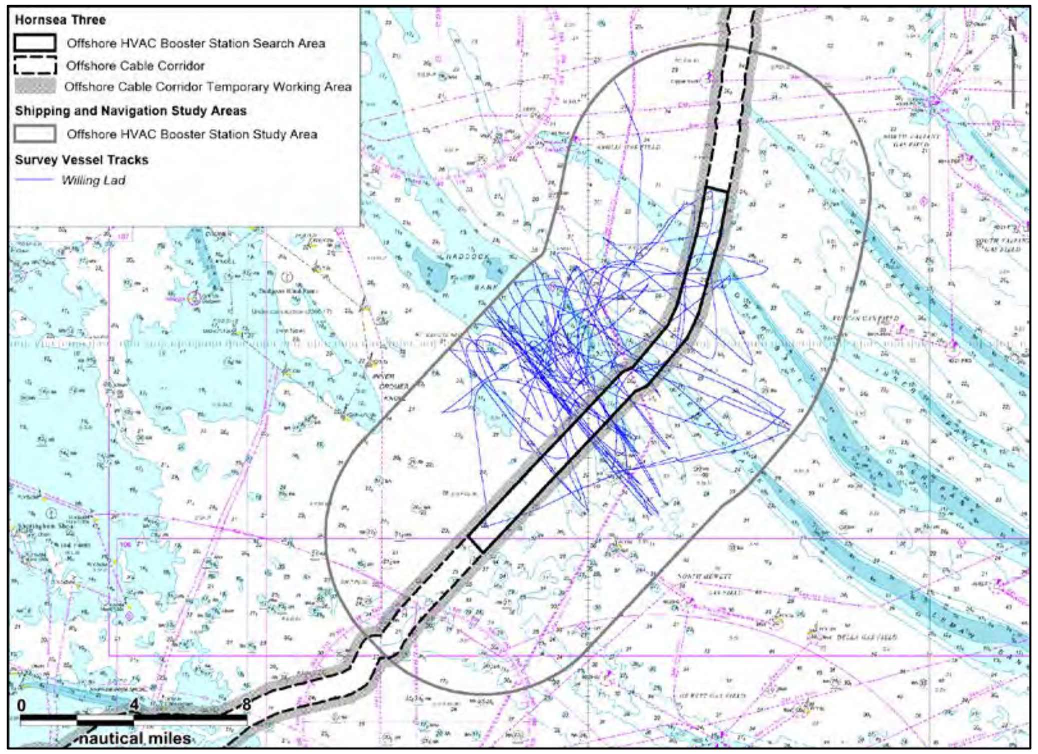


Figure 7.3: Summer (September 2016) Hornsea Three offshore HVAC booster station search area survey vessel AIS tracks.

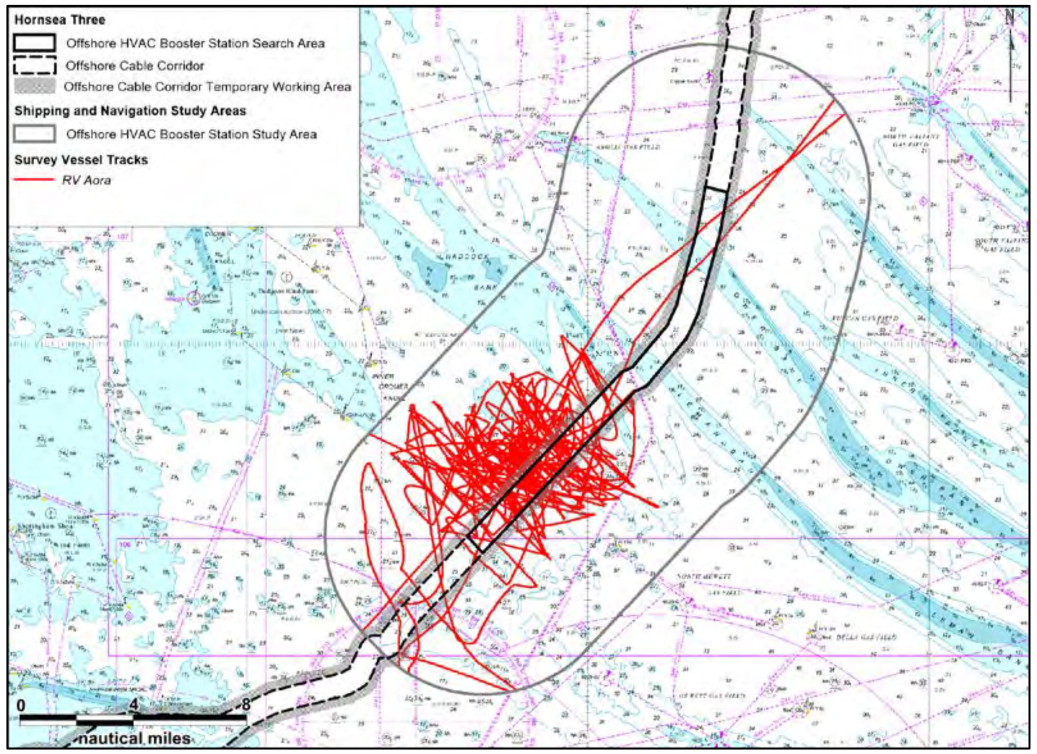


Figure 7.4: Winter (November to December 2016) Hornsea Three offshore HVAC booster station search area survey vessel AIS tracks.

7.4 Commercial vessels dataset

7.4.1.1 The marine traffic survey for the baseline navigation review of the Hornsea Three array area included a combined dataset of 40 days of AIS, visual and Radar data recorded from vessels working at the Hornsea Three array area during 6 June to 4 July 2016 and 10 November to 3 December 2016.

7.4.1.2 The marine traffic survey for the baseline navigation review of the Hornsea Three offshore HVAC booster station search area included a combined dataset of 28 days of AIS, visual and Radar data recorded from survey vessels working at the Hornsea Three offshore HVAC booster station search area during 16 to 29 September 2016 and 4 to 15 December 2016.

7.5 Recreational activity

7.5.1.1 The RYA and CA represent the interests of recreational users including yachting and motor cruising. In 2005 the RYA, supported by the TH and the CA, compiled and presented a comprehensive set of charts which defined the cruising routes, general sailing, and racing areas used by recreational craft around the UK coast. This information was published as the UK Coastal Atlas of Recreational Boating and has been subsequently updated (RYA, 2009). The latest addition of GIS shapefiles from 2016 showing cruising routes, sailing and racing areas has been used in this assessment.

7.5.1.2 The RYA has also developed a detailed position statement (RYA, 2015) based on analysed data for common recreational crafts; this, along with consultation at the Hazard Workshop, were used to inform the NRA.

7.5.1.3 In addition, recreational vessel data was extracted from the AIS, visual and Radar survey tracks recorded during the marine traffic surveys (June to July 2016 and November to December 2016).

7.6 Fishing activity

7.6.1.1 Fishing activity data was extracted from the AIS, visual and Radar tracks recorded during the marine traffic surveys (June to July 2016 and November to December 2016).

7.6.1.2 In addition, fishing vessel sightings and satellite monitoring data were obtained (fishing surveillance satellite data (2009) and observation data (2005 to 2009) which was validated against data in volume 2, chapter 6: Commercial Fisheries) from the Marine Management Organisation (MMO) and presented in density grids to validate the fishing survey data presented in the baseline assessment.

7.6.1.3 Sightings data were analysed for the 2005 to 2009 period (full time analyses). These data have been collected through the deployment of patrol vessels, surveillance aircraft and the sea fisheries inspectorate. Each patrol logs the position and details of fishing vessels within the area being patrolled. All vessels are logged, irrespective of size, provided they can be identified from their Port Letter Number (PLN).

7.6.1.4 Satellites record the positions of fishing vessels of 15 m length and over every two hours. Data have been analysed on a full annual basis from 2009 (all nationalities).

7.6.1.5 It is noted that satellite and sightings data is no longer available in the point format, and therefore these datasets cannot be updated.

7.6.1.6 Validation of fishing data was also undertaken against volume 2, chapter 6: Commercial Fisheries.

8. Other Offshore Users

8.1 Oil and gas installations

8.1.1.1 Offshore oil and gas installation data were assessed using charted information. Including fixed platforms and wellheads that may have an impact on navigational transit by a surface vessel. A desktop study was undertaken using these data to identify any possible cumulative effects with offshore oil and gas developments.

8.2 Marine aggregate areas

8.2.1.1 Marine aggregates dredging data (licenced areas and active areas) were supplied by TCE and passage plans of dredgers were supplied by BMAPA. A desktop study was carried out using this information to identify commercial aggregate dredging activity in the vicinity of the development area.

8.3 Navigational features

8.3.1.1 Other navigational features such as IMO routeing measures and Ministry of Defence (MOD) Practice and Exercise Areas (PEXAs) have been considered based on information from Admiralty charts.

9. Design Envelope

9.1 Introduction

9.1.1.1 The NRA reflects the Design Envelope defined in volume 1, chapter 3: Project Description. The following section details the maximum extents of Hornsea Three for which any identified impacts will be assessed.

9.1.1.2 For the allision and collision risk modelling, a maximum design scenario assessment of floating foundations has been undertaken. The maximum design scenario foundation for shipping and navigation is a floating foundation design due to the necessary mooring lines, potential for structure movement (not modelled) and the maximum number and size (at waterline) of the foundations. The maximum design scenario has been defined by Anatec using information available at the time of writing within volume 1, chapter 3: Project Description.

9.2 Hornsea Three development boundaries

9.2.1.1 The proposed Hornsea Three array area is located approximately 65.3 nautical miles (nm) (121 km) to the northeast of the UK coast, at Tringham, Norfolk. The total area of Hornsea Three is approximately 203 nm^2 (696 km^2) with water depths within the Hornsea Three array area boundary ranging from approximately 27 m to 73 m above Lowest Astronomical Tide (LAT).

9.2.1.2 The corner co-ordinates of the Hornsea Three array area are presented in Table 9.1 and shown in Figure 9.1.

Table 9.1: Corner co-ordinates of Hornsea Three array area.

Corner	Latitude (World Geodetic System 84)	Longitude (WGS 84)
C1 (northwest (NW))	53° 59' 22.42'' north (N)	002° 11' 50.69'' east (E)
C2 (N)	53° 58' 42.51'' N	002° 32' 43.90'' E
C3 (northeast (NE))	54° 00' 04.03'' N	002° 40' 52.65'' E
C4 (southeast (SE))	53° 41' 22.17'' N	002° 47' 35.93'' E
C5 (southwest (SW) 1)	53° 48' 23.27'' N	002° 24' 43.63'' E
C6 (SW2)	53° 48' 27.12'' N	002° 23' 43.61'' E

9.2.1.3 Two wind turbine layouts are being used to inform the assessment; however only the maximum design scenario parameters have been listed. The layouts are shown in Figure 9.2 to Figure 9.5, both with and without a chart background.

9.3 Infrastructure

9.3.1.1 Layout A incorporates the following 361 structures:

- 342 turbines;
- 12 offshore HVAC collector substations;
- Four offshore HVDC substations; and
- Three accommodation platforms.

9.3.1.2 The turbines within Layout A each have a maximum rotor diameter of 185 m and maximum blade tip height (above LAT) of 240 m.

9.3.1.3 A minimum structure spacing of 1 km has been included.

9.3.1.4 For Layout B there are 125 structures:

- 106 turbines;
- 12 offshore HVAC collector substations;
- Four offshore HVDC substations; and
- Three accommodation platforms.

9.3.1.5 The turbines within Layout B each have a maximum rotor diameter of 265 m and maximum blade tip height (above LAT) of 325 m.

9.3.1.6 A minimum structure spacing of 1 km has been included.

9.4 Turbine design

9.4.1.1 Floating foundations have been considered as the maximum design scenario for shipping and navigation due to the necessary mooring lines, potential for structure movement (excursion). The number of turbines and maximum spread is also considered. The Design Envelope includes slack (catenary) and taut mooring lines. The mooring lines could be anchored using drag, gravity, pile or suction anchors. The maximum design scenario wind turbine measurements assuming floating foundation design for Layout A (maximum number of structures present greatest allision risk) and Layout B (maximum spacing presents greatest risk to visual navigation) are presented in Table 9.2.

9.4.1.2 Other types of foundation being considered include a monopile, jacket, suction bucket and gravity base. Descriptions of these foundation types can be found within volume 1, chapter 3: Project Description.

9.4.1.3 Table 9.2 identifies the maximum design scenario parameters.

Table 9.2: Maximum design scenario (and modelled) parameters for turbines design.

Parameter	Specification for 342 turbines (Layout A)	Specification for 106 turbines (Layout B)
Foundation type	Floating with catenary or taut mooring lines	Floating with catenary or taut mooring lines
Maximum design scenario floating foundation dimensions at the water line (dependent on water depth, geology and turbine type)	50×50 m	75×75 m
Hub height (LAT)	148 m	193 m
Maximum blade tip height (LAT)	240 m	325 m
Minimum blade tip height (LAT)	34.97 m	34.97 m
Rotor diameter	185 m	265 m

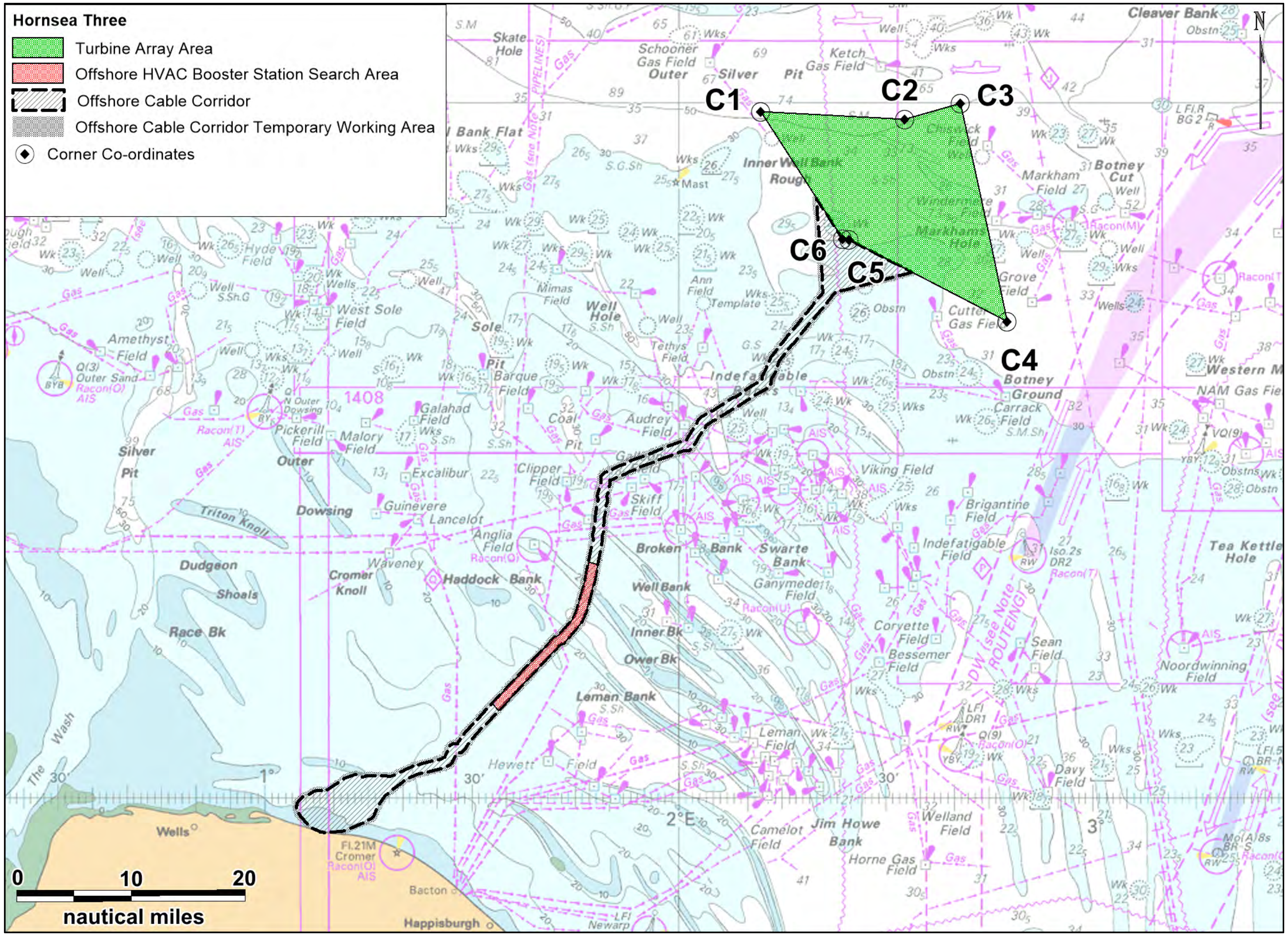


Figure 9.1: Chart overview of Hornsea Three including corner co-ordinate points.

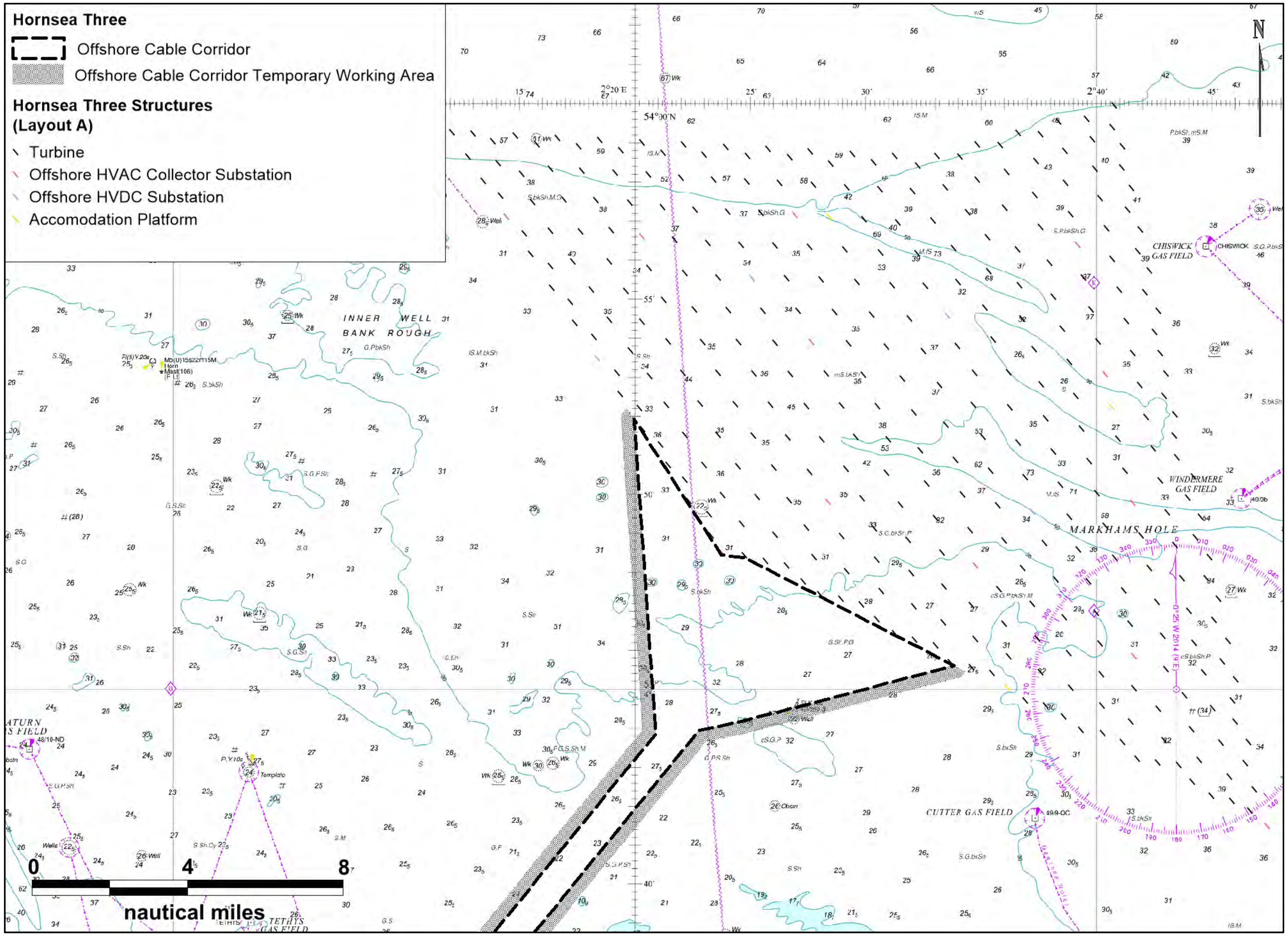


Figure 9.2: Overview of Layout A (342 infrastructure locations with chart).

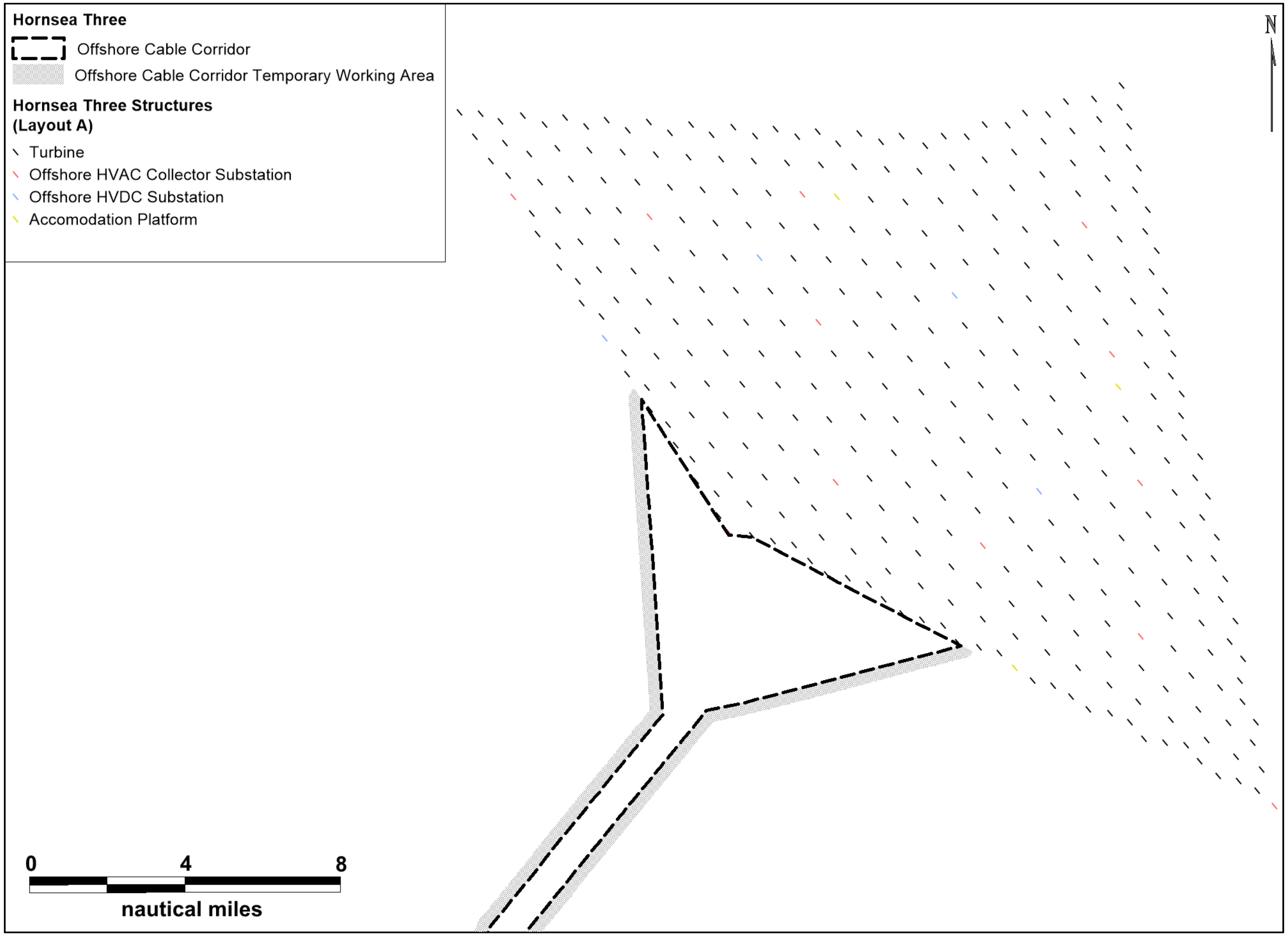


Figure 9.3: Overview of Layout A (342 infrastructure locations without chart).

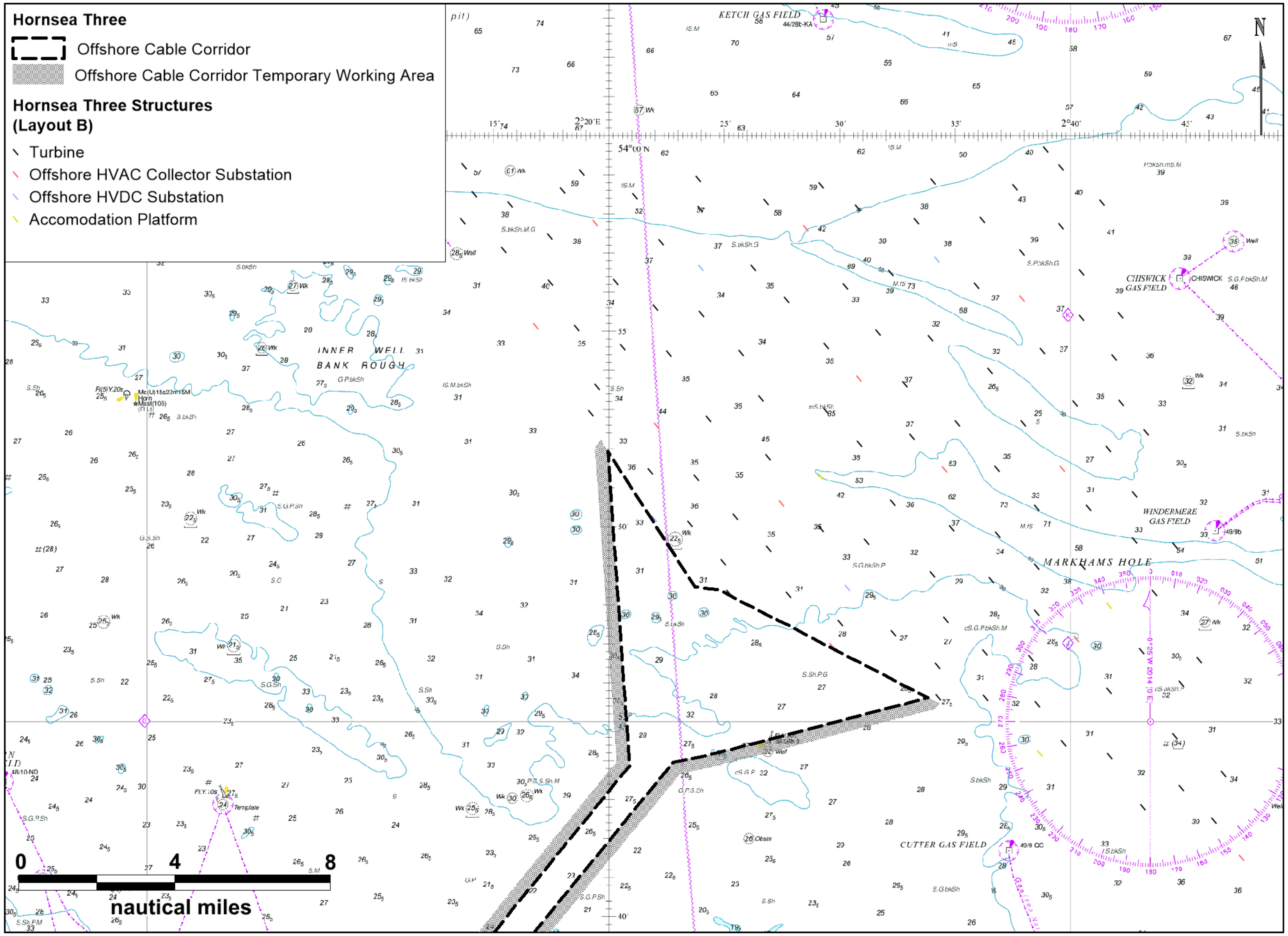


Figure 9.4: Overview of Layout B (125 infrastructure locations with chart).

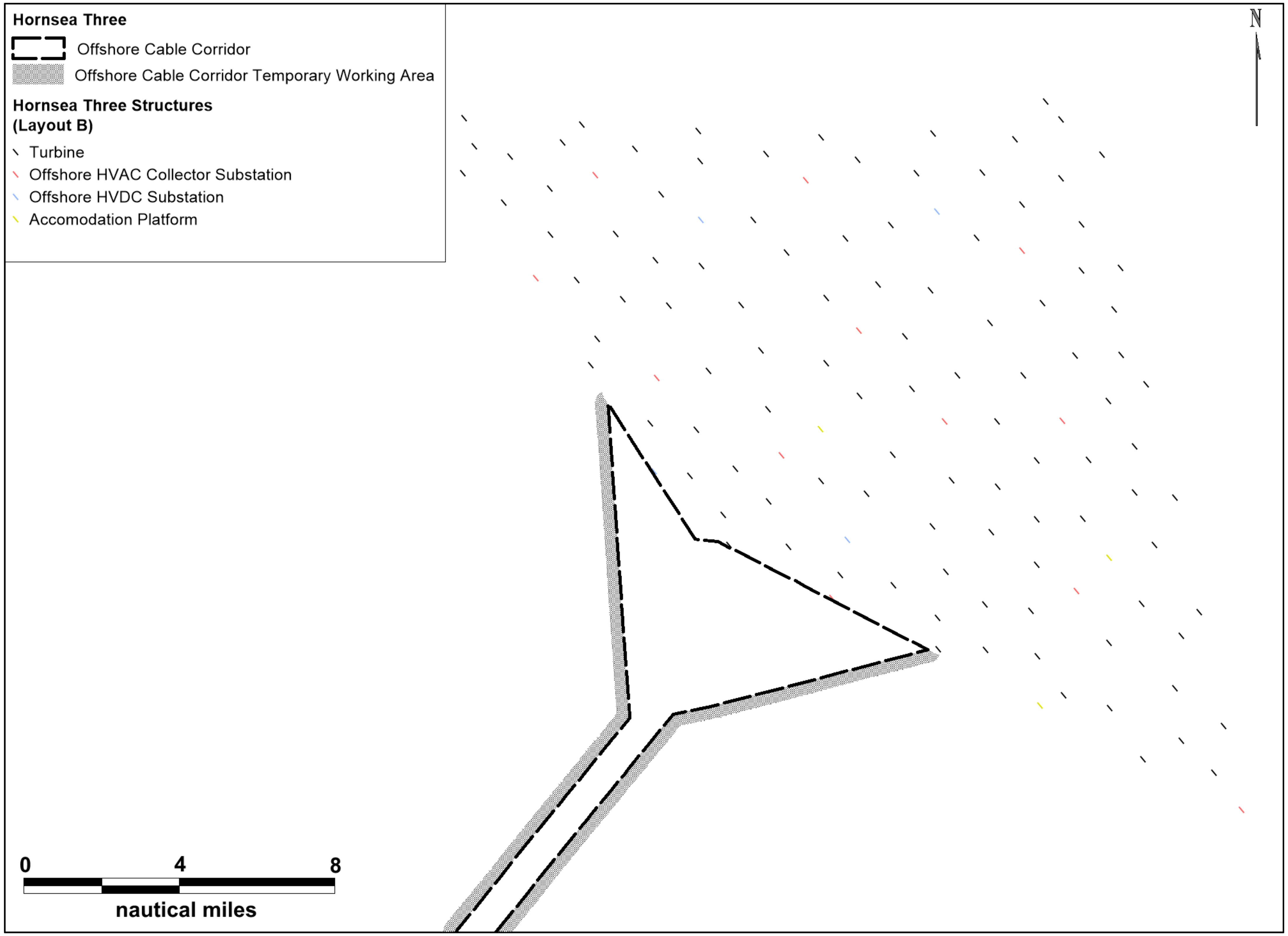


Figure 9.5: Overview of Layout B (125 infrastructure locations without chart).

9.5 Further detail on other structures within the Hornsea Three array area and Hornsea Three offshore cable corridor

9.5.1.1 The following section details the associated structures within the Hornsea Three array area and Hornsea Three cable corridor as described in volume 1, chapter 3: Project Description.

9.5.1.2 Table 9.3 identifies the number of structures and their maximum dimensions, as applicable for both Layout A and Layout B.

Table 9.3: Structures within the Hornsea Three array area and Hornsea Three cable corridor.

Structure	Location	Specification (maximum)	At water line dimensions
Offshore HVAC collector substation	Hornsea Three array area	12	80×80 m
Offshore HVDC substation	Hornsea Three array area	4	180×90 m
Accommodation platform	Hornsea Three array area	3	60×60 m
Hornsea Three offshore HVAC booster station	Hornsea Three offshore cable corridor	4	80×80 m

9.5.1.3 If the HVDC transmission option is selected, offshore HVAC collector substations and offshore HVDC substations may be required within the Hornsea Three array area. If the HVAC transmission option is selected, only offshore HVAC collector substations would be required within the Hornsea Three array area. The HVDC transmission option therefore represents a conservative case in terms of the number of structures within the Hornsea Three array area and has therefore been modelled for the Hornsea Three array area shipping and navigation study area.

9.5.1.4 If the HVAC transmission option is selected, Hornsea Three offshore HVAC booster stations will be required within the Hornsea Three offshore HVAC booster station search area located along the Hornsea Three offshore cable corridor. If the HVDC transmission option is selected, no Hornsea Three offshore HVAC booster stations will be required. The HVAC transmission option therefore represents a conservative case in terms of the number of structures within the Hornsea Three offshore HVAC booster station search area and has therefore been modelled for the offshore HVAC booster station shipping and navigation study area. As the final location of the Hornsea Three offshore HVAC booster station(s) is not known, modelling has been undertaken on conservative locations (proximity to shipping routes) and surface area (largest number of platforms within a cluster). Any other location or design is then considered to be lower risk.

9.6 Cables

9.6.1.1 Hornsea Three will require various types of submarine cables which can be split into three main categories:

- Array cables;
- Interconnector cables; and
- Export cables.

9.6.2 Array cables

9.6.2.1 The array cables will connect individual turbines to offshore HVAC collector substations. Hornsea Three may require a total of up to 459 nm (850 km) of array cables. The total length will be determined by considerations such as the layout and voltage capacity. Including installation and protection, each cable may directly affect a 10 m width of the seabed.

9.6.3 Interconnector cables

9.6.3.1 The purpose of offshore platform interconnector cables is to provide interlink connections between the offshore platforms within the array area. Hornsea Three will require up to 15 interconnector cables, with a total length of up to 121 nm (225 km), depending on the chosen layout, number of substations and substation locations.

9.6.4 Export cables

9.6.4.1 A plot of the Hornsea Three offshore cable corridor, within which the export cables will be located, is presented in Figure 9.6.

9.6.4.2 The proposed Hornsea Three offshore export cable corridor runs southwest for 78 nm (145 km) from the southern and western boundary of the Hornsea Three array area to the landfall area at Weybourne, Norfolk. Up to six cables of diameter 320 millimetres (mm) will be installed, depending on the transmission option selected.

9.6.4.3 The process of selection and routeing of the Hornsea Three offshore cable corridor has avoided, where possible, significant engineering and environmental constraints, such as deep water and aggregate dredging areas.

9.6.5 Cable burial

9.6.5.1 Where available, the primary means of cable protection will be by seabed burial. The extent and method by which the subsea cables will be buried will depend on the results of a detailed seabed survey of the final cable routes and associated Cable Burial Risk Assessment. Cable protection methods may be used where burial is not possible; this will again be assessed within the Cable Burial Risk Assessment.

9.7 Construction phase(s)

9.7.1.1 The combined maximum design scenario for the offshore construction phase is considered to be up to 11 years, split over three phases.

9.7.1.2 For turbines, foundations and array cables the maximum design scenario is:

- Up to 11 years over three phases, this would also assume construction buoyage is deployed throughout that phase.

9.7.1.3 For the Hornsea Three offshore cable corridor and Hornsea Three offshore HVAC booster stations the maximum design scenario is:

- Maximum installation duration for the surface or subsea HVAC booster station is three phases of up to seven years duration (including periods of construction and inactivity) for which construction buoyage would be deployed throughout; and
- Maximum installation duration for the export cables is three years with gaps of up to six years.

9.8 Indicative vessel numbers

9.8.1 Construction vessels

9.8.1.1 The following numbers are the indicative numbers assumed to be a conservative case for shipping and navigation over the 11 year construction phase.

- Up to 11,026 return trips:
  - Wind turbine installation vessels: up to four vessels and up to 12 transport vessels;
  - up to three installation vessels, up to 13 support vessels, up to 12 dredging vessels and on average four transport vessels (tugs) for wind turbine gravity base foundation installation;
  - up to two installation vessels, up to 12 support vessels and up to four transport vessels for offshore substation foundations installation; and
  - up to three main cable laying vessels, up to three main cable burial vessels, up to four crew boats or OSVs, up to two service vessels, up to two diver vessels, up to two pre lay grapnel run vessels, and up to two dredging vessels for array cable installation. Operations and maintenance vessels, helicopters and personnel.

9.8.2 Operations and maintenance vessels

9.8.2.1 Values quoted are for the assumed 25 year operational phase.

- Up to 20 Crew Transfer Vessels (CTV) (2,433 visits per year);
- Up to four Offshore Support Vessels (OSVs);
- Supply vessel visits 312 per year;
- 87 jack up visits per year;
- Number of personnel 680;
- Accommodation platforms housing up to 600 people; and
- 5,273 total helicopter trips.

9.8.2.2 During both the construction, and the operation and maintenance phases logistics will be managed by a marine coordination team, and an integrated health, safety and environment (HSE) management system will be in place to ensure control of all vessels and their respective works.

9.8.2.3 The project will be operational 24/7.

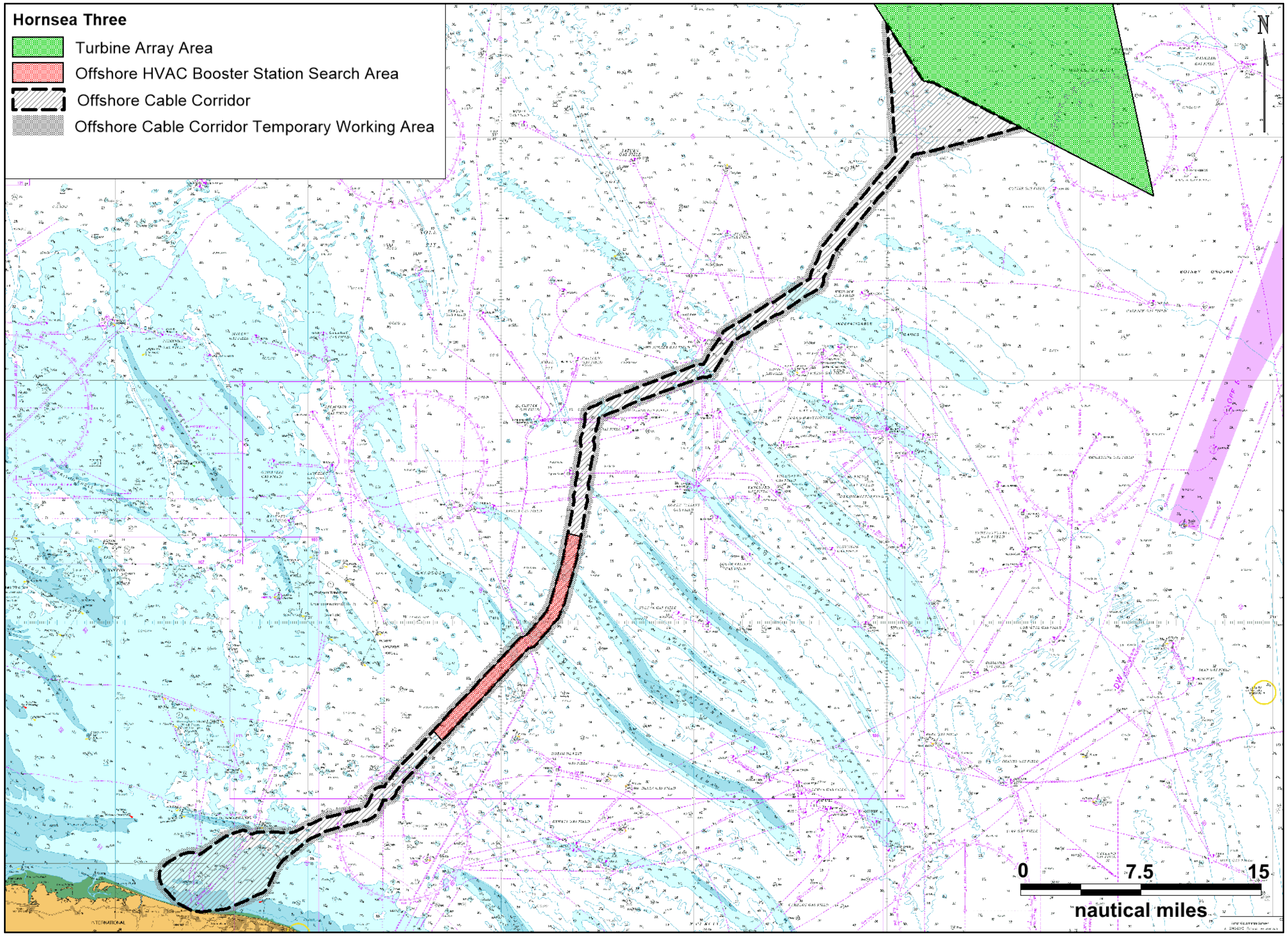


Figure 9.6: Detailed Hornsea Three offshore cable corridor.

9.9 Maximum design scenarios

9.9.1.1 The following table details the maximum design scenarios considered within the NRA.

Table 9.4: Maximum design scenarios considered.

Phase	Element	Maximum Design Scenario
Construction	Hornsea Three array area	• Construction of the Hornsea Three array area could take up to eleven years and up to three phases; and • Buoyed construction area around the Hornsea Three array area for the duration of construction.
Construction	Hornsea Three offshore cable corridor	• Buoyed construction area around the Hornsea Three offshore HVAC booster station development area for the duration of construction; • Maximum installation duration for the surface or subsea offshore HVAC booster stations is three phases of seven years; • Maximum export cable installation duration of three years with gaps of up to six years; and • Minimum safe passing distance of 1,000 m for cable laying vessels.
Construction	Vessels	Up to 11,776 round trips: • Wind turbine installation vessels: up to 40 vessels (3,420 return trips); • Wind turbine foundation installation vessels: up to 60 vessels (2,394 return trips) OR up to 19 vessels (gravity base) (4,446 return trips); • Substation foundation installation vessels: up to 18 vessels (304 return trips); • Array cable installation vessels: up to 18 vessels (2,856 return trips); and • Export cable installation vessels: up to 24 vessels (750 return trips).
Operation and Maintenance	Hornsea Three array area	• Up to 342 wind turbines with floating foundations; up to 4,104 m mooring; excursion area 25% of water depth; 1,000 m mooring cable radius; • Total development area of up to 696 km^2; • Up to 12 offshore HVAC collector substations; • Up to three offshore accommodation platforms; • Up to four offshore HVDC substations. • Bridge links (up to 100 m); • Up to 850 km array and 225 km interconnector cables; • Up to 15 degree arc of movements at the Nacelle; and • Safety zones of 500 m may be applied for, for example around all infrastructure during major maintenance activities and around all platforms during operations.
Operation and Maintenance	Hornsea Three offshore cable corridor	• 145 km offshore cable corridor; • Up to six export cables of up to 145 km in length (from Hornsea Three array boundary to the landfall area) – buried or protected within 1,000 m consent corridor width (550 to 850 m final corridor width); • Cable protection measures (all); • Rock protection berm, sloped profile above seabed level: 7 m overall width and 2 m maximum height; • Up to four surface or six subsea offshore HVAC booster stations; • Up to 37 cable/pipeline crossings; and • Minimum safe passing distance of 1,000 m for cable laying vessels (maintenance).
Operations and Maintenance	Vessels and Aircraft over assumed 25 year operational life	• Up to 20 CTVs (2,433 visits per year); • Up to four OSVs; • Supply vessel visits 312 per year; • 87 jack up visits per year; • Operational hours 24/7; • Number of personnel 680; • Accommodation platforms housing up to 600 people; and • 5,273 total helicopter trips.
Decommissioning	Hornsea Three array area	• Decommissioning of the Hornsea Three array area could take up to eleven years and up to three phases; and • Buoyed area around the Hornsea Three array area for the duration of decommissioning.
Decommissioning	Hornsea Three offshore cable corridor	• Buoyed area around the Hornsea Three offshore HVAC booster station development area for the duration of decommissioning; • Maximum decommissioning duration for the surface or subsea offshore HVAC booster stations is three phases of seven years; and • Minimum safe passing distance of 1,000 m for cable laying vessels.
Decommissioning	Vessels	• Maximum number of decommissioning vessel.

10. Existing Environment

10.1 Navigational features

10.1.1.1 Figure 10.3 shows an overview of the navigational features in proximity to the Hornsea Three array area and Hornsea Three cable corridor. These features will be discussed in the following subsections.

10.2 Ports

10.2.1.1 The ports in the vicinity of the Hornsea Three array area and Hornsea Three cable corridor are presented in Figure 10.1, based on Admiralty charts. The number of vessel arrivals to the principal ports in the Northeast and Humber (DfT, 2016) is presented in Figure 10.2.

10.2.1.2 It is noted that while these statistics exclude some movements, which occur within the port or harbour limits, they provide a good indication of the relative traffic levels and trends. Ports within the Humber Estuary have been grouped together and therefore show an above average number of arrivals in comparison to other single ports; however this does not impact the assessment given that routeing of these vessels through Hornsea Three is the same.

10.2.1.3 Great Yarmouth is the closest port to the Hornsea Three array area, located approximately 66nm (121 km) south of the Hornsea Three array area and southeast of the landfall area. There are a number of ports within the Humber Estuary including Kingston upon Hull, Grimsby, Immingham and Goole. For the purposes of this assessment, the Humber Estuary ports have been considered cumulatively.

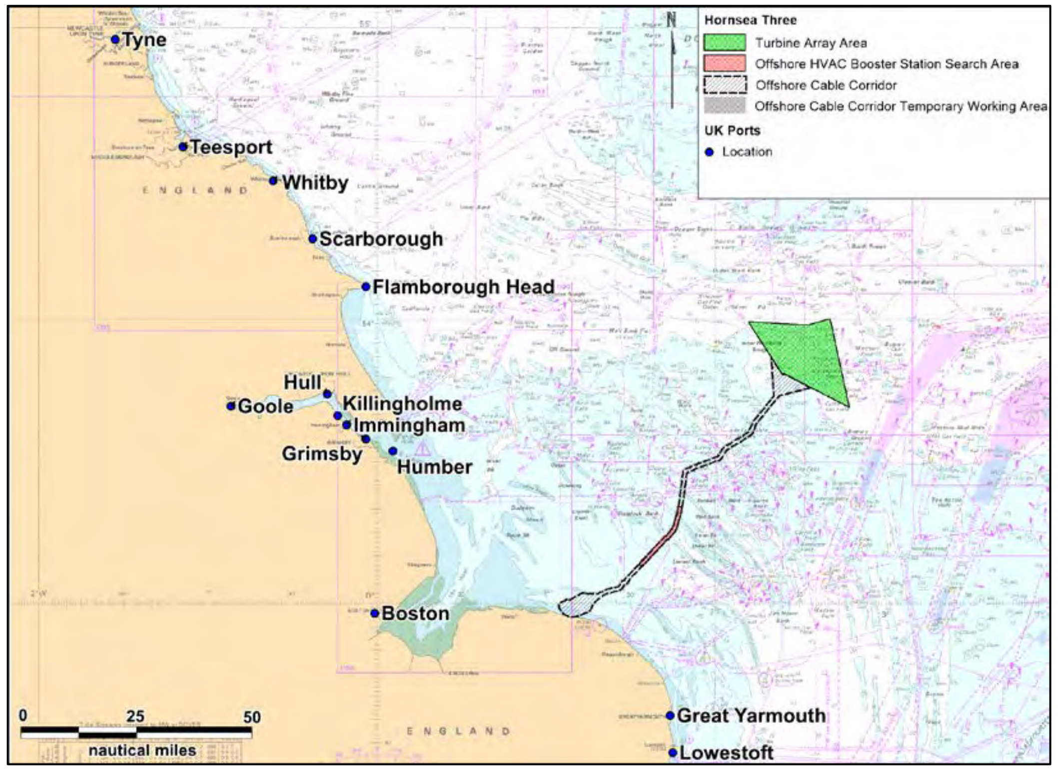


Figure 10.1: Ports in proximity to Hornsea Three.

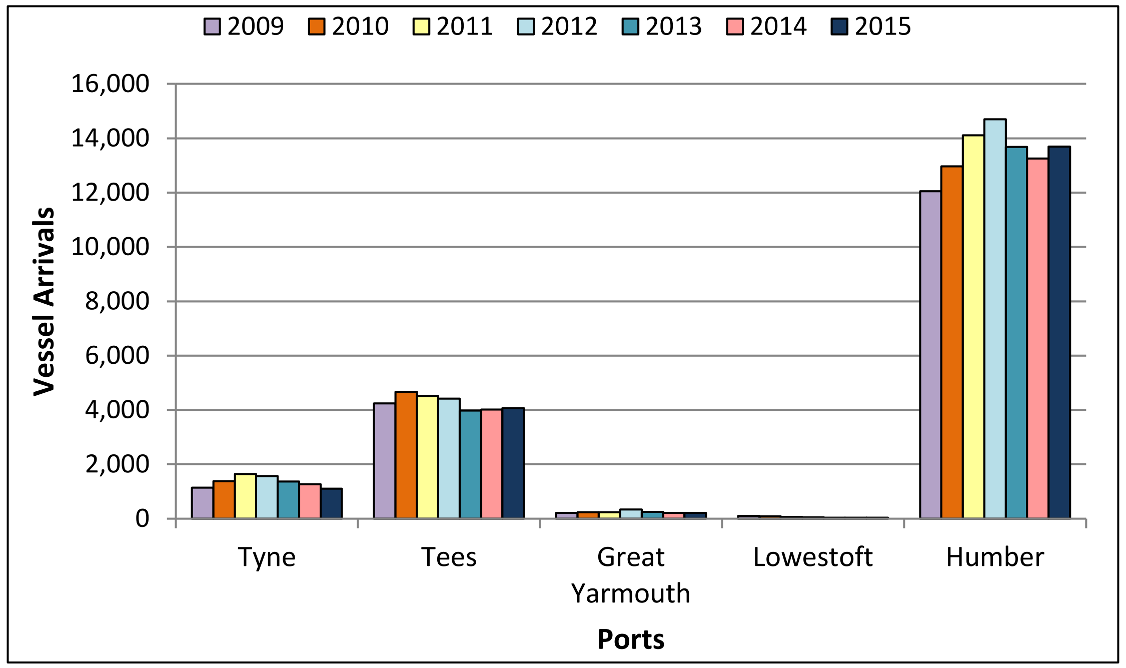


Figure 10.2: Vessel arrivals to principal ports (2009 to 2015) (DfT, 2016).

10.3 Anchoring

10.3.1.1 There are no anchorage areas in the vicinity of the Hornsea Three array area and Hornsea Three cable corridor. The only anchorage areas within the region are located in or nearby to the Humber Harbour Authority. The Humber Deep Water Anchorage, where large vessels awaiting a pilot should anchor, lies 10 nm to the east of Spurn Head, within Vessel Traffic Services (VTS) Humber.

10.3.1.2 The Bull Anchorage and Hawke Anchorage, located within the Humber Harbour Authority, are general anchorage areas each containing 25 designated anchorage berths. These are used by smaller vessels.

10.4 IMO routeing measures and existing aids to navigation

10.4.1.1 There are several IMO routeing measures located within the region of the southern North Sea containing the Hornsea Three array area and Hornsea Three cable corridor, as presented in Figure 10.4.

10.4.1.2 The Off Botney Ground Traffic Separation Scheme (TSS) is the closest IMO routeing measure, located approximately 6.54 nm (12.1 km) to the southeast of the southeastern corner of the Hornsea Three array area. The West Friesland TSS and Off Brown Ridge TSS are also located in the region.

10.4.1.3 The Deep Water Route (DWR) via the DR1 light-buoy connects to the Off Botney Ground TSS. The DWR via the TSS West Friesland connects to the West Friesland TSS.

10.4.1.4 There are no IMO routeing measures in place in the vicinity of the Hornsea Three landfall area.

10.4.1.5 There are a number of existing aids to navigation located in proximity to the Hornsea Three array area and Hornsea Three offshore cable corridor, as presented in Figure 10.5.

10.4.1.6 The closest AtoN to the Hornsea Three array area is a buoy located approximately 2.90 nm (5.37 km) to the southwest. Among the other AtoN in the vicinity of the Hornsea Three array area is the Hornsea meteorological mast located within Hornsea Project One.

10.4.1.7 The closest AtoN to the Hornsea Three offshore cable corridor is a buoy located approximately 3.18 nm (5.89 km) to the southeast.

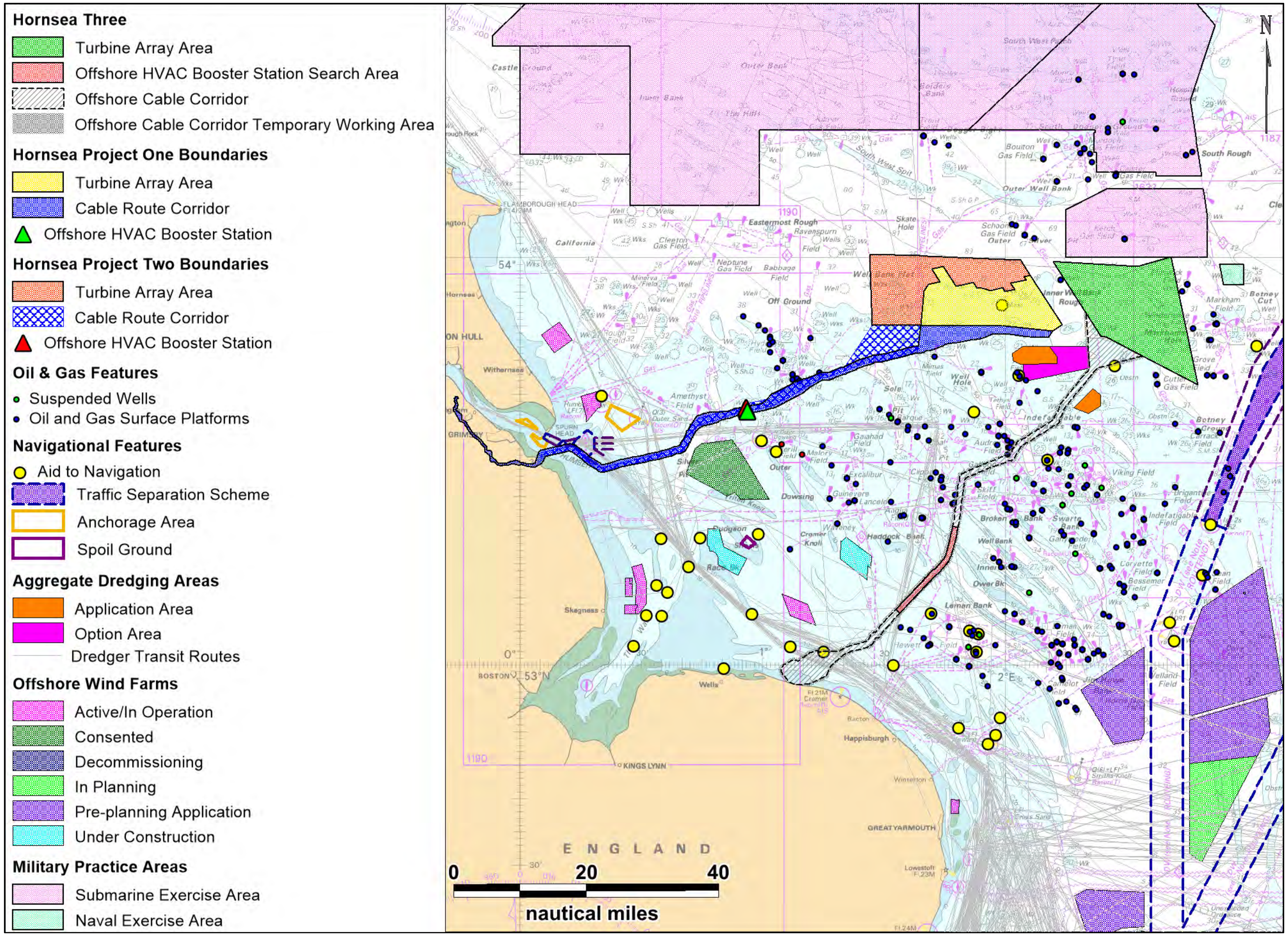


Figure 10.3: Navigational features in proximity to Hornsea Three.

10.5 Oil and gas infrastructure

10.5.1.1 Figure 10.6 presents an overview of the nearby oil and gas surface platforms and charted suspended wells (wells that could pose a risk to navigational safety) in proximity to the Hornsea Three array area and Hornsea Three cable corridor.

10.5.1.2 There are no oil or gas surface platforms located within the Hornsea Three array area. The nearest existing offshore surface installations to Hornsea Three are detailed in Table 10.1.

10.5.1.3 There are a number of offshore oil and gas installations within the Hornsea Three offshore cable corridor, with the closest to the Hornsea Three offshore cable corridor being the Clipper South platform located 0.49 nm (910 m) to the west and the Audrey A platform located 0.74 nm (1.37 km) to the northwest.

10.5.1.4 Existing platforms are generally protected by safety zones (i.e. typically 500 m radius) which prohibit vessels from transiting within 500 m of the platforms.

10.5.1.5 There are no suspended wells located within the Hornsea Three array area or offshore cable corridor. The closest suspended well to the Hornsea Three array area is located 950 m from the western boundary.

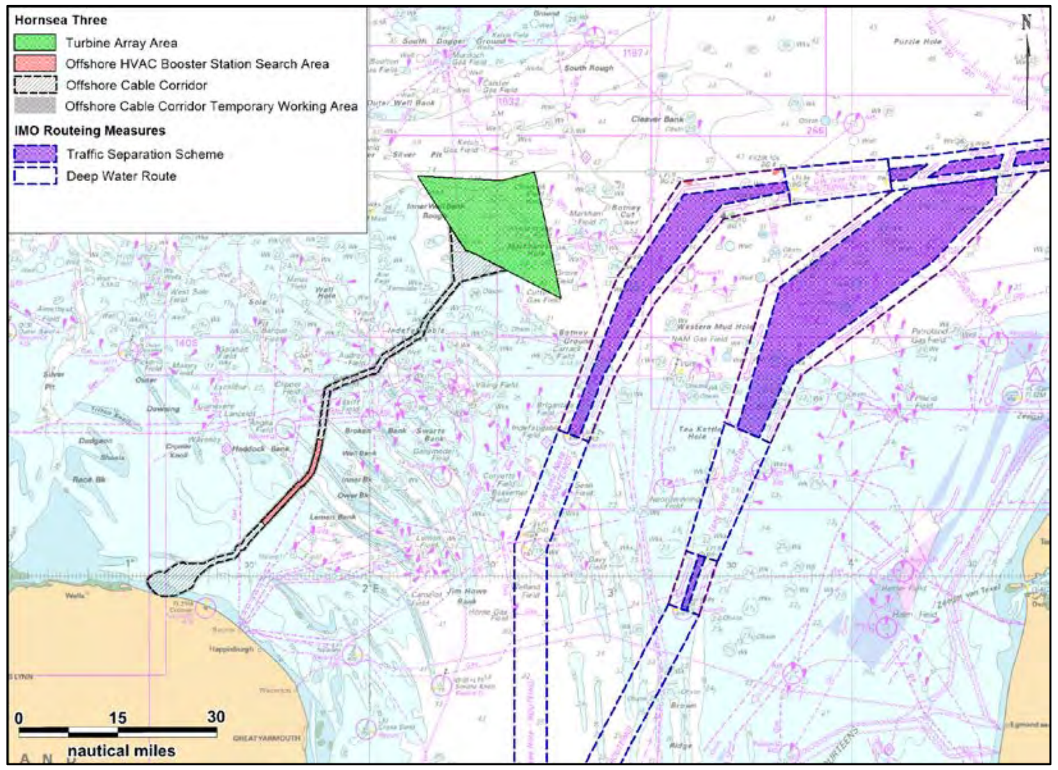


Figure 10.4: IMO routeing measures relative to Hornsea Three.

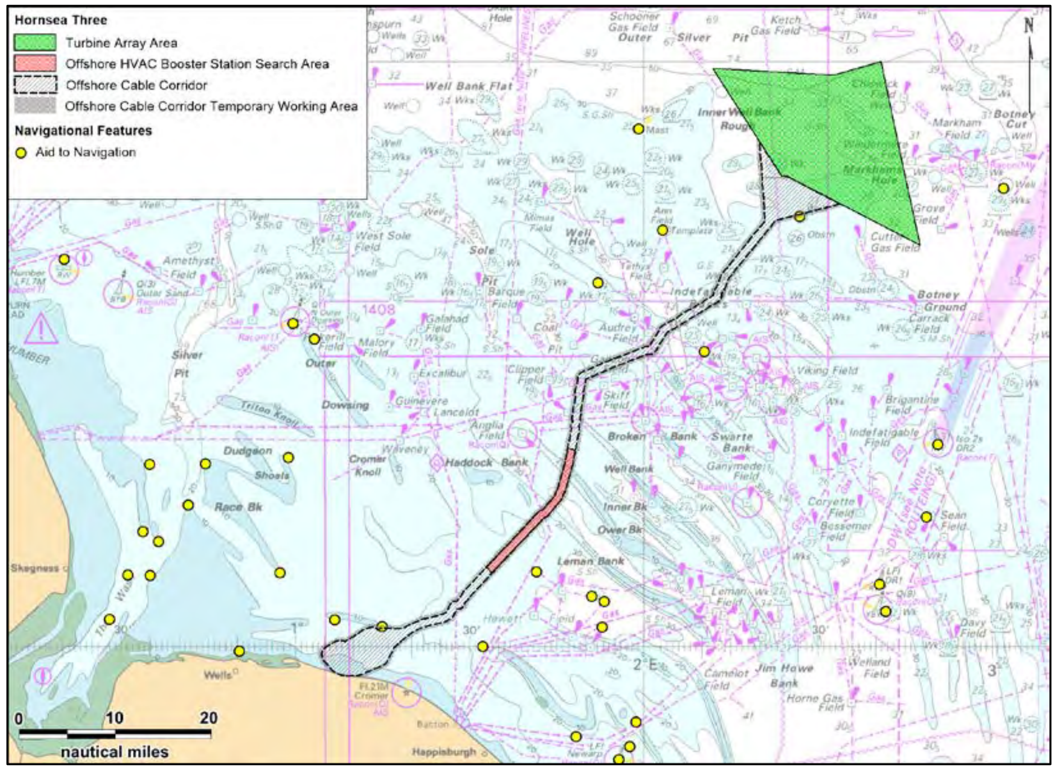


Figure 10.5: Existing AtoN relative to Hornsea Three.

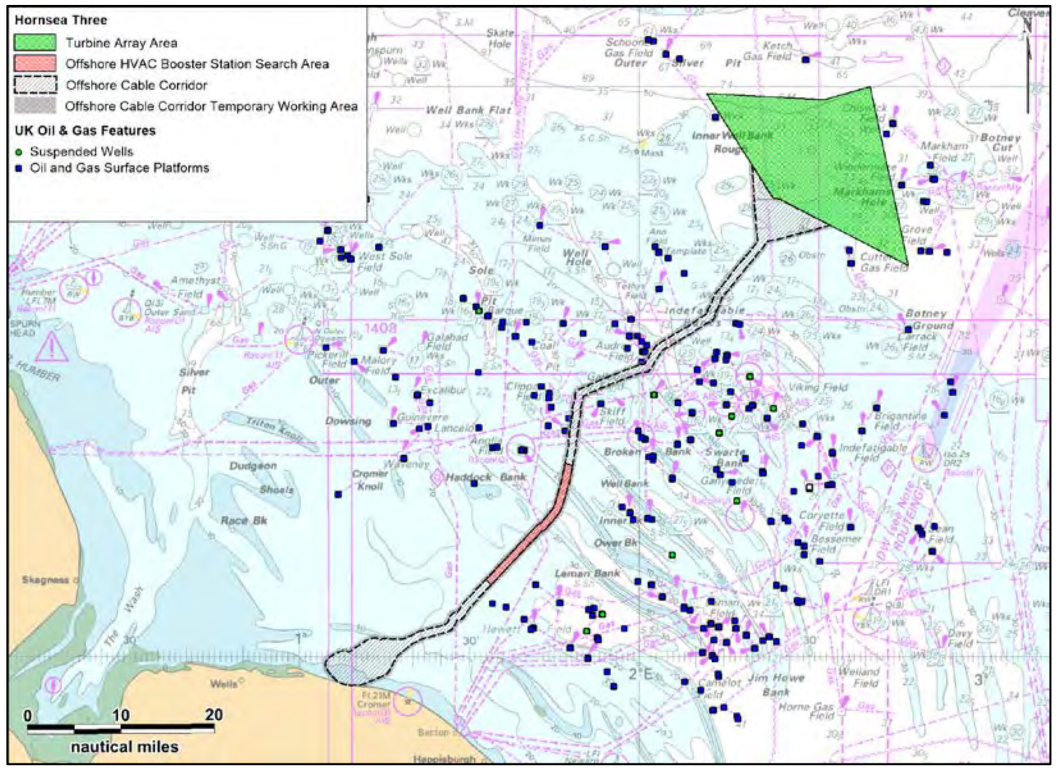


Figure 10.6: Oil and gas platforms and suspended wells relative to Hornsea Three.

Table 10.1: Offshore surface installations within 5 nm of Hornsea Three array area.

Offshore surface installation	Approximate distance from Hornsea Three array area	Nearest array area boundary to the offshore surface installation
Windermere platform	0.98 nm	East
Chiswick platform	1.45 nm	East
Grove platform	2.43 nm	East
Cutter platform	2.52 nm	South
Ketch platform	4.15 nm	North
ST-1 platform (Markham)	4.46 nm	East

10.5.1.6 There are not anticipated to be any impacts on shipping and navigation receptors associated with oil and gas platforms, however routeing to these installations is considered as part of the baseline within section 17 and as part of cumulative routeing in section 22.7.

10.6 Aggregate dredging areas and transit routes

10.6.1.1 Figure 10.7 presents the aggregate dredging areas in the vicinity of the Hornsea Three array area and Hornsea Three cable corridor.

10.6.1.2 There are no aggregate dredging areas intersecting the Hornsea Three array area or the Hornsea Three offshore cable corridor.

10.6.1.3 The eastern boundary of an option area (area 491) runs alongside the boundary of the Hornsea Three offshore cable corridor close to the Hornsea Three array area. This dredging area is owned by DEME Building Materials UK Ltd. There are two application areas (areas 483 and 506) also located in proximity to the Hornsea Three offshore cable corridor and owned by DEME Building Materials UK Ltd. which are anticipated to go into production during 2017.

10.6.1.4 Passage plans of dredgers from BMAPA show that the Hornsea Three array area is not used heavily by transiting dredgers, with only one passage plan intersecting the Hornsea Three array area.

10.6.1.5 There are not anticipated to be any impacts on shipping and navigation receptors associated with marine aggregate dredging, however routeing of marine aggregate dredgers is considered within section 17 as part of the baseline assessment.

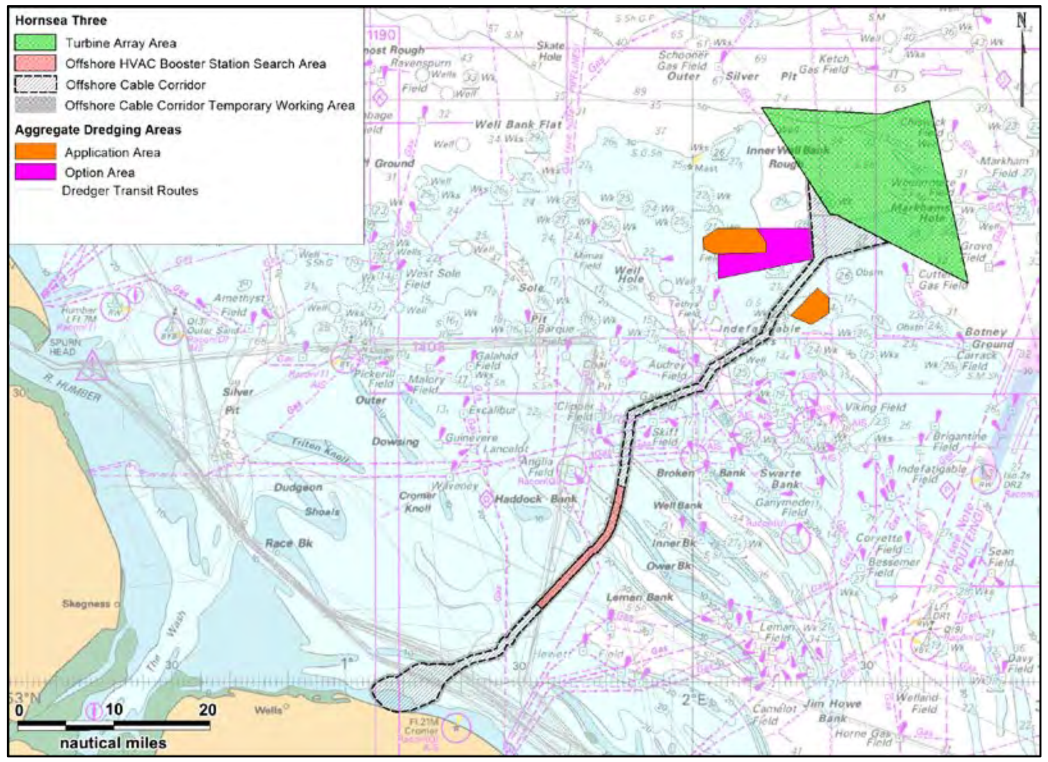


Figure 10.7: Aggregate dredging areas relative to Hornsea Three.

10.7 Other wind farm developments

10.7.1.1 Other offshore wind farm developments in the vicinity of Hornsea Three are presented in Figure 10.8.

10.7.1.2 There are a number of Round 1 and Round 2 offshore wind farms to the southwest of the Hornsea Three array area, closer to shore. The nearest of these sites are Dudgeon Offshore Wind Farm, and Triton Knoll Offshore Windfarm, located approximately 46.9 nm (86.9 km) and 54.4 nm (101 km) to the southwest respectively.

10.7.1.3 In addition to the former Hornsea Zone, there are two further Round 3 zones within the southern North Sea. The former East Anglia Zone is located approximately 28.5 nm (52.7 km) to the south of the Hornsea Three array area and the Dogger Bank Zone is located approximately 41.0 nm (75.9 km) to the north of the Hornsea Three array area.

10.7.1.4 Other wind farm developments are considered within the cumulative section, section 21.

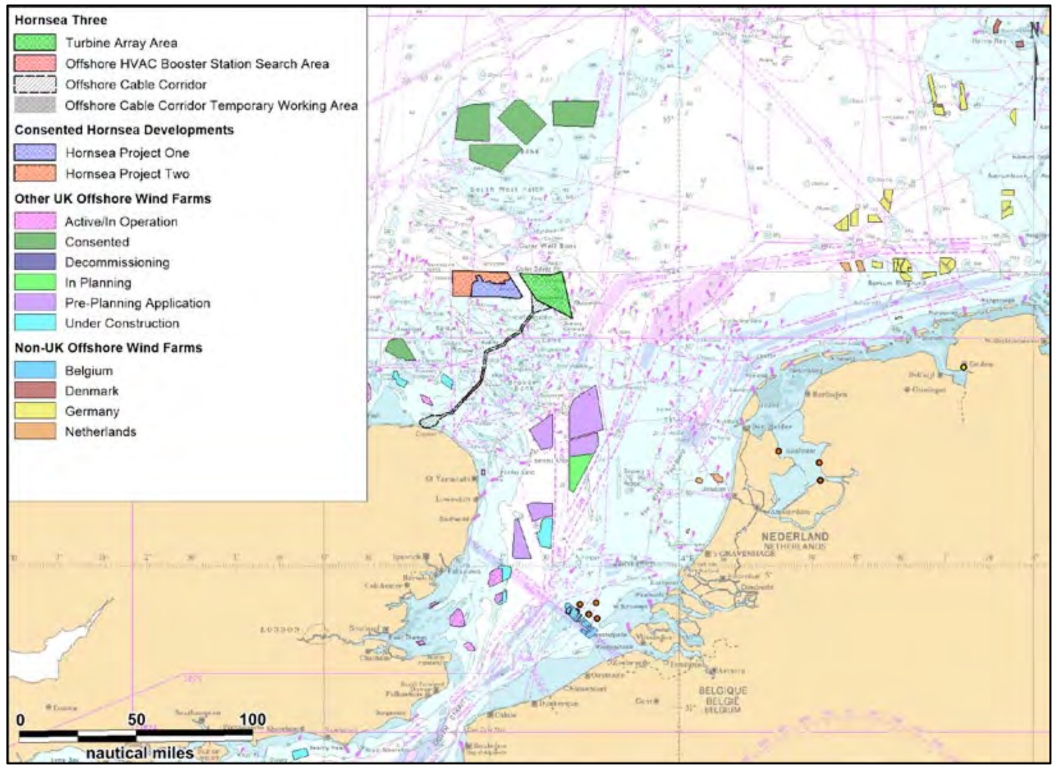


Figure 10.8: Other offshore wind farms relative to Hornsea Three.

10.8 Ministry of Defence (MOD) Practice and Exercise Areas (PEXAs)

10.8.1.1 It can be seen from Figure 10.9 that there are several MOD practice and exercise areas (PEXAs) to the north of the Hornsea Three array area. These include a submarine exercise area immediately north of the Hornsea Three array area and a naval exercise area located approximately 6.75 nm (12.5 km) to the east of the Hornsea Three array area.

10.8.1.2 No restrictions are placed on the right to transit these areas at any time although mariners are advised to exercise caution. Exercises and firing only take place when the areas are considered to be clear of all shipping.

10.8.1.3 There are not anticipated to be any impacts on shipping and navigation receptors associated with MOD PEXAs, however military vessel traffic is considered as part of the baseline in section 17

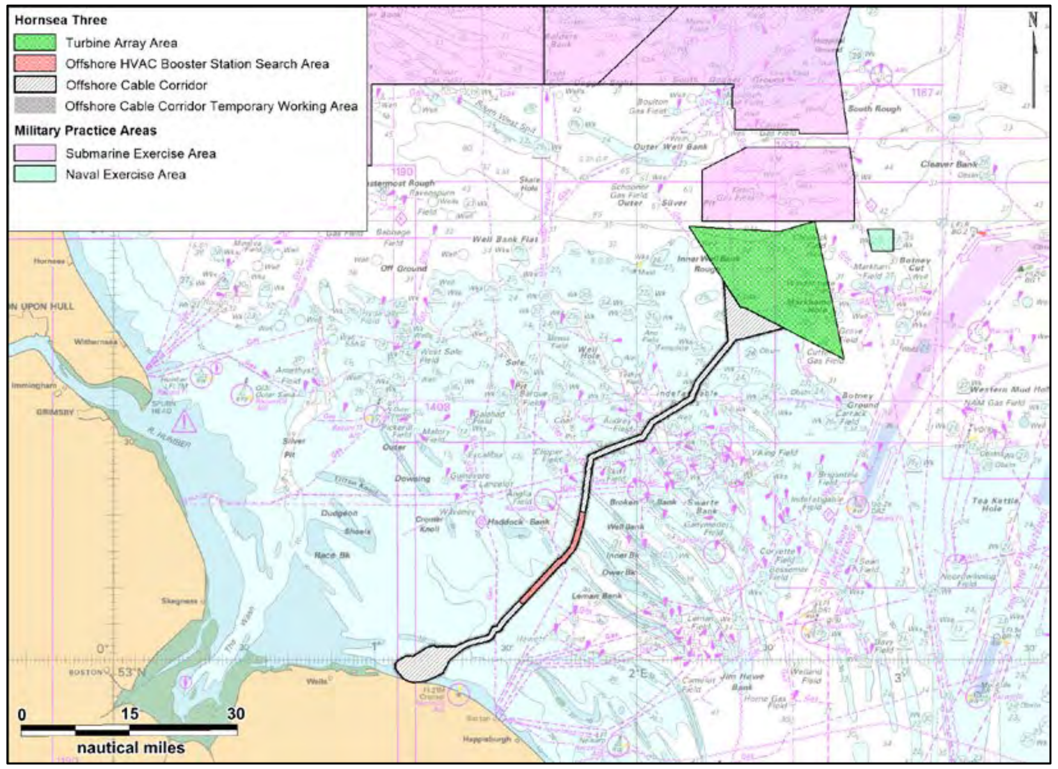


Figure 10.9: Military exercise areas relative to Hornsea Three.

10.9 Marine Environment High Risk Areas (MEHRAs)

10.9.1.1 It can be seen from Figure 10.10 that there are no Marine Environment High Risk Areas (MEHRAs) located in the vicinity of the Hornsea Three array area and Hornsea Three cable corridor. The nearest MEHRA is the Spurn Bight MEHRA located approximately 49.2 nm (91.1 km) to the northwest of the Hornsea Three offshore cable corridor.

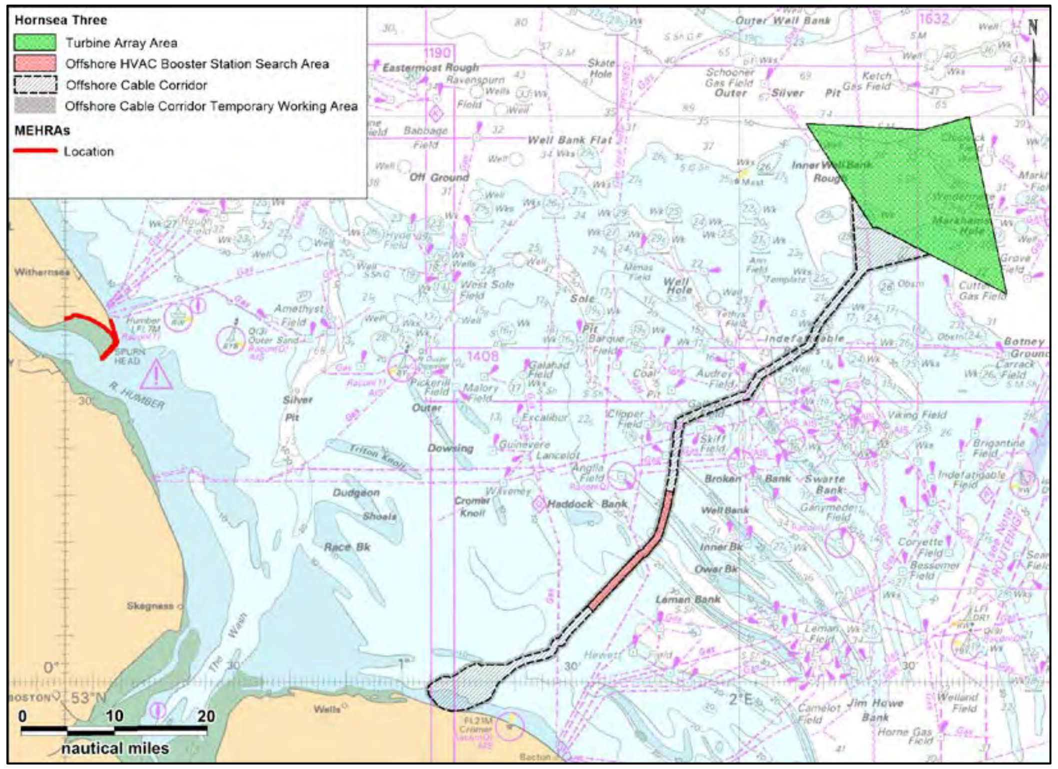


Figure 10.10:MEHRAs relative to Hornsea Three.

10.10 Wrecks

10.10.1.1 Based on Admiralty Charts of the region, the locations of wrecks in the vicinity of the Hornsea Three array area and Hornsea Three cable corridor are presented in Figure 10.11.

10.10.1.2 There are two charted wrecks within the Hornsea Three array area, located near the northern and western boundaries. There are three charted wrecks within the Hornsea Three offshore cable corridor, all located near the Hornsea Three landfall area.

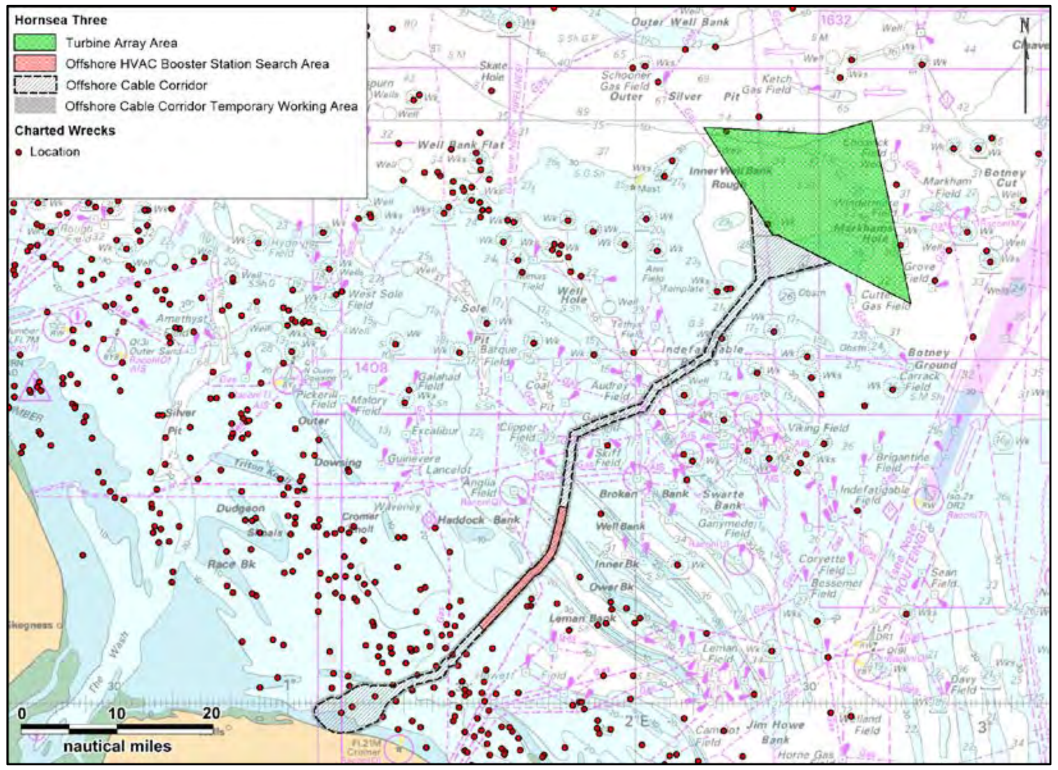


Figure 10.11:Charted wrecks relative to Hornsea Three.

11. Metocean Data

11.1 Introduction

11.1.1.1 This section presents nearby meteorological and oceanographic statistics for Hornsea Three which have been used as input to the risk assessment.

11.2 Wind

11.2.1.1 The wind data for the Hornsea Three array area (Health and Safety Executive, 2001), in terms of the average annual wind direction, are presented in Figure 11.1 in the form of a wind rose. It can be seen that winds are predominantly from the south and west, with 22% of the annual winds recorded from the southwest. This wind data has been used as an input throughout the collision and allision risk modelling carried out as part of the NRA (see section 18).

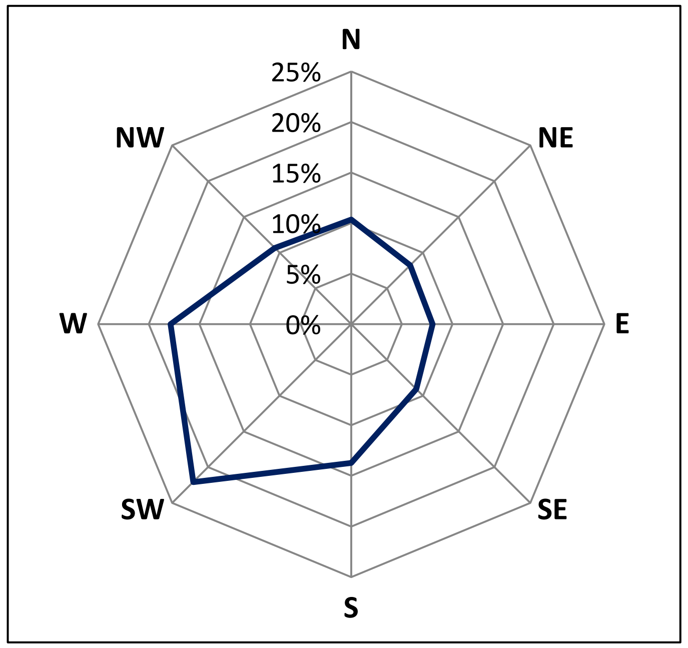


Figure 11.1: Annual wind direction distribution in proximity to Hornsea Three.

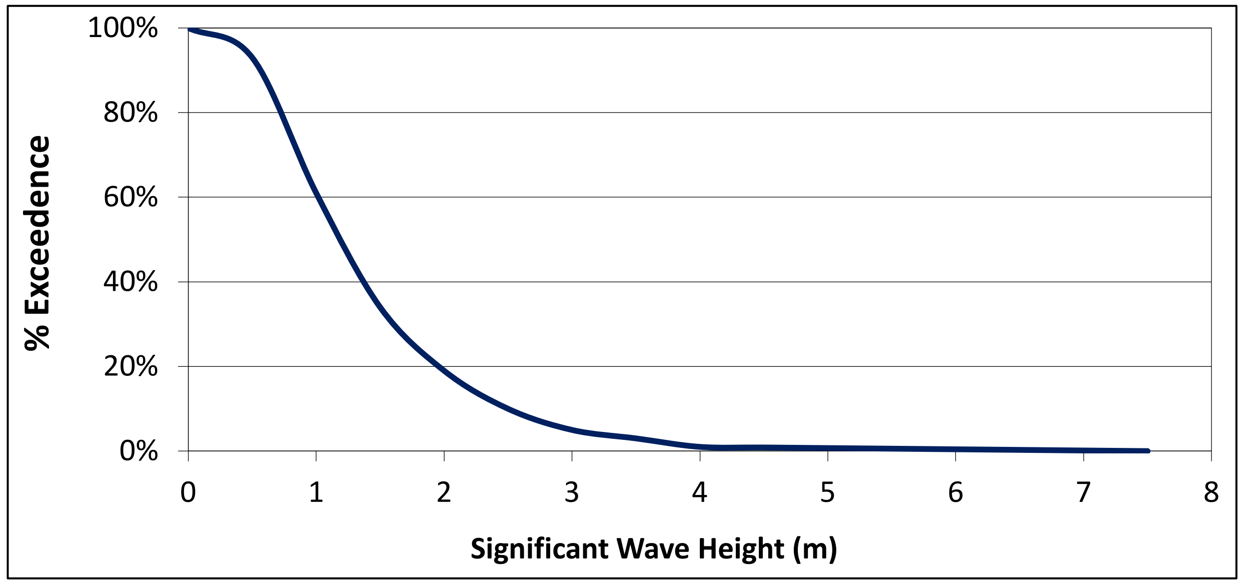


Figure 11.2: Annual significant wave height distribution in proximity to Hornsea Three.

11.3 Wave

11.3.1.1 The wave data for the area (HSE, 2001), in terms of the average percentage exceedence of the significant wave height, are presented in Figure 11.2. From this, the sea state is defined as follows:

- Calm (significant wave height <1 m);
- Moderate (1–5 m); and
- Severe (>5 m)

11.3.1.2 Overall, 39.5% of significant wave height recordings are deemed to be characteristic of a calm sea state and 59.7% deemed to be characteristic of a moderate sea state, leaving 0.8% deemed to be characteristic of a severe sea state.

11.4 Visibility

11.4.1.1 Appendix C notes that visibility is generally good or very good at the Hornsea Three array area and that the total percentage of time that the visibility is below 2 km is 1.3% for the Hornsea Three array area.

11.4.1.2 From a marine perspective, historically, visibility has been shown to have a major influence on the risk of vessel collision. The annual average incidence of poor visibility (defined as less than 1 km) for the UK North Sea (UKHO, 2016) is approximately 0.03 (i.e. an average of 3% of the year).

11.5 Tide

11.5.1.1 Admiralty Chart 1187 (Tidal Diamond “K” within the Hornsea Three array area), indicates that currents in the area set in a generally northwest to southeast direction on the flood tide and southeast to northwest direction on the ebb tide, with a peak spring tide of 1.1 knots (kn) and peak neap tidal rate of 0.6 kn. Based on Admiralty Chart 1187, the tidal stream data points in the vicinity of Hornsea Three can be seen in Figure 11.3. The Tidal Diamond “K” information can be seen in Table 11.1.

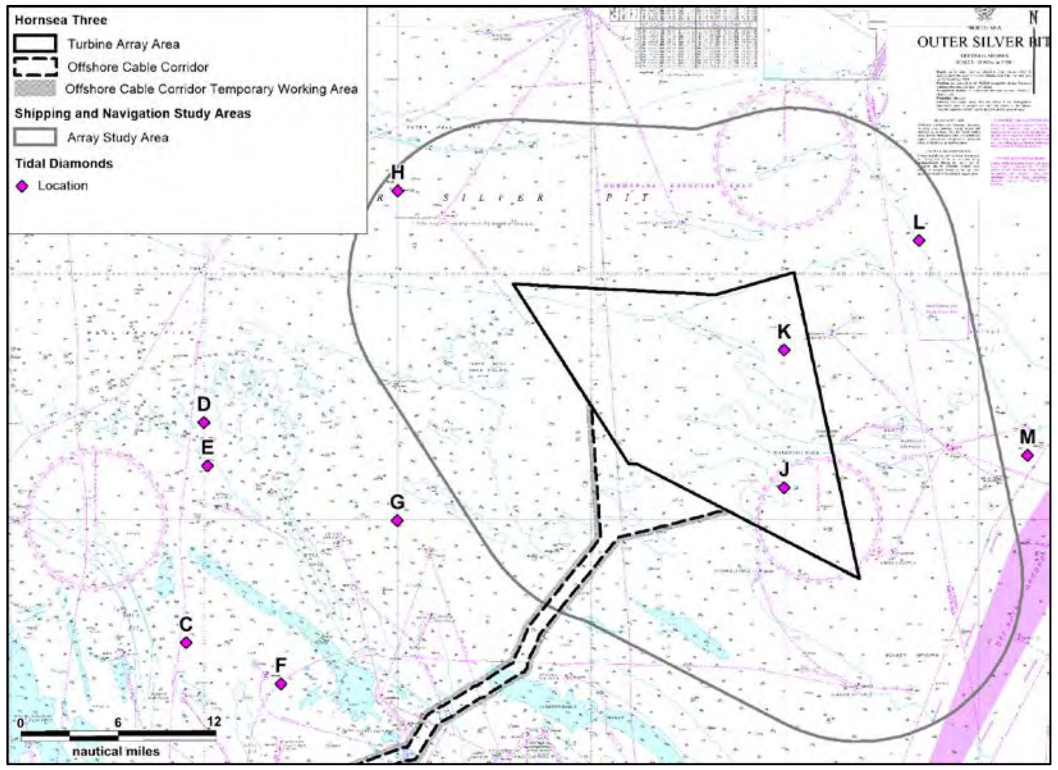


Figure 11.3: Tidal stream data points in proximity to Hornsea Three.

Table 11.1: Details for Tidal Diamond "K" Admiralty Chart 1187.

Hours		Directions of streams (degrees)	Rates at spring tide (knots)	Rates at neap tide (knots)
Before high water	6	119	0.7	0.4
	5	123	1.0	0.5
	4	126	1.1	0.6
	3	133	0.9	0.5
	2	142	0.7	0.4
	1	190	0.1	0.1
High water		291	0.6	0.3
After high water	1	302	1.0	0.5
	2	307	1.1	0.6
	3	315	1.0	0.6
	4	326	0.5	0.3
	5	030	0.2	0.1
	6	110	0.5	0.3

12. Emergency Response Overview

12.1 Introduction

12.1.1.1 This section summarises the existing search and rescue (SAR) resources in the southern North Sea and the issues being considered in relation to the design of the project.

12.2 Emergency response resources

12.2.1.1 In March 2013, the Bristow Group were awarded the contract by the MCA (through their DfT remit) to provide helicopter SAR operations in the UK over a ten year period, and took over the service from the previous provider in April 2015. There are ten base locations for the SAR helicopter service, with three of these based on existing infrastructure expected to go live in 2017. The nearest SAR helicopter base is a new purpose-built base located at Humberside, approximately 105 nm to the west of the centre of the Hornsea Three array area (see Figure 12.1), and has been in operation since April 2015. This base operates two Sikorsky S-92 aircraft.

12.2.1.2 Further information on SAR helicopters is provided in Appendix C.

12.2.1.3 Companies operating offshore typically have resources of vessels, helicopters and other equipment available for normal operations that can assist with emergencies offshore. Alongside that, all vessels under IMO obligations set out in the International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974) as amended, are required to render assistance to any person or vessel in distress if safely able to do so.

12.2.1.4 The Royal National lifeboat Institution (RNLI) is organised into six divisions, with the relevant regions for Hornsea Three being North and East. Based out of more than 230 stations, there are more than 350 lifeboats across the RNLI fleet, including both all-weather lifeboats (ALBs) and inshore lifeboats (ILBs). Based on the offshore position of Hornsea Three it is likely that ALBs from Humber would not respond to an incident in proximity to Hornsea Three given that they generally operate closer to shore due to endurance and transit time; it is also noted that the RNLI have a 100 nm operational limit. Locations of RNLI lifeboat stations along the east coast of England are presented in Figure 12.1 and details of the types of lifeboats operating out of these stations are given in Table 12.1. At each station crew, ALBs or ILBs are available on a 24-hour basis throughout the year.

12.3 HM Coastguard stations

12.3.1.1 HM Coastguard (HMCG), a division of the MCA, is responsible for requesting and tasking SAR resources made available to other authorities and for co-ordinating the subsequent SAR operations (unless they fall within military jurisdiction).

Table 12.1: Lifeboats held at nearby RNLI stations.

Station	Lifeboats	All Weather Lifeboat (ALB) Class	Inshore Lifeboat (ILB) Class	Approximate distance to centre of Hornsea Three array area (nm)
Scarborough	ALB & ILB	Shannon	D Class	106
Filey	ALB & ILB	Mersey	D Class	101
Flamborough	ILB		B Class	94
Bridlington	ALB & ILB	Mersey	D Class	97
Withernsea	ILB		D Class	88
Humber	ALB	Severn		88
Cleethorpes	ILB		D Class	93
Mablethorpe	ILB (x2)		B & D Class	87
Skegness	ALB & ILB	Mersey	D Class	89
Hunstanton	ILB & Hovercraft		B Class	91
Wells	ALB & IRB	Mersey	D Class	81
Sheringham	ILB		B Class	73
Cromer	ALB & ILB	Tamar	D Class	72
Happisburgh	ILB (x2)		B & D Class	73

12.3.1.2 The HMCG co-ordinates SAR operations through a network of 11 Coastguard Operations Centres (CGOC), including a National Maritime Operations Centre (NMOC) based in Hampshire. A corps of over 3,500 volunteer Coastguard Rescue Officers (CROs) around the UK form over 352 local Coastguard Rescue Teams (CRT) involved in coastal rescue, searches and surveillance.

12.3.1.3 All of the MCA's operations, including SAR, are divided into three geographical regions. The East of England Region covers the east and south coasts of England from the Scottish border down to the Dorset/Devon border, and therefore covers the area around Hornsea Three.

12.3.1.4 Each region is divided into six districts with its own CGOC, which coordinates the SAR response for maritime and coastal emergencies within its district boundaries (East of England includes an additional station, London Coastguard, for co-ordinating SAR on the River Thames). The nearest rescue co-ordination centre to Hornsea Three is the Humber CGOC based in Bridlington, East Yorkshire, located approximately 83.7 nm (155 km) from Hornsea Three.

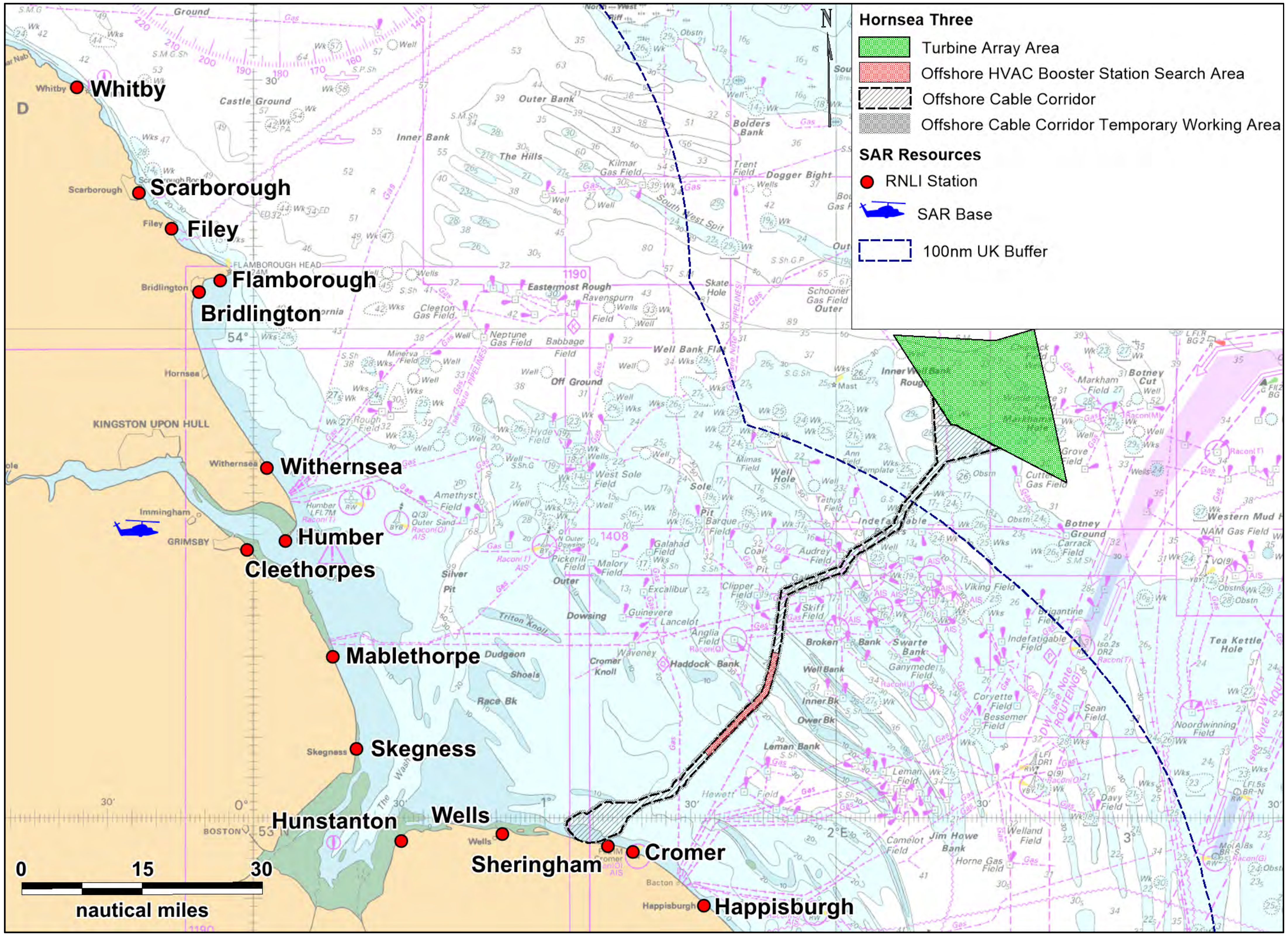


Figure 12.1: SAR resources in proximity to Hornsea Three.

13. Maritime Incidents

13.1 Introduction

13.1.1.1 This section reviews maritime incidents that have occurred in the vicinity of Hornsea Three between 2005 and 2014.

13.1.1.2 The analysis relies on expert opinion is intended to provide a general indication as to whether the area of the proposed development is currently low or high risk in terms of maritime incidents. If it was found to be a particularly high risk area for incidents, this may indicate that the development could exacerbate the existing maritime safety risks in the area.

13.1.1.3 Data from the following sources have been analysed:

- Marine Accident Investigation Branch (MAIB); and
- Royal National Lifeboat Data (RNLI).

13.1.1.4 It is noted that the same incident may be recorded by both sources.

13.2 MAIB incident data

13.2.1.1 All UK commercial vessels are required to report accidents to the MAIB. Non-UK vessels do not have to report unless they are in a UK port or are in 12 mile territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report accidents to the MAIB.

13.2.1.2 The locations of accidents, injuries and hazardous incidents reported to the MAIB within the Hornsea Three array area shipping and navigation study area for the ten year period between January 2005 and December 2014 are presented in Figure 13.1 and are colour-coded by type. It should be noted that the MAIB aim for 97% accuracy in reporting locations of incidents.

13.2.1.3 A total of five unique incidents, with one incident involving two vessels, were reported within the Hornsea Three array area shipping and navigation study area, corresponding to an average of approximately one incident every two years. None of these incidents occurred within the Hornsea Three array area.

13.2.1.4 The most frequently recorded incident type (throughout the ten year dataset) was “Accident to Person”, representing 60% of the total incidents.

13.2.1.5 Figure 13.2 presents the casualty type of the five incidents recorded within the Hornsea Three array area shipping and navigation study area.

13.2.1.6 Fishing and oil and gas affiliated vessels were the most frequently recorded casualty types (33.3% each for all incidents) throughout the ten year period analysed.

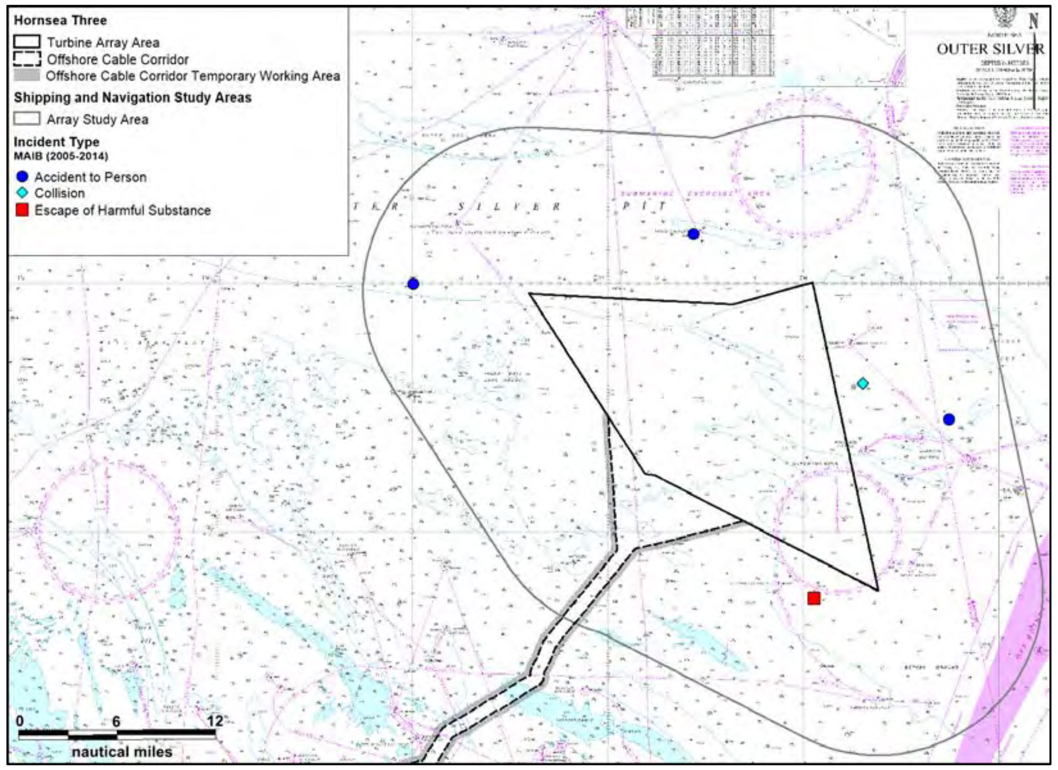


Figure 13.1: MAIB incident locations by type within Hornsea Three array area shipping and navigation study area (2005 to 2014).

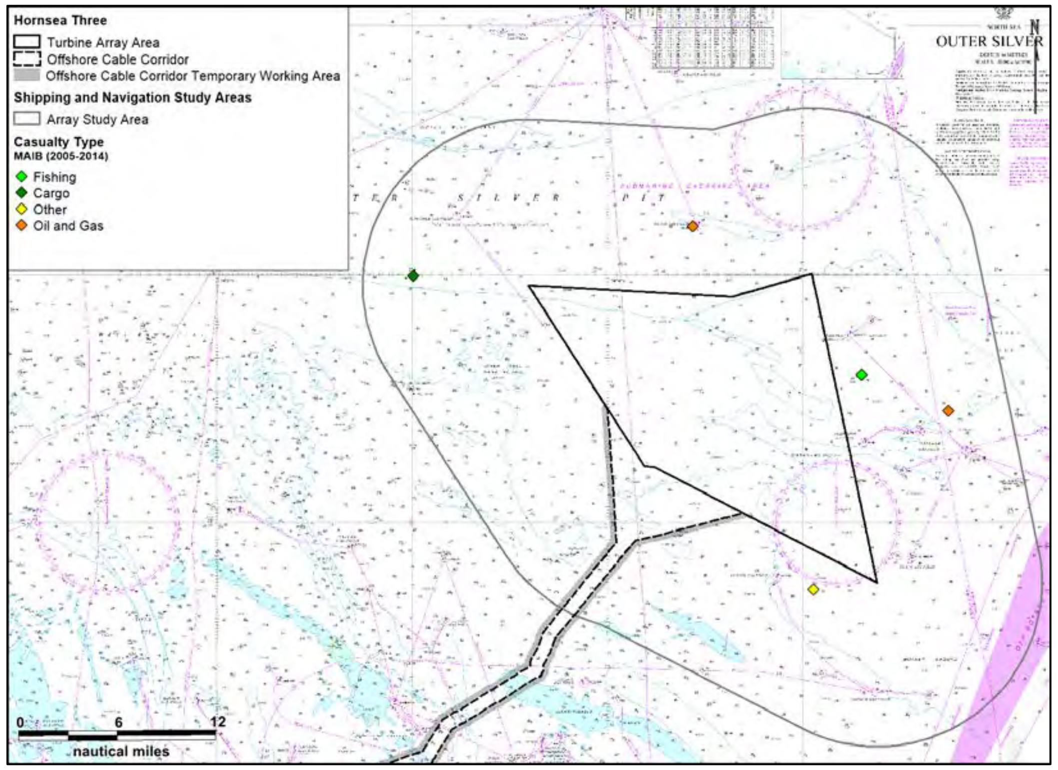


Figure 13.2: MAIB incidents by casualty type within Hornsea Three array area shipping and navigation study area (2005 to 2014).

13.2.1.7 The locations of accidents, injuries and hazardous incidents reported to the MAIB within the Hornsea Three offshore cable corridor shipping and navigation study area for the ten year period between January 2005 and December 2014 are presented in Figure 13.3 and are colour-coded by type.

13.2.1.8 A total of 16 unique incidents, with one incident involving two vessels, were reported within the Hornsea Three offshore cable corridor shipping and navigation study area, corresponding to an average of approximately one incident every 1.5 years. Five of these incidents occurred within the Hornsea Three offshore cable corridor, all in proximity to the coast.

13.2.1.9 The most frequently recorded incident type (throughout the ten year dataset) was “Machinery Failure”, representing 31% of the total incidents.

13.2.1.10 Figure 13.4 presents the casualty type of the 16 incidents recorded within the Hornsea Three offshore cable corridor shipping and navigation study area.

13.2.1.11 Oil and gas affiliated vessels were the most frequently recorded vessel type (of all incidents) throughout the ten year period analysed.

13.2.1.12 Of the five incidents recorded within the Hornsea Three offshore cable corridor, three were classified as “Machinery Failure”, with the others being “Accident to Person” and “Hazardous Incident”. Two of the incidents involved a fishing vessel, with the others involving a passenger vessel, a tanker and an “other” commercial vessel.

13.2.1.13 The locations of accidents, injuries and hazardous incidents reported to the MAIB within the Hornsea Three offshore HVAC booster station search area shipping and navigation study area for the ten year period between January 2005 and December 2014 are presented in Figure 13.5 and are colour-coded by type.

13.2.1.14 Two incidents were reported within the Hornsea Three offshore HVAC booster station search area shipping and navigation study area, corresponding to an average of approximately one incident every five years.

13.2.1.15 Both of the incidents recorded were of the “Accident to Person” type and involved vessels associated with the offshore oil and gas industry, one of which was a standby safety vessel.

13.2.1.16 The most recent incident reported to the MAIB within the offshore HVAC booster station shipping and navigation study area in November 2014 approximately 3.2 nm north of the Hornsea Three offshore HVAC booster station search area.

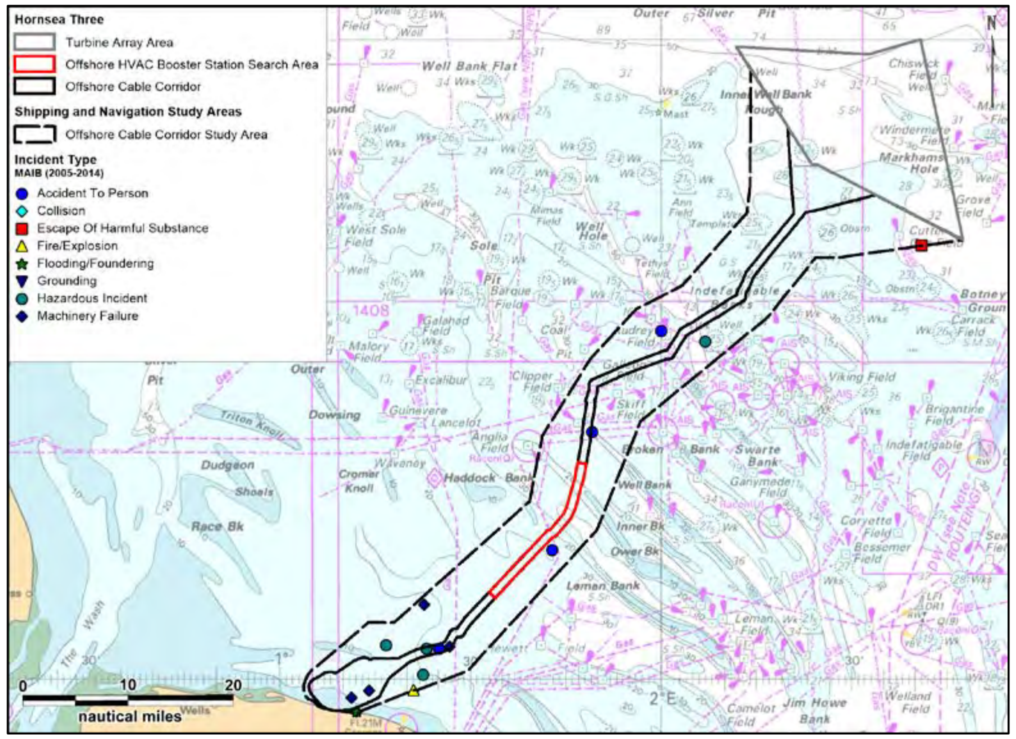


Figure 13.3 MAIB incident locations by type within Hornsea Three offshore cable corridor shipping and navigation study area (2005 to 2014).

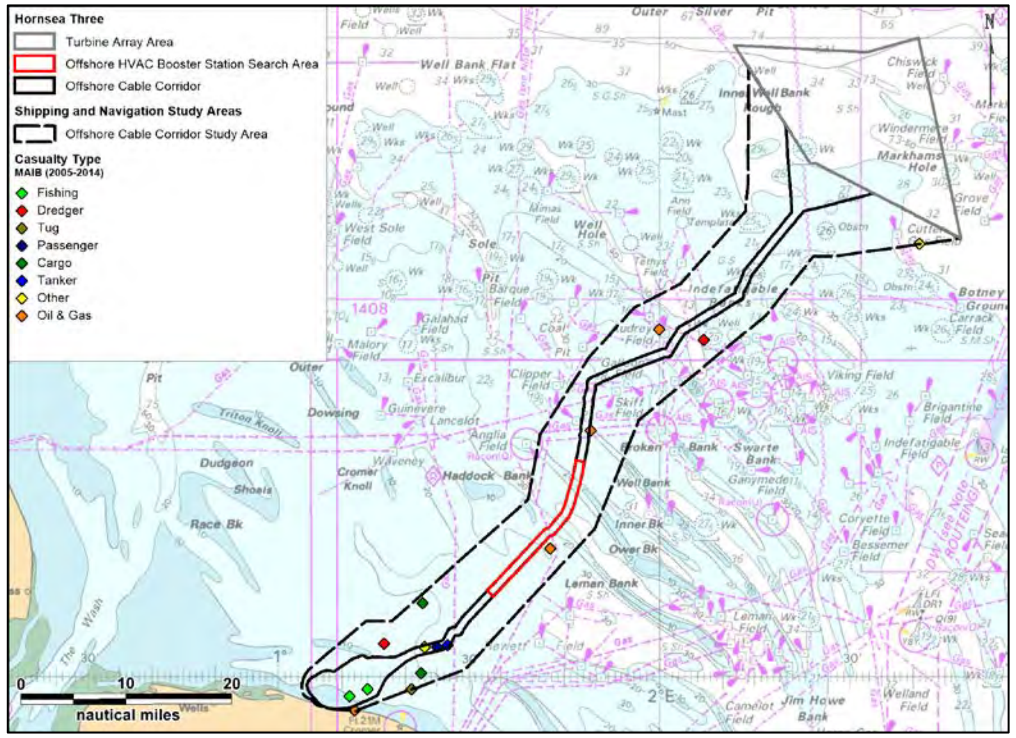


Figure 13.4 MAIB incident locations by casualty type within Hornsea Three offshore cable corridor shipping and navigation study area (2005 to 2014).

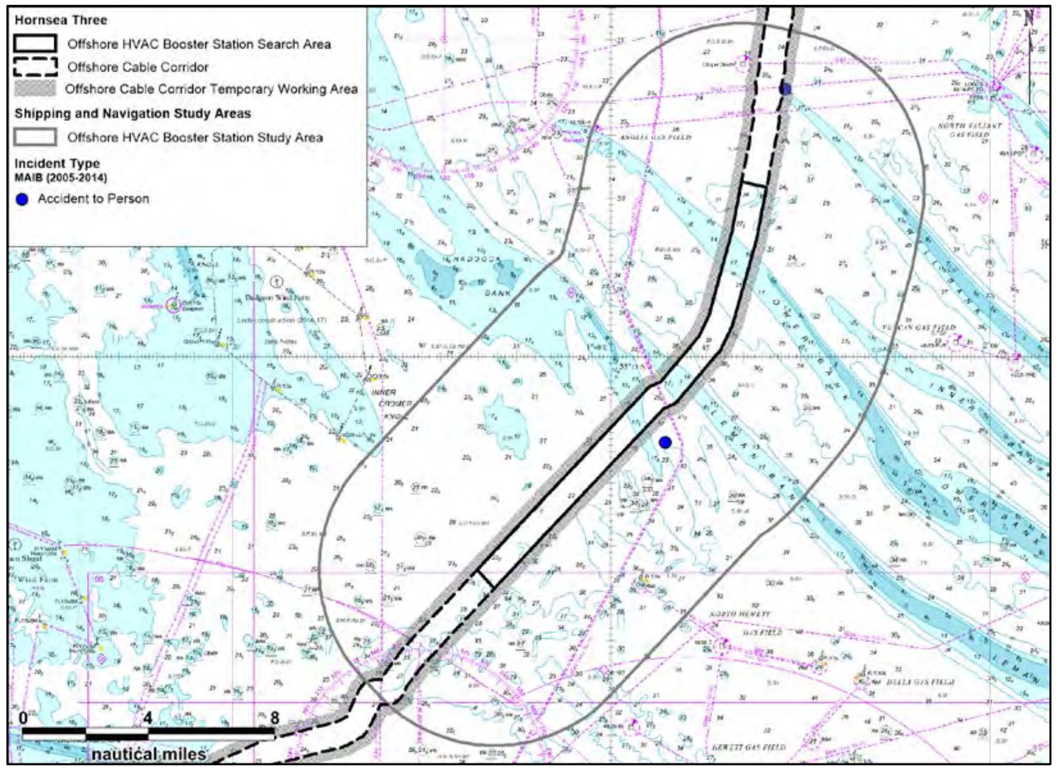


Figure 13.5: MAIB incident locations by type within Hornsea Three offshore HVAC booster station shipping and navigation study area (2005 to 2014).

13.3 RNLI incident data

13.3.1.1 Data on RNLI lifeboat responses within the array area shipping and navigation study area for the ten year period between 2005 and 2014 were analysed, with cases of a hoax or false alarms excluded. It is noted that the RNLI have a strategic performance standard of reaching casualties up to a maximum of 100 nm from shore and therefore due to the distance offshore and journey time to respond, the RNLI may respond to a drifting vessel but are unlikely to respond to a life-saving incident in proximity to the Hornsea Three array area.

13.3.1.2 It was found that no launches to incidents within the Hornsea Three array area shipping and navigation study area were recorded by the RNLI throughout the ten year period analysed. The closest incident recorded by the RNLI occurred approximately 215 m outside of the Hornsea Three array shipping and navigation study area and featured a fishing vessel involved in a collision.

13.3.1.3 A total of 29 launches, excluding hoaxes and false alarms, to 29 unique incidents were recorded within the Hornsea Three offshore cable corridor shipping and navigation study area. Figure 13.6 and Figure 13.7 present the geographical location of incidents colour-coded by cause and casualty type respectively. It can be seen that the majority of incidents attended by the RNLI were located in proximity to the coast and in shallow waters.

13.3.1.4 "Machinery Failure" was the most frequently recorded incident type, representing 48% of the total number of incidents.

13.3.1.5 Fishing vessels were the most frequently recorded casualty type (34% of all incidents) throughout the ten year period analysed.

13.3.1.6 The majority of the reported RNLI incidents within the Hornsea Three offshore cable corridor shipping and navigation study area were responded to by lifeboats from the Sheringham or Cromer RNLI lifeboat station.

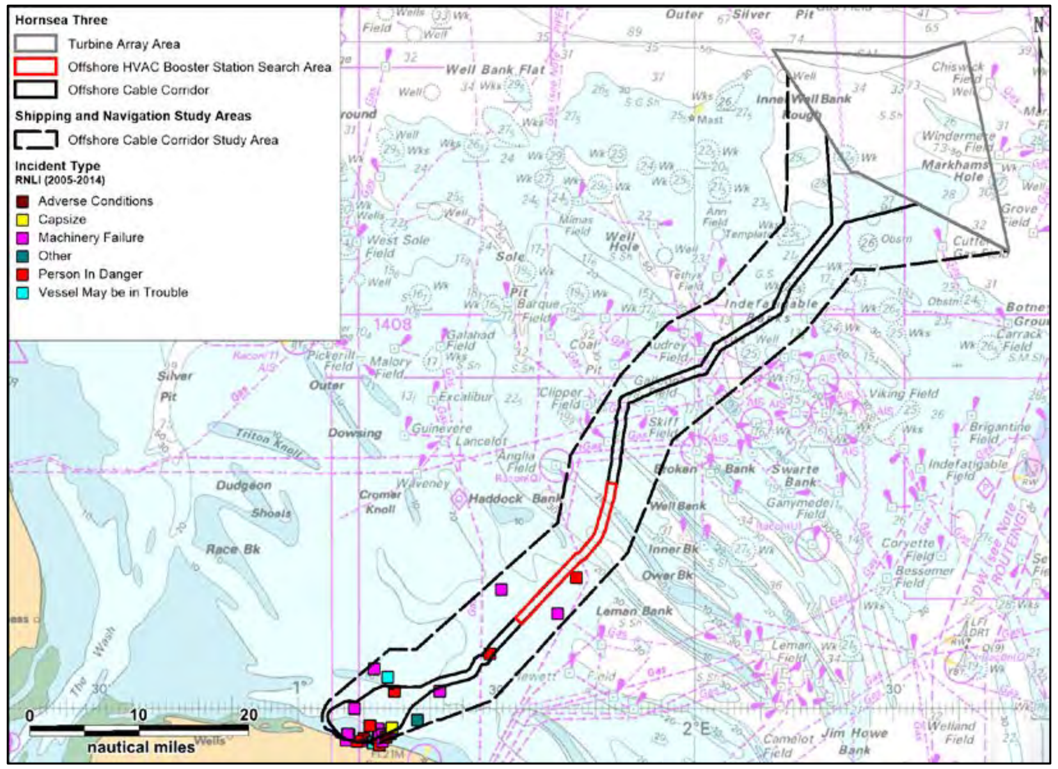


Figure 13.6 RNLI incidents by cause within the Hornsea Three offshore cable corridor shipping and navigation study area (2005 to 2014).

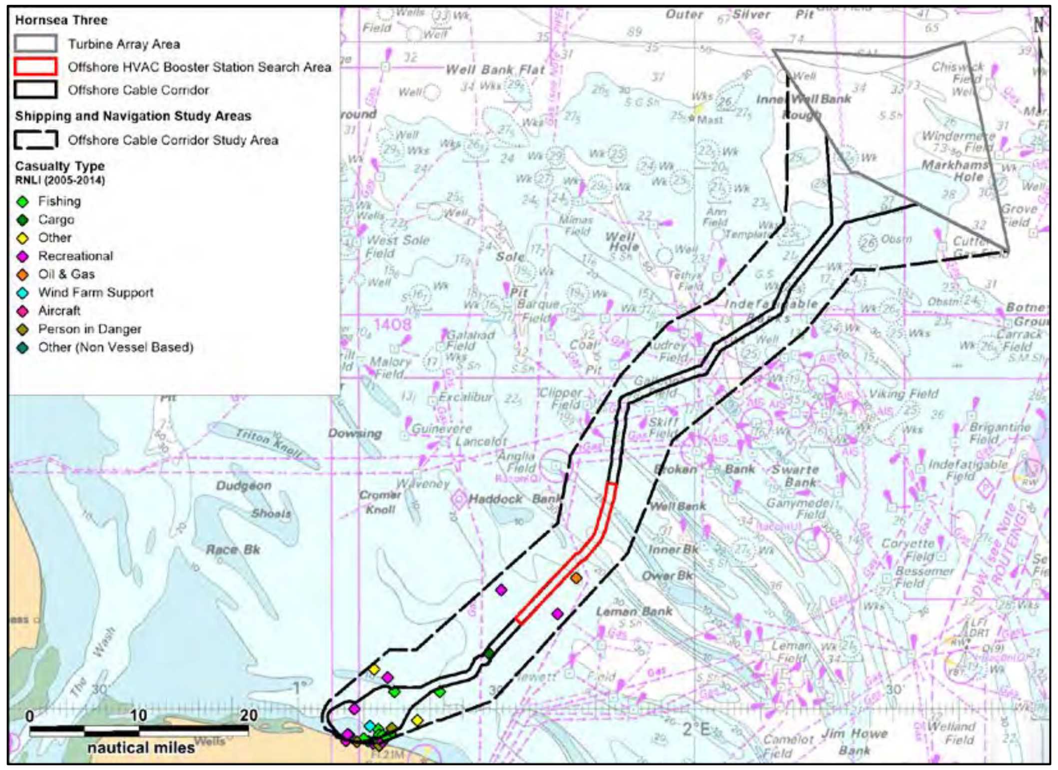


Figure 13.7 RNLI incidents by casualty type within Hornsea Three offshore cable corridor shipping and navigation study area (2005 to 2014).

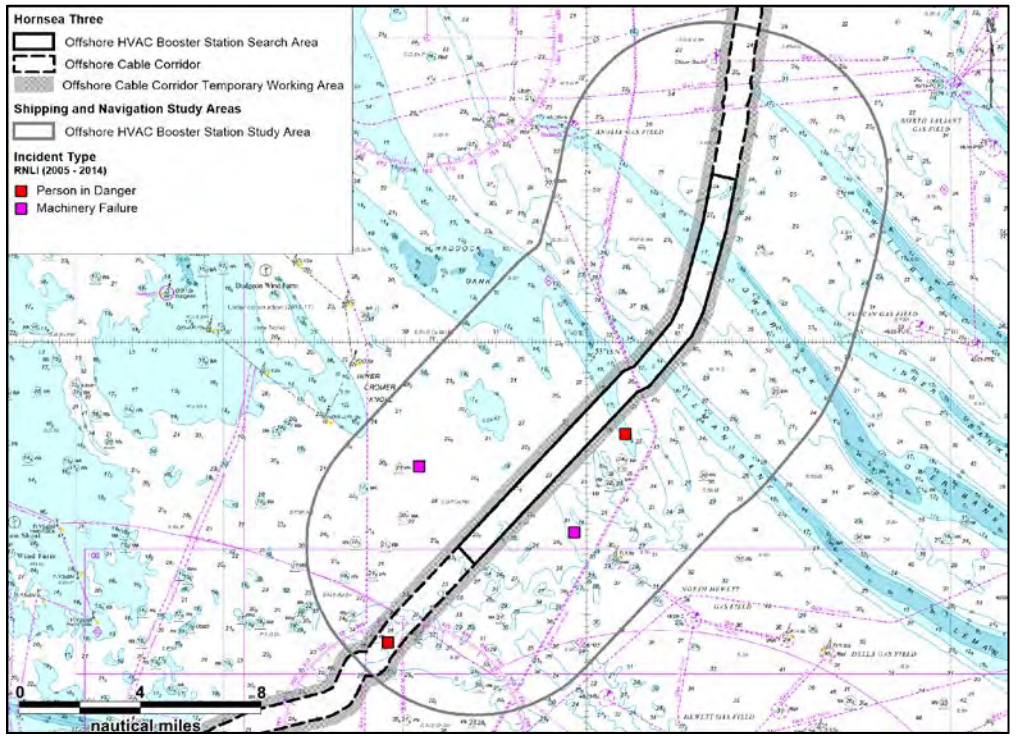


Figure 13.8: RNLI incidents by cause within the Hornsea Three offshore HVAC booster station shipping and navigation study area (2005 to 2014).

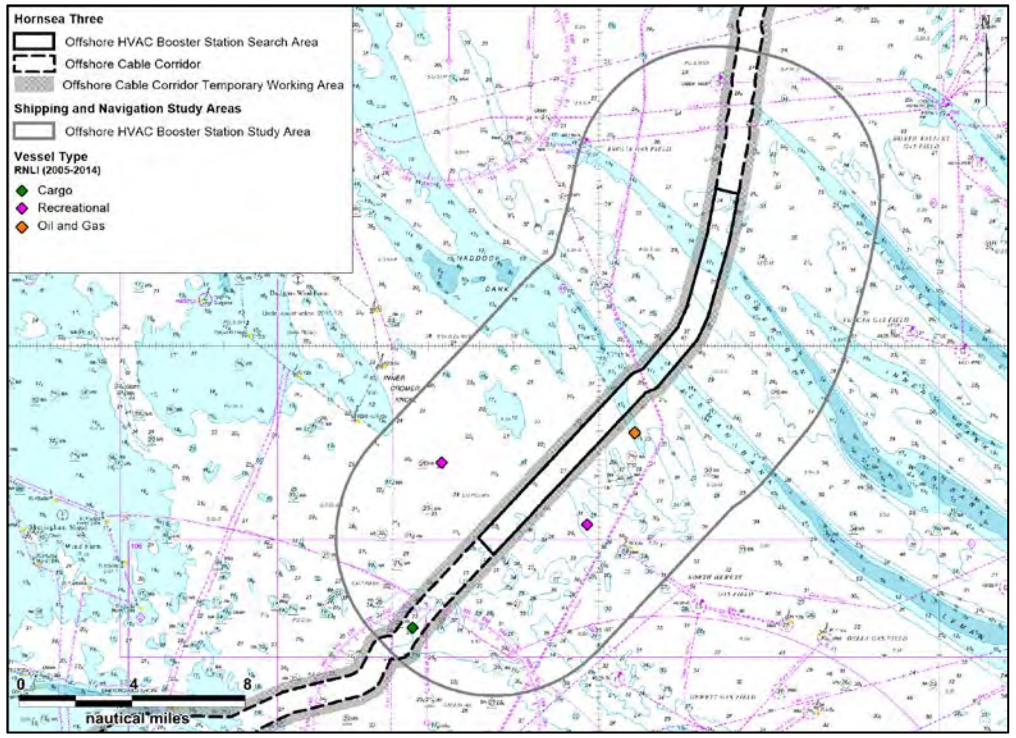


Figure 13.9: RNLI incidents by casualty type within the Hornsea Three offshore HVAC booster station shipping and navigation study area (2005 to 2014).

13.3.1.7 A total of four launches, excluding hoaxes and false alarms, to four unique incidents were recorded within the Hornsea Three offshore HVAC booster station search area shipping and navigation study area. Figure 13.8 and Figure 13.9 present the geographical location of incidents colour-coded by cause and casualty type respectively.

13.3.1.8 “Machinery Failure” and “Person in Danger” were the most frequently recorded incident types each representing 50% of the total number of incidents.

13.3.1.9 Recreational vessels were the most frequently recorded casualty type (50% of all incidents) throughout the ten year period analysed.

13.3.1.10 All of the reported RNLI incidents within the Hornsea Three offshore HVAC booster station search area shipping and navigation study area were responded to by lifeboats from the Cromer RNLI lifeboat station.

13.4 Historical offshore wind farm incidents

13.4.1.1 Table 13.1 presents historical collision and allision incidents involving wind farm sites and the resulting damage to the vessel involved and/or injury to the people involved.

13.4.1.2 Between 2005 and 2016 there were 13 incidents involving a renewable energy installation and/or a wind farm vessel. Of the 14, two were collision incidents and 12 allision incidents.

13.4.1.3 Of the two collision incidents, one was a third party vessel to wind farm vessel whilst manoeuvring within harbour and the second was between two wind farm vessels. To date there have not been any third party to wind farm vessel incidents or third party to third party incidents at or near a wind farm site.

Table 13.1: Summary of historical collision and allision incidents involving wind farm sites.

Project or third party	Incident type	Date	Description of incident	Damage to vessel (as per the incident reports)	Injury to person	Source
Project	ALLISION - Service vessel with turbine	7 August 2005	A vessel involved with the installation of offshore turbines, underestimated the effect of the current and made contact with the base of a turbines while manoeuvring alongside it. Minor damage was sustained to a gangway on the vessel, the tower and a wind turbine blade.	Minor damage to gangway on the vessel	No injury	MAIB
Project	ALLISION - service vessel with turbine	29 September 2006	When approaching an offshore wind turbine, to conduct servicing operations, an offshore support vessel was struck by the tip of a wind turbine blade. The accident occurred because the blade was not secured in a fixed position, and was rotating as the vessel approached.	No damage to vessel	No Injury	MAIB
Project	ALLISION - service vessel with disused pile	8 February 2010	An 18 m work boat was servicing a wind farm. Directly astern of the vessel was a test pile (now disused and no longer required), the position of which was well marked and known to skipper. While vessel was manoeuvring within about 3 metres of this pile, the skippers hand slipped on the throttle controls, pulling the port throttle to full astern. The skipper realised there was a problem, and quickly tried to stop the vessel from moving astern, but as the pile was so close, there was not time or room to do so. The vessel struck the pile, causing minor damage to the stern fenders and deck plating. The impact caused a passenger, who was moving around the interior to be thrown off his feet, and to fall against furniture and injure himself. The passenger injuries did not seem to be very serious at the time and he mounted the turbine to work as usual, but later reported sick and was taken to hospital where back injuries were diagnosed. Once the vessel was safely clear of the pile and the situation stabilised, the skipper checked around for further damage but no serious damage was found. No water ingressed.	Minor damage to vessel	Injury	MAIB
Third party and Project in harbour	COLLISION - service vessel collision with vessel	23 April 2011	Third party catamaran was hit by a project guard boat. The collision took place in Ramsgate harbour.	Moderate damage to vessel	No injury	MAIB
Project	ALLISON - service vessel with turbine	18 November 2011	A cable laying vessel suffered two hull breaches in way of a fresh tank and damage to the steel rubbing strake after it struck the foundations of a partially completed turbine. The subsequent company investigation found that the Officer of the Watch (OOW) had fallen asleep while on watch and woke to find the vessel inside the wind farm. He attempted to take the vessel out of the farm on autopilot but the settings were such that the vessel did not turn quickly enough and the vessel made contact with the partially built structure. Nobody on the vessel felt the impact and the second officer deleted the passage on the electronic chart system to avoid detection. However, when the crew woke the next morning, the mate found that the vessel had lost 90 tonnes of fresh water and there was further cause for concern when the vessel's potable water supply tasted salty. The electronic chart system track was recovered and the second officer challenged. He eventually admitted what had happened and following the investigation, was dismissed from the vessel.	Major damage to vessel	No injury	MAIB
Project	COLLISION - Service vessel collision with service vessel	2 June 2012	Nine wind farm workers were safely evacuated from their personnel transfer vessel into a life raft after their vessel became lodged under the boat landing equipment of the floating hotel. The workers were returning to their accommodation on the "floatel" after their shift installing and commissioning turbines when the incident occurred. A section of the flotels boat landing equipment detached and the bow of the personnel transfer vessel was lodged underneath just as workers were preparing to transfer on-board. The life raft was deployed and all passengers were safely evacuated and transferred to a nearby vessel before being brought in to port.	Moderate damage to vessel	No Injury	Confidential Reporting Programme for Aviation and Maritime
Project	ALLISION - service vessel collision with OWF structure	20 October 2012	A wind farm service vessel caused minor damage when the officers of the watch misjudged its distance from the monopile and made contact with the vessel's stern at a wind farm site.	Minor damage to vessel	No Injury	MAIB

Project or third party	Incident type	Date	Description of incident	Damage to vessel (as per the incident reports)	Injury to person	Source
Project	ALLISION - service vessel with turbine	21 November 2012	Wind farm passenger transfer catamaran struck a floating target at a speed of 23.5 kn, whilst supporting operations at wind farm. During the incident, the 15 member crew were forced to abandon the work boat and the vessel was towed into harbour. The port hull was holed, causing extensive flooding, but there were no injuries. The investigation found that the master did not hold the correct qualifications and that navigation practices, including passage planning and monitoring, use of lookouts and knowledge of the navigation equipment were weak. In addition, the company's crew assessment procedures were not followed and the master had not been formally assessed to determine his suitability for his role. It was also noted that best practice guidance for managers and crew of offshore renewable energy passenger transfer vessels was limited and disparate, and there was no integrated method of promulgating lessons learned to the industry.	Major damage to vessel	No Injury	MAIB
Project	ALLISION - service vessel with turbine	21 November 2012	A work boat allided head on with the unlit transition piece of turbine in an offshore wind farm, at a speed of 12 kn. The impact caused the five persons on board to be forced out of their seats and sustain various injuries. A doctor was transferred to the vessel by lifeboat to treat the injured personnel. The structure immediately aft of the vessels bow fender crumpled as a result of the impact but no water ingress occurred. The investigation determined that the accident occurred because the master had relied too heavily on visual cues and had made insufficient use of the lookout and navigation equipment available. There was insufficient training, particularly in regard to navigation equipment, and no formal assessment of new masters, allowing the possibility of ingrained poor working practices being passed on. Although the turbine transition piece had been reported as unlit, the system for reporting defects had failed to result in a navigation warning being promulgated. Although not formal aids to navigation, it was inevitable that the lights would be utilised as such.	Moderate damage to vessel	Injury	MAIB
Project	ALLISION - service vessel with turbine	16 February 2013	A shipping accident occurred at the offshore wind farm. An offshore service and supply vessel collided with one of the wind farm's turbine foundations, causing serious damage to the bow fender of the twin hulled vessel.	Minor damage to vessel	No Injury	Confidential Reporting Programme for Aviation and Maritime
Project	ALLISION - service vessel with turbine	July 2013	A wind farm service vessel collided with a turbines foundation, after failure of the vessel jet drive. The incident occurred after the vessel had disembarked passengers at the sub-station and had reversed away to drift, whilst standing by for the next assignment. The jets were disengaged and engines left running, as was common practice. Under the influence of currents, the vessel drifted towards another turbine foundation and when approximately 30 m away, the vessel coxswain/skipper attempted to engage the jets. At this moment it was found that neither jet would engage. Several minutes were spent fault finding to no avail, after which the vessel coxswain/skipper assisted the deckhand with fenders. The vessel collided with the foundation, causing a buckled frame and bent plate in the port quarter bulwark, but no damage to the foundation. It was found that there was no guidance from the wind farm operator on a minimum distance of approach to offshore structures while drifting. At the speed the wind farm vessel was drifting, 30 m was not sufficient distance to allow enough time to restart the jets or to anchor.	Minor damage to vessel	No injury	International Marine Contractors Association (IMCA) Safety Flash
Project	ALLISION - service vessel with turbine	14 August 2014	An accident occurred at an offshore wind farm when a standby safety vessel collided with a turbines pile. The accident caused the vessel to leak marine gas oil and a surface sheen, 5-10 m wide and around 0.7 nm in length trailed from the vessel. The standby vessel moved under its own power to a location outside the Port Authority limits, away from environmentally sensitive areas until the leak was stopped.	Minor damage to vessel and pollution	No Injury	Confidential Reporting Programme for Aviation and Maritime
Third party	ALLISION – fishing vessel with turbine	26 May 2016	A fishing vessel collided with a wind turbine at an offshore wind farm. The incident occurred after a crew member left the vessel on auto-pilot. A lifeboat attended the incident. The vessel had been travelling to Ravenglass at the time of the incident. Vessel Master prosecuted.	Moderate damage to vessel	Injury	Web Search (BBC, 2016)

13.4.1.4 As shown in Figure 13.10, minor damage to vessels involved in the incidents was the most frequent (approximately 46%) followed by moderate damage (30%). No incidents resulted in vessel loss and in some cases no damage was sustained to the vessel involved (8%). Major damage was reported in approximately 15% of incidents. The majority of incidents involved wind farm vessels.

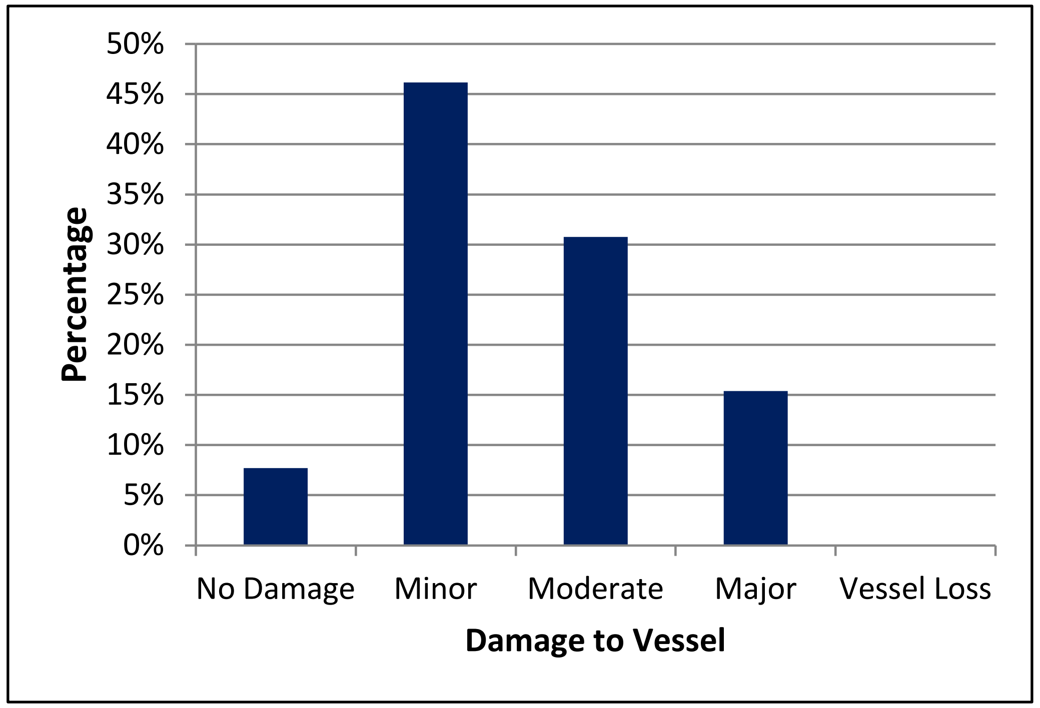


Figure 13.10: Damage to vessels involved in incidents.

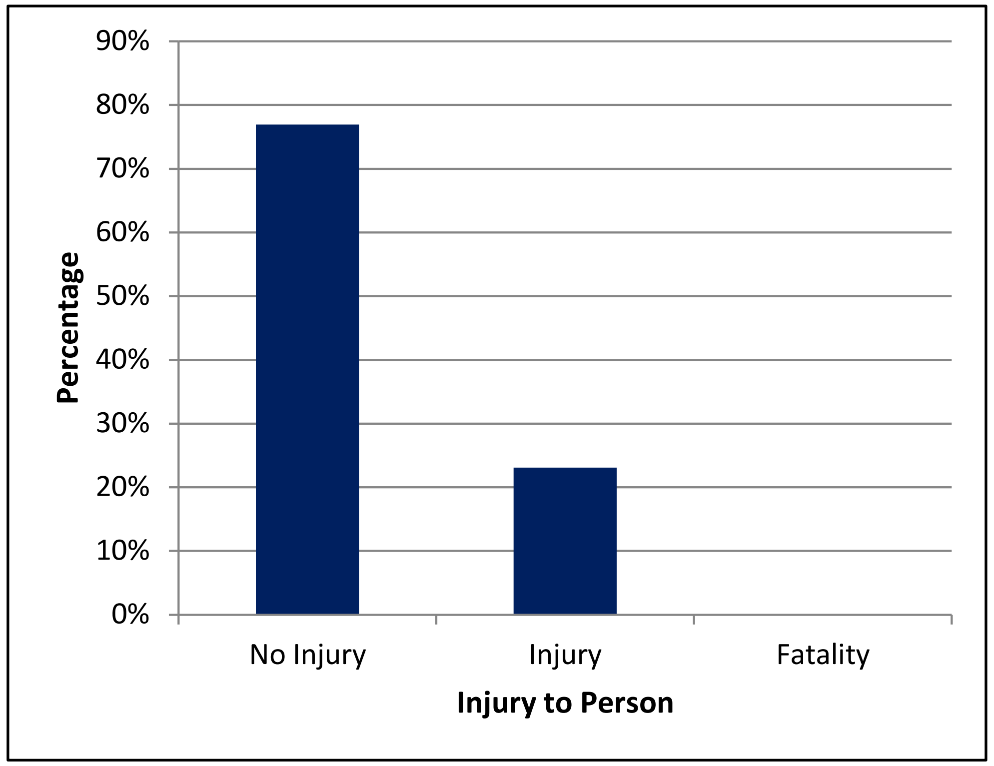


Figure 13.11: Injury as result of incident.

13.4.1.5 As shown in Figure 13.11, the majority of incidents resulted in no injury (approximately 77%). Injury occurred in approximately 23% of incidents and no fatalities were recorded. Again the majority of incidents involved wind farm vessels.

14. Overview of Key Consultation

14.1.1.1 There were 47 regular operators identified (from the marine traffic surveys) that would be required to deviate their routes due to the Hornsea Three array area or offshore HVAC booster stations were consulted via electronic or hardcopy mail. The email/letter gave an overview of Hornsea Three. Table 14.1 details the regular operators and responses received. 0 details the consultation email/letter sent to the regular operators.

14.1.1.2 Table 14.2 below summarises the issues raised relevant to shipping and navigation during consultation for Hornsea Project One and Hornsea Project Two; and applicable to Hornsea Three. Table 14.2 also indicates either how these issues have been addressed within this NRA or how Hornsea Three has had regard to them.

14.1.1.3 Table 14.3 below summarises the issues raised relevant to shipping and navigation, which have been identified during consultation activities undertaken to date for Hornsea Three. Table 14.3 also indicates either how these issues have been addressed within this NRA or how Hornsea Three has had regard to them.

Table 14.1: Regular Operators and responses.

Vessel operator	Comments received
Acciona Trasmediterranea	No comments received to date.
Aggregate Industries UK Ltd.	No comments received but attended Hazard Workshop.
Arklow Shipping	No comments received to date.
Associated Maritime CO HK Ltd.	No comments received to date.
BG Freight Line BV	No comments received to date.
Boston Putford Offshore Safety	No comments received to date.
Brostrom AB	No comments received to date.
Carnival Plc	No comments received to date.
Chemgas Shipping BV	No comments received to date.
Cobelfret Ferries NV	No comments received to date.
DFDS Seaways	*Note that following the Hazard Workshop, an additional assessment was undertaken in liaison with DFDS Seaways regarding adverse weather routes (see section 16).* The Cuxhaven-Immingham route used by the *Selandia Seaways* will be impacted by the Hornsea Three array area, with extra fuel for a longer passage necessary in order to maintain the average speed required to keep the current schedule. Navigating in adverse weather would be a concern from a safety perspective. DFDS suggest that the Hornsea Three offshore HVAC booster stations are located on or close to the banks where navigation is not possible anyway. The Newcastle-Amsterdam route used by the *King Seaways* and *Princess Seaways* will not be directly affected by the Hornsea Three array area as this route normally operates south of the Hornsea Three array area through Hornsea Project One and Hornsea Project Two. DFDS see no benefit to the navigational corridor. The Esbjerg-Immingham route used by the *Ark Germania* and *Ark Dania* will require a change to the normal passage due to the Hornsea Three array area but this change will not increase the crossing time. However the Hornsea Three array area may make complying with International Convention for the Prevention of Collision at Sea (COLREGS) (IMO, 1972/77) difficult due to the presence of the wind farm and nearby oil and gas infrastructure resulting in the turn to starboard being an issue. The current adverse weather route will require a change as it passes directly through the Hornsea Three array area. This will result in a significant increase in the distance of the route and will impact upon safety due to limited manoeuvrability. DFDS will not use the navigational corridor. The northerly Cuxhaven-Immingham route used in the past by the *Suecia Seaways* will require a deviation due to the Hornsea Three array area. However the southerly route used is not affected. The Hornsea Three offshore HVAC booster station search area will not pose a problem for the *Suecia Seaways* on its current Vlaardingen-Immingham route.
Eckero Shipping AB Ltd.	No comments received to date.
Eimskip Ehf	No comments received to date.
Essberger JT GmbH	No comments received to date.
Euro Marine Carrier BV	No comments received to date.
Euronav NV	No comments received to date.
Exmar NV	No comments received to date.
GloMar Shipmanagement BV	No comments received to date.
GulfMark UK Ltd.	No comments received to date.
HJH Shipmanagement GmbH	No comments received to date.
Hyundai Glovis Co Ltd.	No comments received to date.
James Fisher Everard Ltd.	No comments received to date.
Kawasaki Kisen Kaisha Ltd. ("K"-Line)	No comments received to date.
KESS	The Hornsea Three array area may have a slight impact on routeing, although vessels can avoid the area, and therefore there are no notable safety concerns. KESS vessels will not use the navigational corridor as the transits to and from the UK are west-east bound only.

Vessel operator	Comments received
Longship BV	No comments received to date.
Lundqvist Rederierna AB	No comments received to date.
MarConsult Schiffahrt GmbH	No comments received to date.
Mitsui OSK Lines Ltd	No comments received to date.
Neda Maritime Agency Co Ltd.	No comments received to date.
NGM Energy SA	No comments received to date.
Nordic Tankers Trading A/S	No comments received to date.
North Sea Tankers BV	No comments received to date.
P&O North Sea Ferries Ltd.	(From the *Pride of Rotterdam*) The ideal position for Hornsea Three offshore HVAC booster stations is between Leman and Haddock Banks, but to keep clear of P&O routes they should be located north of 53° 11' 00''. Vessels sailing from Europort to Teesport are using routes south of the Hornsea Three offshore HVAC booster station search area, including the *Estraden*, although this vessel only does so once or twice per year.
Samskip Multimodal Container	No comments received to date.
Sea-Cargo AS	No comments received to date.
Sentinel Marine Pte Ltd.	No comments received to date.
Stena Line BV	No comments received to date.
Stenersen Chartering AS	No comments received to date.
Subsea 7 Int'l Contracting Ltd (Subsea).	Subsea 7 vessels operate on an ad-hoc basis and the routeing is generally governed by the projects and where they are operating. Subsea 7 only had one vessel in this location [the Hornsea Three array area] in 2016 (*Seven Pacific*) and have no vessels which would transit the area on a standard shipping / cargo route. Therefore the impact for any routeing is not possible to confirm. As with any other navigational hazard, as long as the development is charted, details available via notices to mariners, charts etc. then there are no specific concerns.
Thenamaris Ships Management	No comments received to date.
UECC	No comments received to date.
Unifeeder A/S	No comments received to date.
Unigas International Ltd.	No comments received to date.
Vroon Offshore Services Ltd.	No comments received but attended Hazard Workshop.
Wagenborg Shipping BV	No comments received to date.
Wijnne & Barends Cargadoors	No comments received to date.
Wilson EuroCarriers AS	No comments received to date.

Table 14.2: Summary of key consultation issues raised during consultation activities undertaken for Hornsea Project One and Hornsea Project Two relevant to shipping and navigation.

Date	Consultee and type of response	Issue raised on Hornsea Project One, Hornsea Project Two or in relation to both	Issues raised	Response to issue raised and/or where considered in this chapter
December 2010	RYA Scoping Response	Hornsea Project One	The RYA believes that the threat to recreational yachts can be minimised by specifying: • A minimum rotor height clearance above mean high water springs of 22 m; and • A minimum underwater clearance of 4 m below mean low water spring.	Minimum rotor height clearance is 34.97 m above LAT. A Cable Burial Risk Assessment will be undertaken to assess under keel clearance (UKC). See the mitigation measures adopted as part of Hornsea Three in section 23.
December 2010	MCA – Pre Application Consultation	Hornsea Project One	The MCA recommended that turbines should not be set out in curves, circles or random arrangement as this could hinder search and rescue operations and make navigation for smaller vessels more difficult.	SAR impacts are considered in Appendix C.
January 2011	Chamber of Shipping (CoS) – Scoping Response	Both	The CoS has extensive experience of assisting with the planning and development of offshore renewable projects in UK waters and would be happy to provide further input from a shipping perspective. CoS also believe it will be vital to include the shipping industry in any future discussions on the development of the greater Hornsea Zone.	Regular operator and CoS consultation was undertaken as per section 14; feedback was limited.
February 2011	Cruising Association (CA) – Pre Application Consultation	Both	The CA has concerns that any heavy population of the zone as a whole, particularly to the west, could cause an in-combination or cumulative effect on cruising routes.	Recreational activity at the Hornsea Three array area is very low; cumulatively even considering Hornsea Project One and Hornsea Project Two recreational activity is very low. Cumulative scenarios are considered within section 22 and recreational activity (including cruising routes) in section 15.2.
February 2011	MCA and TH – Pre Application Consultation	Both	TH raised concerns regarding cumulative impacts on the East Coast, including Hornsea, East Anglia (former zone now Vattenfall and Scottish Power Projects) and Galloper offshore wind farms. TH stressed the fact that these zones/projects need to be considered from a cumulative perspective in relation to shipping and navigation.	Future case routeing is considered in section 17 and cumulative scenarios in section 21.
October 2011	DFDS Seaways – Pre Application Consultation	Both	DFDS Seaways have concerns relating to further development within the zone. Deviations will mean that vessels will need to increase speed to continue to meet current scheduling.	Consultation is noted within section 14. Future case routeing for DFDS Seaways is considered in section17. Effects have been identified as broadly acceptable given the available sea room (section 22.4).
July 2012	CoS – Pre Application Consultation	Both	CoS raised the issue of the cumulative impact of the Hornsea Zone as a whole where impacts such as route changes and assessment of deviations should be considered.	Future case routeing is considered in section 17 and cumulative scenarios in section 21.
September 2012	Rijks-waterstaat North Sea (the Dutch Ministry of Infrastructure and Environment) – PEIR Response	Hornsea Project One	Rijks-waterstaat North Sea advised that when assessing safety of shipping the following needs to incorporated: • Ability to comply with the international collision regulation; • Consideration of general IMO vessel routeing; • Size and manoeuvring characteristics of the vessel transiting site etc.; • Radar interference; and • Vessel traffic services, pilotage.	An FSA has been undertaken in section 22. Given the available sea room and the distance of the Hornsea Three array area from ports, direct impacts have not been identified. Cumulative routeing is considered in section 21. Impacts on communication and position fixing are considered in section 19.
November 2012	TH – Scoping Opinion	Hornsea Project Two	The possible cumulative and in combination effects on shipping routes and patterns should be fully assessed. The decommissioning plan should include a scenario where on decommissioning and on completion of removal operations an obstruction is left on site (attributable to the wind farm) which is considered to be a danger to navigation and which it has not proved possible to remove. Such an obstruction may be required to be marked until such time as it is either removed or no longer considered a danger to navigation, the continuing cost of which would need to be met by the applicant.	Future case routeing is considered in section 17 and cumulative scenarios in section 21. Decommissioning phase considers a maximum design scenario of cables left in situ.

Date	Consultee and type of response	Issue raised on Hornsea Project One, Hornsea Project Two or in relation to both	Issues raised	Response to issue raised and/or where considered in this chapter
December 2012	MCA and TH – Pre Application Consultation	Hornsea Project Two	Discussed potential impact of Hornsea Project Two upon SAR operations. MCA agreed with the developer an approach to include self-help facilities and advised this should be outlined in the Draft Environmental Statement as a concept and detailed in the post consent phase within the Emergency Response and Cooperation Plan (ERCoP).	SAR impacts are considered in Appendix C.
January 2013	MCA and TH – Pre Application Consultation	Both	The MCA and TH advised that they would prefer turbine layout within the array to be grid based such that a SAR vessel or helicopter can navigate on a fixed course from one side of the array to the other in at least two axes. The indicative edge-weighted layout presented during the meeting was deemed to have a small number of rows within the array and to be curved in one axis in the southeast corner. The MCA and TH had not formulated an opinion on edge-weighted layouts however it was considered that they would probably be acceptable with regard to navigational safety. SAR operations required further consultation with the SAR aviators on this issue.	Internal navigation is discussed in section 22.13 and Appendix C.
February 2013	CA – Pre Application Consultation	Hornsea Project One	The CA recommends that any export cables in depths of less than 10 m are buried to a minimum of one metre below the seabed to avoid snagging by anchors.	A Cable Burial Risk Assessment will be undertaken - see mitigation measures adopted as part of Hornsea Three (section 23).
March 2013	CoS	Hornsea Project One	CoS identified the following issues with regard to the Draft Environmental Statement: When assessing the route deviation impacts of future projects, the Applicant should take the existing 0.01-0.5% deviations resulting from Hornsea Project One into account; CoS were extremely concerned over the potential increase in interaction between vessels and oil and gas infrastructure resulting from route deviation to the south of Hornsea Zone and would welcome the opportunity to discuss this issue with the applicant in greater detail. The use of the 10 nm buffer for traffic analysis makes a current assessment of vessel interaction with this infrastructure extremely difficult; and The requirement for 500 m safety zones around individual turbine structures during construction, major maintenance and decommissioning as standard practice were agreed.	Future case routeing is considered in section 17 and cumulative scenarios in section 21. 500 m safety zones will be applied for during the construction, pre-commissioning, decommissioning and during major maintenance phases - see mitigation measures adopted as part of Hornsea Three (section 23).

Table 14.3: Summary of key consultation issues raised during consultation activities undertaken for Hornsea Three relevant to shipping and navigation.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
July 2016	MCA and TH – Consultation Meeting	Agreement on consultation methodology for the NRA, PEIR and Environmental Statement process. Marine traffic survey method was discussed and agreed. An initial discussion on the proposed navigational corridor (cumulative impact) was undertaken.	The NRA methodology is contained within section 3. The marine traffic survey methodology is within section 7. Outcomes of the proposed navigational corridor assessment are in section 22.9.
September 2016	MCA and TH – Consultation Meeting	The proposed navigational corridor was discussed and it was agreed that a separate technical note to cover the corridor width would be provided. The key points were noted. Both parties agreed that safe navigation was key. Both parties were unable to agree on a definition of a corridor during the meeting and whether the navigational activity of vessels on the approaches to and from the corridor should or should not be considered when defining the corridor length. Hornsea Three noted that the corridor length/width guidance was one of many assessment methods to be used and that the 20 degree approach only related to the area considered to be a corridor and not to vessels on the approach to it. Following definition of the corridor the NRA would then take all other factors into account, separately but as part of the FSA, and assess the risks in the areas to the north and south of the area. Further progress was made at the meeting in February 2017, as detailed below. TH noted that the design of a corridor should not prevent compliance, or give reason for a vessel not complying, with COLREGS (narrow channels and overtaking).	Outcomes of the proposed navigational corridor assessment are in section 22.9. Technical note – Anatec, 2016. *Assessment of Marine Traffic and Corridor Design Hornsea Project 3*. Aberdeen: Anatec. The navigational corridor is assessed within section 22.9.
November 2016	MCA and TH – Consultation Meeting	TH noted that Hornsea Three may wish to consider applying for permanent 500 m Safety Zones around manned platforms. MCA SAR noted that the MCA may ask for additional detail on SAR resources and may also ask for additional features (such as 406 MegaHertz (MHz) Personal Locator Beacons (PLB) and direction finding equipment used to locate persons or vessels) to aid SAR requirement in the area. MCA confirmed they were content with the proposed NRA method and should follow the usual process, noting the additional supporting information that will be required for the floating foundations. MCA noted the project's own vessels should also be considered within the NRA. The Applicant confirmed that minimum spacing would be 1,000 m centre point to centre point. MCA SAR indicated this was acceptable and that there was no maximum spacing. The NRA methodology and matrix were shown and agreed.	500 m safety zones will be applied for during the construction, pre-commissioning, decommissioning and major maintenance phases – see mitigation measures adopted as part of Hornsea Three (section 23). This will also include 500 m around manned platforms during operation. The NRA methodology is contained within section 3. The marine traffic survey methodology is within section 7. Indicative project vessel numbers are in section 9.8 and considered within the FSA in section 22.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
November 2016	TH – Scoping Opinion	Require comprehensive vessel traffic analysis as per Marine Guidance Note (MGN) 543. Any proposed layout should confirm to MGN 543 and any structure out with the actual wind farm should have additional risk assessments undertaken. The separation between Hornsea Three and Hornsea Project One and Hornsea Project Two should be individually risk assessed and the final proposed separation should be submitted to both the MCA and TH for review. TH will require the Hornsea Three array area and obstructions within the offshore cable corridor to be marked as per IALA-O-139. Any possible national trans-boundary issues should be assessed and consultation should be undertaken with the Dutch authorities. A decommissioning plan which includes a scenario where obstructions are left on site should be considered.	See mitigation measures adopted as part of Hornsea Three (section 23) which includes Aids to Navigation. The marine traffic survey methodology is within section 7 and is analysed in section 15. Rijkwaterstraat will be issued the PEIR and NRA as part of the section 42 consultation but have not yet responded to invitations for feedback. Outcomes of the proposed navigational corridor assessment are in section 22.9 Decommissioning plan is considered in section 25.8.
November 2016	MCA – Scoping Opinion	The NRA and Environmental Statement should comply with MGN 543. The NRA should consider routeing particularly in heavy weather so that vessels can make safe passage without significant larger scale deviations. The MCA require that a Cable Burial Protection Index study should be undertaken in respect to export cabling. Reductions in water depth, particularly nearshore should be assessed. Any application for safety zones would need to be carefully assessed and supported by experience at the development and construction stages. Assessment of impacts on SAR capability within the region must be undertaken. An Emergency Response and Cooperation Plan (ERCoP) will be required within the draft Development Consent Order (DCO). Hydrographic data (International Hydrographic Organisation Order 1a) should be supplied to the MCA as per MGN 543.	The NRA methodology is contained within section 3. Adverse weather is considered within section 16 and assessed within section 22. Mitigation measures adopted as part of Hornsea Three are in section 23 and include commitment to a Cable Burial Risk Assessment and ERCoP. SAR impacts are considered in section in Appendix C. The project shall comply with MGN 543 hydrographic requirements as per section 23.
November 2016	MMO – Scoping Opinion	The MMO agrees with the approach and data sources outlined by the applicant regarding navigation and other sea users. We would expect due consideration of all navigation and sea user issues to be included within the EIA process. We understand that the applicant will be holding a number of public consultation events to involve, engage and communicate with consultees prior to submission of the proposal to PINS. Iterative discussions with consultees upon the requirement and feasibility of any mitigation measures are expected to provide a robust assessment of the proposed development.	Noted, consultation feedback is within section 14.
December 2016	PINS – Scoping Opinion	The Environmental Statement should assess the impacts on ports and harbours. The layout of the Hornsea Three array area will not be fixed at the point of the application and therefore maximum design scenario should be considered within the NRA. The proposed navigational corridor should be considered in consultation with the MCA and TH. The MCA require that a Cable Burial Protection Index study should be undertaken in respect to export cabling. The marine traffic survey must "include non-AIS traffic". The NRA must be in line with MGN 543. Consultation will be undertaken with the MCA on SAR capability within the region. An ERCoP will be required within the draft DCO. The Environmental Statement must consider phasing of the development.	Ports assessment is considered in section 10.2; however no impacts were identified. The NRA methodology is contained within section 3. The marine traffic survey methodology is within section 7. SAR impacts are considered in section in Appendix C. Section 22 considers the impact of phasing.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
January 2017	Regular Operator Consultation – Consultation letters issued to the identified regular operators. The responses received are summarised here.	P&O Ferries – Ideal location for the Hornsea Three offshore HVAC booster stations would be between the Lehman and Haddock Bank, but to avoid vessel routeing should stay North of 53°11.0'N. Marine Aggregate Industries – Requested attendance at the Hazard Workshop. Kess – Noted that there were small but manageable deviations for their vessels that operated east – west. Subsea 7 – As their vessel routeing was governed by specific projects they were working on they could not confirm specifics but did not raise any notable impacts. Subsea 7 noted that as with any other navigational hazard, as long as the development is chartered, details available via notices to mariners, charts etc., then they did not have any specific concerns. DFDS Seaways – Noted that increases in distance and time would be required for their Cuxhaven to Immingham track. This route also raised concerns about adverse weather routeing and agreed to provide more information. No notable impacts for Hornsea Three were noted for the Newcastle to Amsterdam route. The Esbjerg to Immingham route noted no changes to the crossing time but noted adverse weather concerns including compliance with COLREGs.	Final location of the Hornsea Three offshore HVAC booster stations has not yet been agreed but the maximum design scenario locations for shipping and navigation have been assessed in section 18.4 and section 22. Marine Aggregate Industries attended the Hazard Workshop – see section 20. Vessel deviations are reported in section 18.2.2 and section 22.3. Commercial ferry impacts are assessed in section 22.
February 2017	MCA and TH – Consultation Meeting	MCA and TH confirmed that they were content with the marine traffic survey and that it met with the requirements of MGN 543 (2016). TH confirmed that any navigational corridor would be assessed on a case by case basis and that given the location of Hornsea Three and the volume of traffic, they were content with the red line boundary and thus corridor width. TH and MCA were clear that MGN 543 states that applicant should plan for two lines of orientation unless they can clearly demonstrate that fewer is acceptable and safe for SAR helicopter operations. TH indicated that, using the experience of the oil and gas industry, and the approach taken for wrecks, any subsea structures would need a 30 m vertical clearance distance or require additional marking on the surface. As the water depths in the HVAC booster station search area are less than 30 m surface marking will therefore be required.	Outcomes of the proposed navigational corridor assessment are in section 22.9. Subsea impacts are considered in section 22. Internal navigation impacts are considered in section 22.
February 2017	RYA – Consultation Meeting	RYA mentioned that, from a recreational perspective, the RYA would not be too concerned with respect to the Hornsea Three array area. This is largely based on the fact that there is very little recreational activity that far offshore and anyone who is transiting that far offshore would be very experienced and well equipped. *The RYA's main concern would be relating to the cable landfall where the cable comes* within the 10 m contour and any resulting reduction in water depth. From the RYA's perspective, the Hornsea Three array area did not present any significant problems. With respect to layouts, the RYA stated that they did not have any concerns regarding the indicative layouts presented. The RYA also considered the corridor between the projects to be more than adequate with respect to use by recreational craft.	Mitigation measures adopted as part of Hornsea Three are in section 23 and include a Cable Burial Risk Assessment. Internal navigation impacts are considered in section 22.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
February 2017	CA – Consultation Meeting	CA stated that it is difficult to consult on sites this far offshore due to the variation in routes taken by recreational craft as well as the international component; however it was stated that CA have no major issues with the development. CA stated that the corridor was at a good angle and the width more than adequate for any recreational vessels sailing in the area. With respect to layouts the CA preferred larger straight lines where possible. The CA would also like to see advice added to the Nautical Almanac for recreational vessels sailing through the area, advice on courses etc. for navigating through the corridor or Hornsea Three array area. They stated that lots of yachtsmen will not go through a wind farm.	Internal navigation impacts are considered in section 22.
February 2017	CoS – Consultation Meeting	Introductory meeting to the Hornsea Three development. Overview of the winter and summer marine traffic was shown; no specific comments were raised by the CoS. It was noted that there are DFDS Seaways Roll on Roll off (Ro Ro) routes passing through the Hornsea Three array area, CoS noted that it would be for the operator of those routes to comment in the first instance. Anatec explained the process for identification of regular operators within the marine traffic survey datasets and showed examples of the consultation letters issued. A number of regular operator letters (40+) had been issued either by email or surface mail, requesting feedback on the Hornsea Three array area and offshore cable corridor. Approach to the NRA, in line with MCA guidance was discussed. No comments were made. CoS queried if any additional routeing measures had been considered for the corridor; it was noted that this would be a decision for the MCA.	Future case routeing is considered in section 17 and cumulative scenarios in section 21.
February 2017	Hazard Workshop	See Hazard Log in Appendix B.	N/A

15. Marine Traffic Surveys

15.1 Introduction

15.1.1.1 This section presents shipping data in relation to three areas; the area around the Hornsea Three array area shipping and navigation study area, Hornsea Three offshore cable corridor shipping and navigation study area and the Hornsea Three offshore HVAC booster stations shipping and navigation search area. As described in section 7 – marine traffic survey methodology.

15.2 Hornsea Three array area survey analysis

15.2.1.1 A plot of all the vessel tracks recorded within the Hornsea Three array area shipping and navigation study area during a 26 day survey period from 6 June to 4 July 2016 (summer), colour-coded by vessel type, is presented in Figure 15.1. A plot of all the tracks recorded within the Hornsea Three array area during a further 14 day survey during November and December 2016 (winter) is presented in Figure 15.2.

15.2.1.2 These figures include tracks for the survey vessels *Neptune* and *RV Aora* as well as offshore support vessels operating at temporary (mobile) drilling rigs (such drilling operations typically only last four to six weeks).

15.2.1.3 A number of tracks recorded during the summer and winter survey were classified as temporary (non-routine), such as the tracks of the survey vessels and traffic associated with temporary drilling rigs. These have therefore been excluded from further analysis. Oil and gas affiliated vessels supporting permanent installations were retained in the analysis.

15.2.1.4 Plots of vessels tracks recorded during each respective survey period, colour-coded by vessel type and excluding temporary traffic (as defined above), are presented in Figure 15.3 and Figure 15.4 respectively, with corresponding density grids presented in Figure 15.5 and Figure 15.6 respectively. The density grids are colour-coded by the average number of vessels per day and can therefore be compared directly despite the difference in the length of the summer and winter survey periods. All figures excluded temporary traffic.

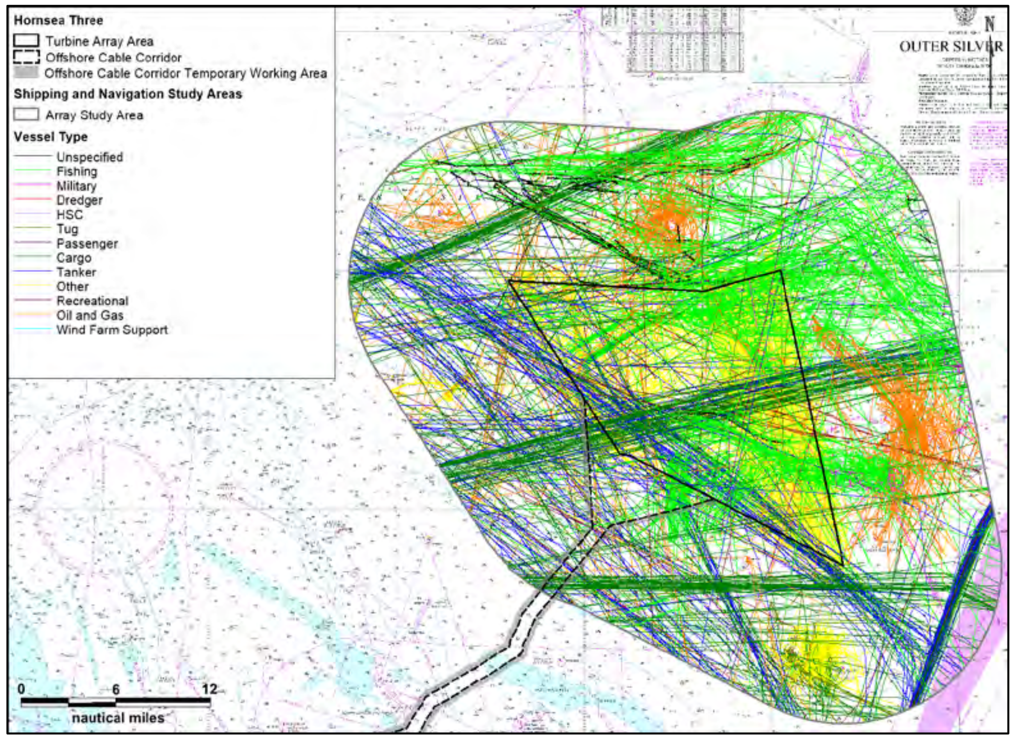


Figure 15.1: AIS, visual and Radar data within the Hornsea Three array area shipping and navigation study area (26 days summer 2016).

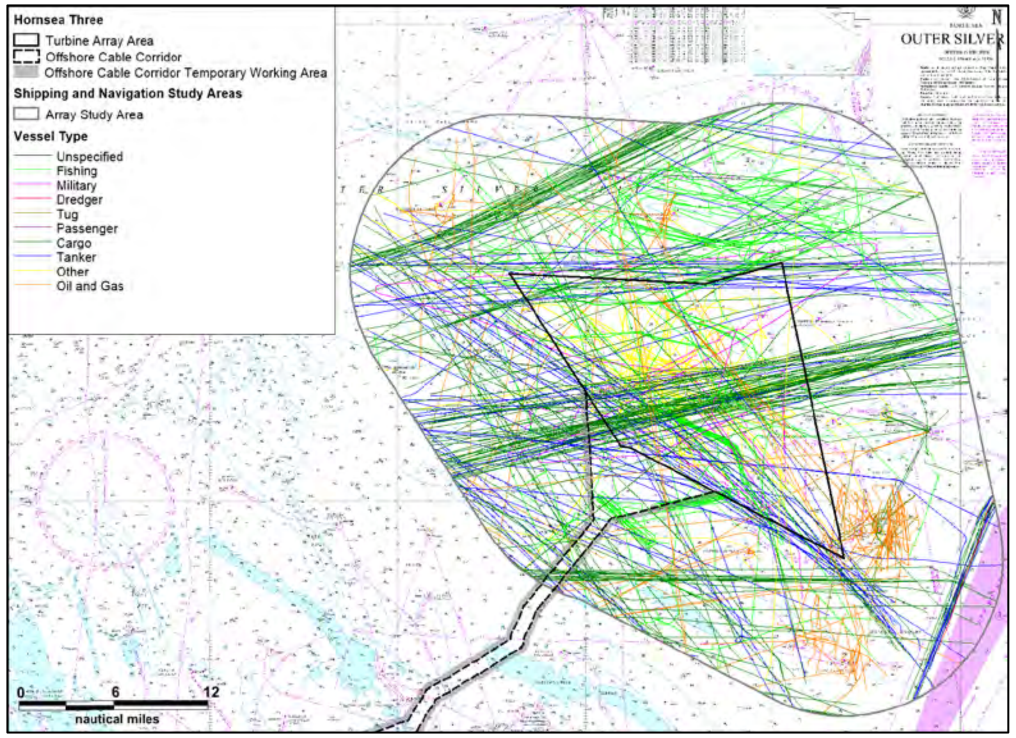


Figure 15.2: AIS, visual and Radar data within the Hornsea Three array shipping and navigation study area (14 days winter 2016).

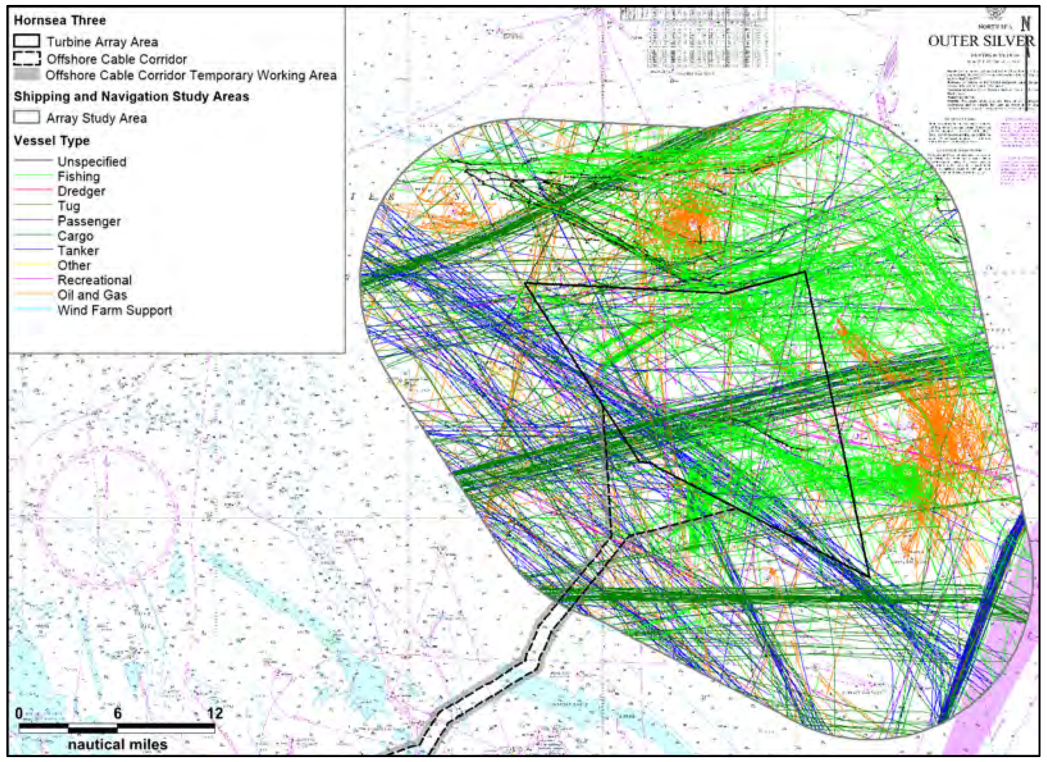


Figure 15.3: AIS, visual and Radar data within the Hornsea Three array shipping and navigation study area excluding temporary traffic (26 days summer 2016).

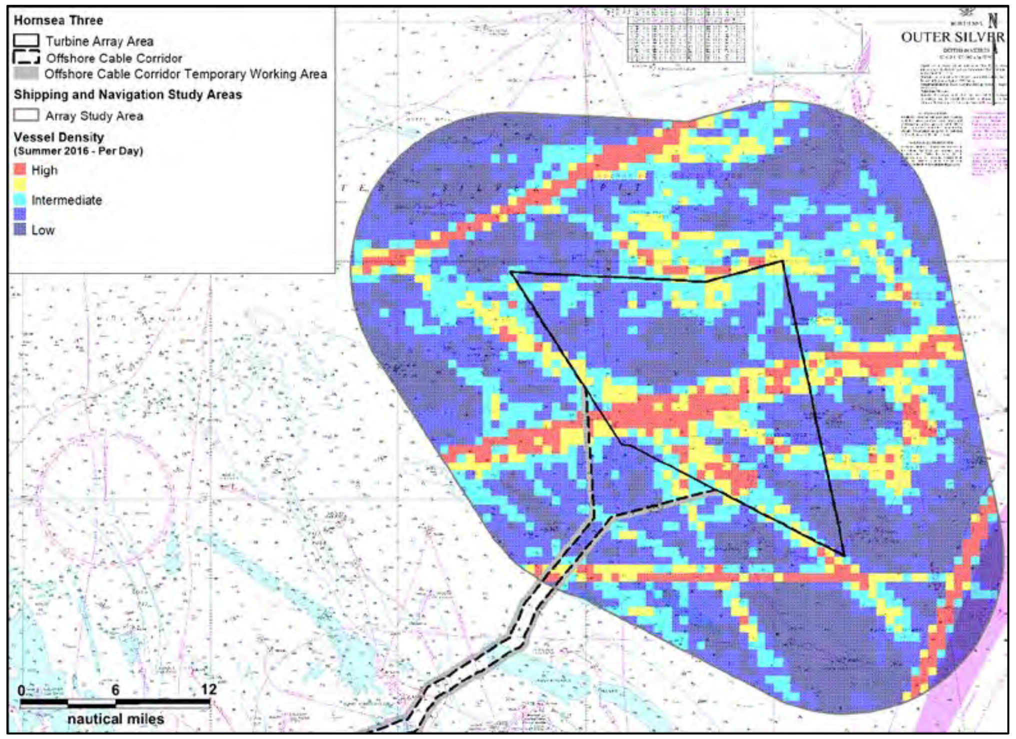


Figure 15.5: Vessel density from AIS, visual and Radar within the Hornsea Three array shipping and navigation study area excluding temporary tracks (26 days summer 2016).

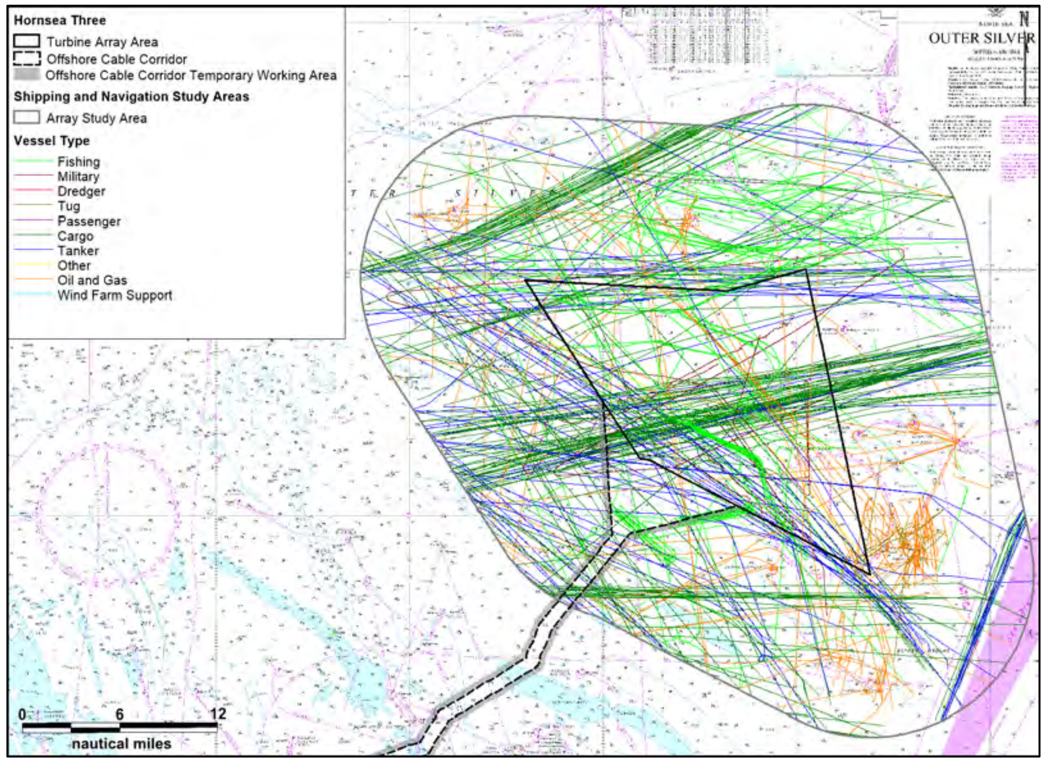


Figure 15.4: AIS, visual and Radar data within the Hornsea Three array area shipping and navigation study area excluding temporary traffic (14 days winter 2016).

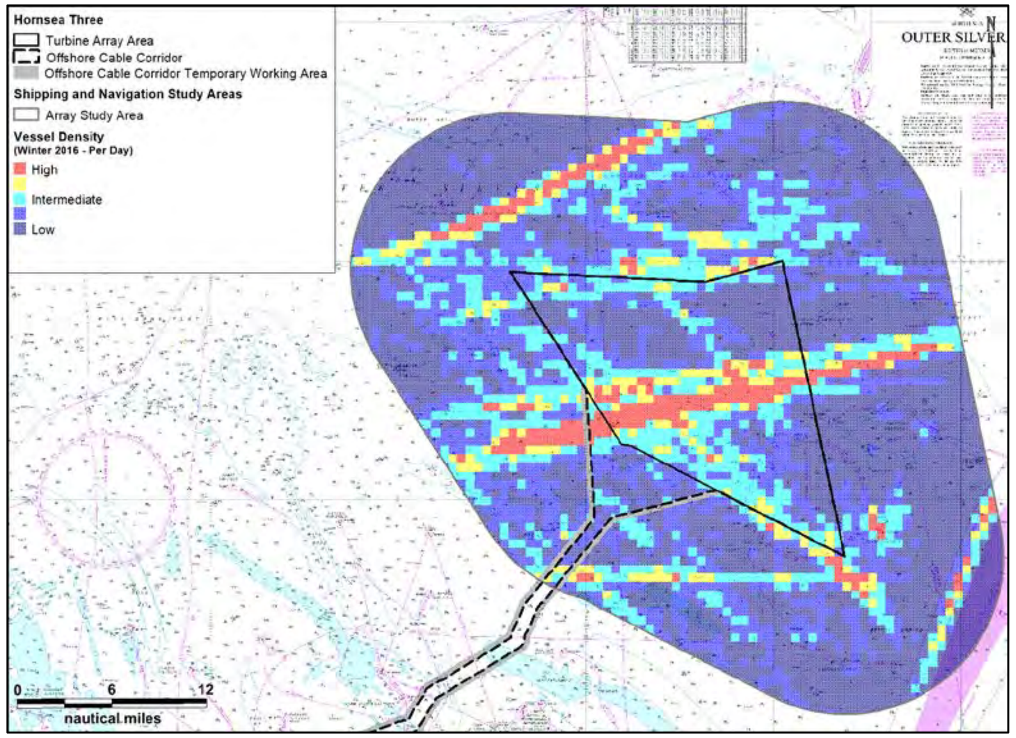


Figure 15.6: Vessel density from AIS, visual and Radar within the Hornsea Three array shipping and navigation study area excluding temporary tracks (14 days winter 2016).

15.2.2 Vessel counts

15.2.2.1 For the 26 days analysed in summer 2016, there were an average of 42 unique vessels per day passing within the Hornsea Three array area shipping and navigation study area, recorded on AIS, visual and Radar. In terms of vessels intersecting Hornsea Three array area, there was an average of 15 unique vessels per day.

15.2.2.2 Figure 15.7 illustrates the daily number of unique vessels passing through the Hornsea Three array area shipping and navigation study area, Hornsea Three only and intersecting any of Hornsea Three, Hornsea Project One or Hornsea Project Two during summer 2016.

15.2.2.3 The busiest day recorded throughout the survey period was 10 June 2016 when 55 unique vessels were recorded within the Hornsea Three array area shipping and navigation study area, 18 within Hornsea Three only and 21 within Hornsea Three, Hornsea Project One and Hornsea Project Two.

15.2.2.4 The quietest day throughout the survey period was 23 June 2016 when 29 unique vessels were recorded within the Hornsea Three array area shipping and navigation study area, ten within Hornsea Three only and 14 within Hornsea Three, Hornsea Project One and Hornsea Project Two.

15.2.2.5 Throughout the survey period only 36% of traffic recorded within the Hornsea Three array area shipping and navigation study area intersected the Hornsea Three array area.

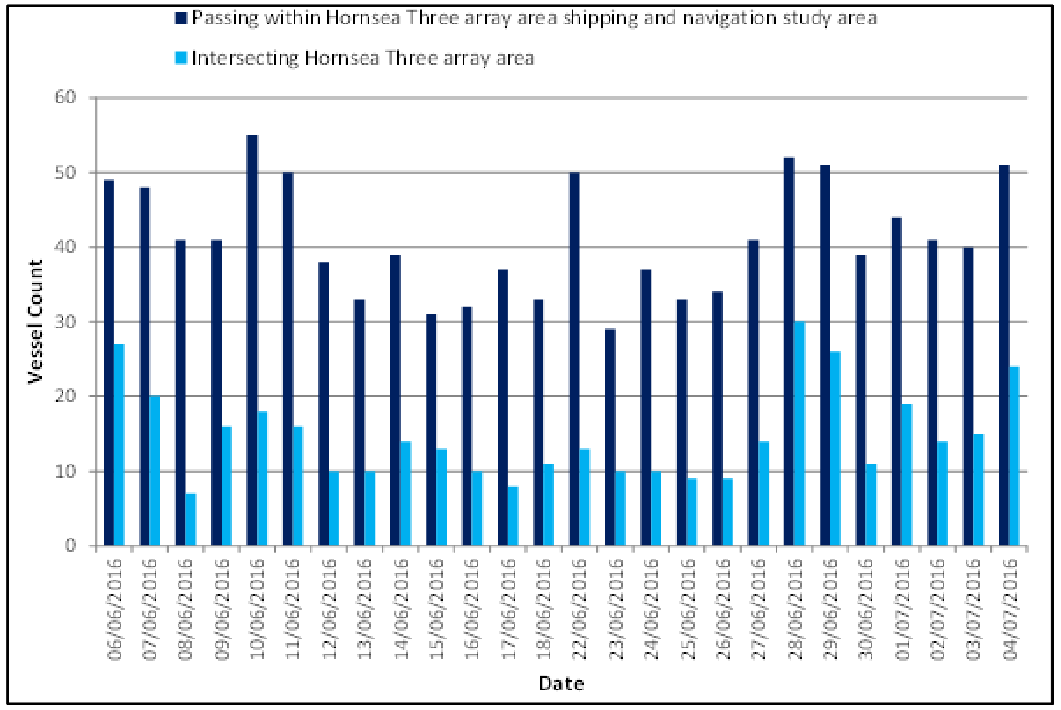


Figure 15.7: Unique vessels per day within Hornsea Three array area shipping and navigation study area during 26 days summer 2016 (AIS, Visual and Radar).

15.2.2.6 For the 14 days analysed in winter 2016, there were an average of 28 unique vessels per day passing within the Hornsea Three array area shipping and navigation study area, recorded on AIS, visual and Radar (excluding temporary traffic). In terms of vessels intersecting the Hornsea Three array area, there was an average of 13 unique vessels per day.

15.2.2.7 Figure 15.8 illustrates the daily number of unique vessels passing through the Hornsea Three array area shipping and navigation study area, and the Hornsea Three array area during 14 days between November and December 2016.

15.2.2.8 The busiest day recorded throughout the survey period was the 14 November 2016 when 39 unique vessels were recorded within the Hornsea Three array area shipping and navigation study area and 22 within the Hornsea Three array area only.

15.2.2.9 The quietest day throughout the survey period was the 26 November 2016 when 16 unique vessels were recorded within the Hornsea Three array area shipping and navigation study area and three within Hornsea Three array area only.

15.2.2.10 Throughout the survey period 45% of traffic recorded within the Hornsea Three array area shipping and navigation study area intersected the Hornsea Three array area.

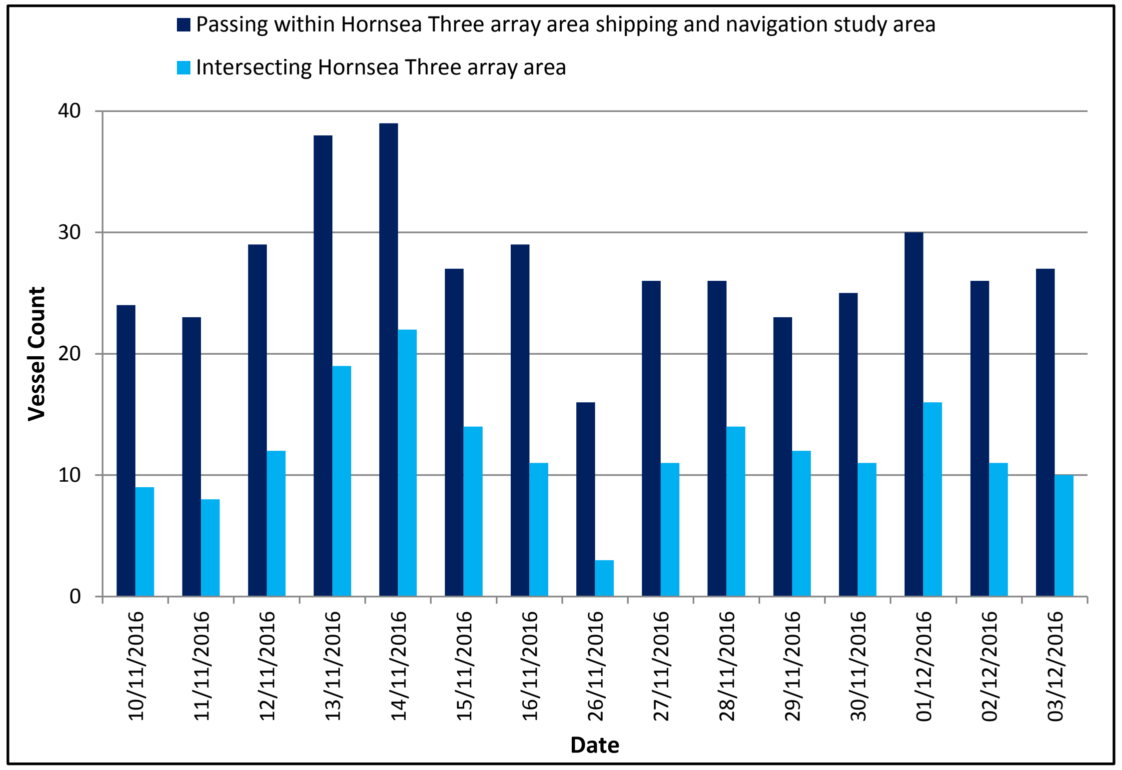


Figure 15.8: Unique vessels per day within the Hornsea Three array area shipping and navigation study area during 14 days winter 2016 (AIS, visual and Radar).

15.2.3 Vessel types

15.2.3.1 Analyses of the vessel types recorded passing within the Hornsea Three array area shipping and navigation study area and Hornsea Three array area throughout both survey periods are presented in Figure 15.9. The category of “other” vessels includes those that are not large enough in quantities (i.e. less than 5%) to mention on their own. This includes the likes of anchor handling vessels, dive support vessels, pipe-lay vessels and research/survey vessels.

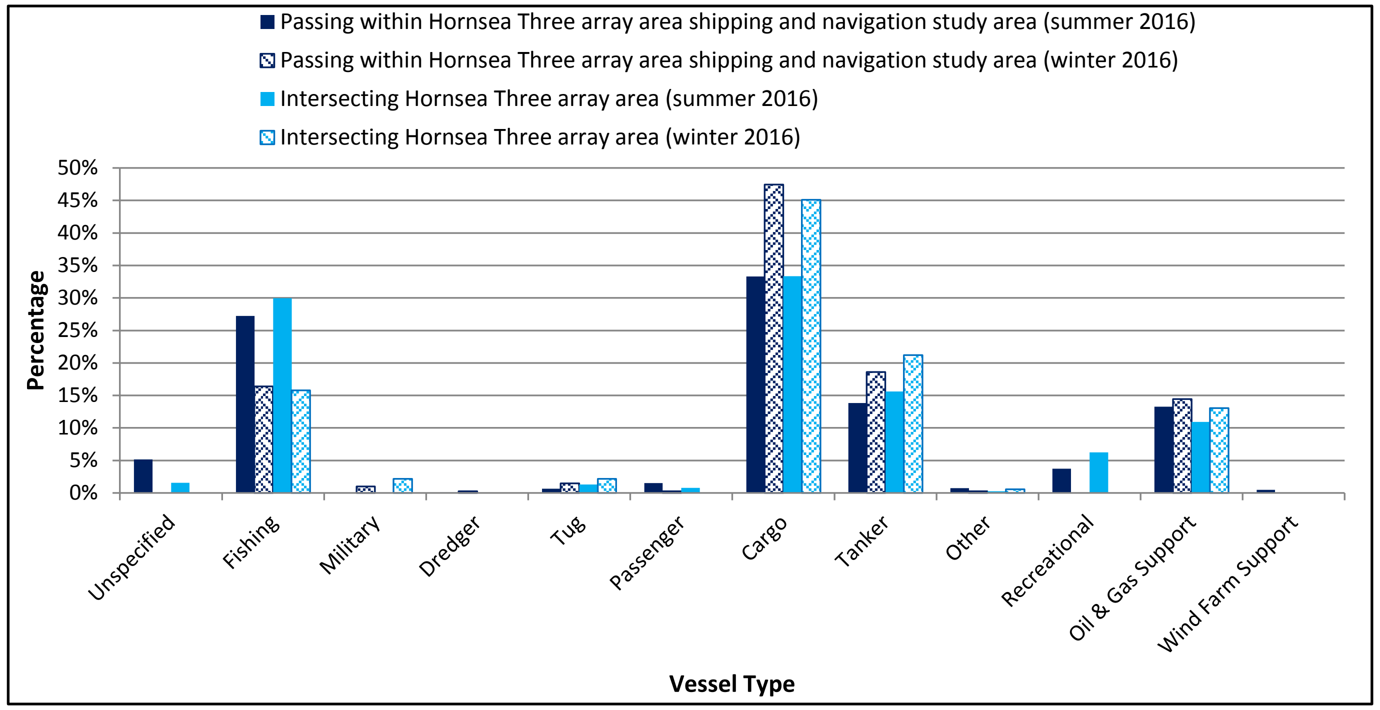


Figure 15.9: Distribution of vessel types within the Hornsea Three array area shipping and navigation study area during 40 days summer and winter 2016 (AIS, visual and Radar).

15.2.3.2 Throughout the summer period, the majority of tracks were cargo vessels (33% within the Hornsea Three array area) and fishing (30%). Throughout the winter period the majority of tracks were cargo vessels (45% in the Hornsea Three array area) and tankers (21%). It should be noted that the cargo vessel category includes commercial ferries (e.g. DFDS Seaways) operating in the Hornsea Three array area shipping and navigation study area who generally broadcast their vessel types on AIS as cargo. Details specific to commercial ferries are presented in section 15.2.8.

15.2.3.3 Figure 15.10 presents a plot of cargo vessels, including commercial ferries, recorded within the Hornsea Three array area shipping and navigation study area on AIS, visual and Radar throughout both the summer and winter survey periods. Equivalent plots of tankers and oil and gas affiliated vessels are presented in Figure 15.11 and Figure 15.12 respectively.

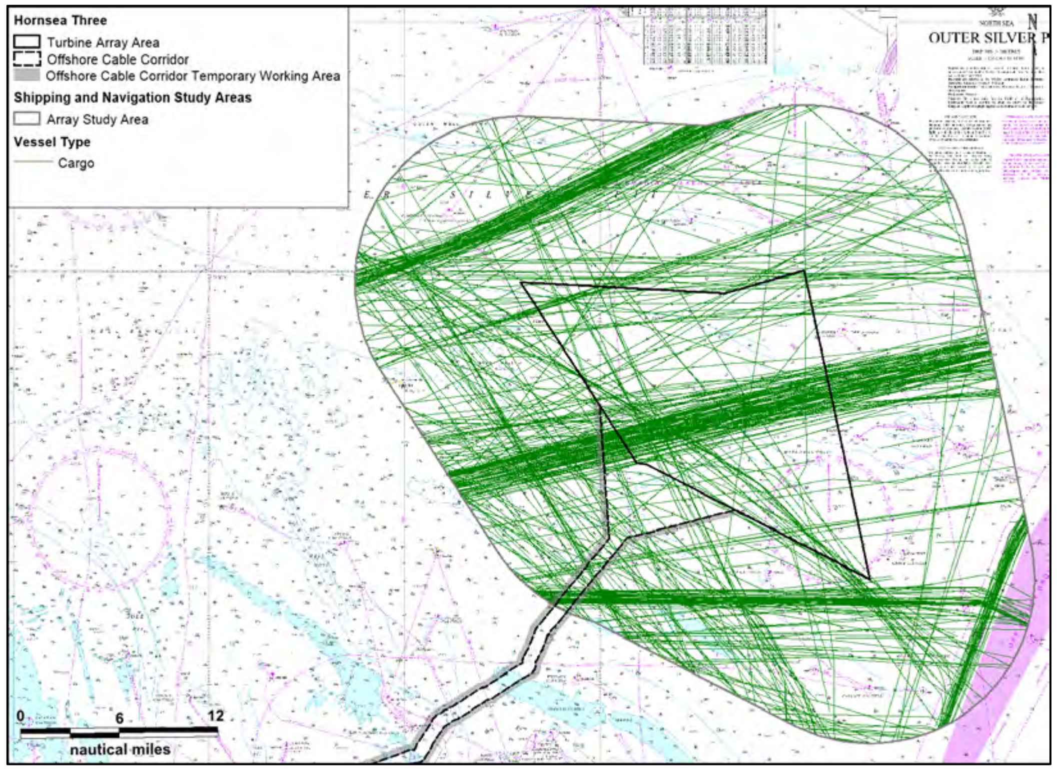


Figure 15.10: AIS, visual and Radar cargo vessels within the Hornsea Three array area shipping and navigation study area (40 days summer and winter 2016).

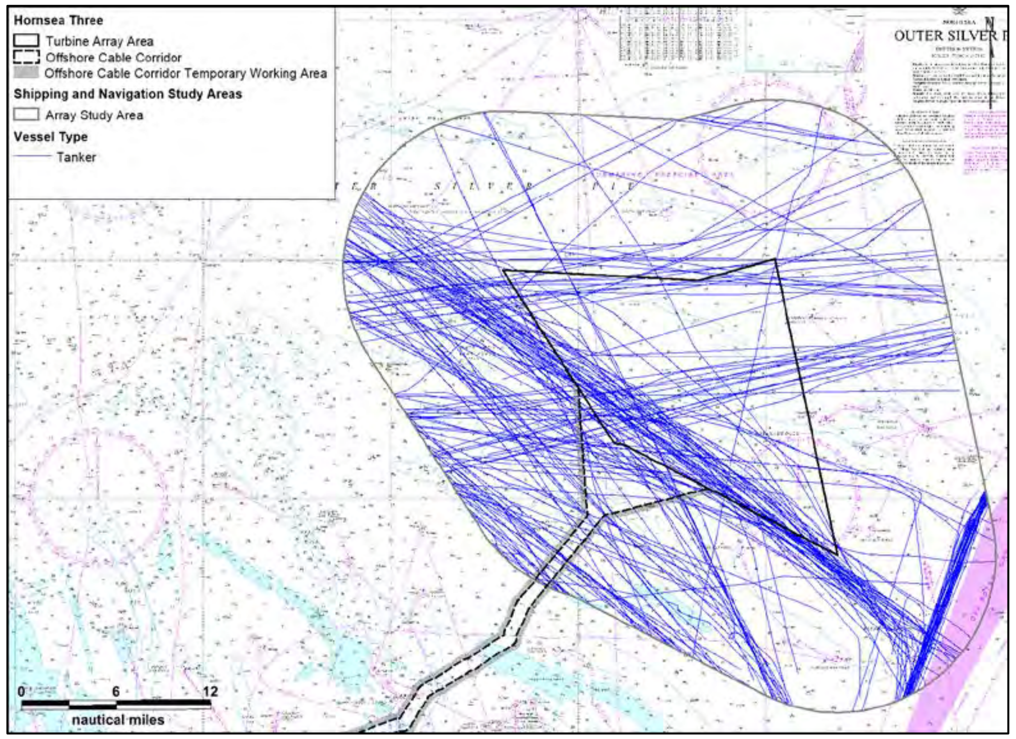


Figure 15.11: AIS, visual and Radar tankers within the Hornsea Three array area shipping and navigation study area (40 days summer and winter 2016).

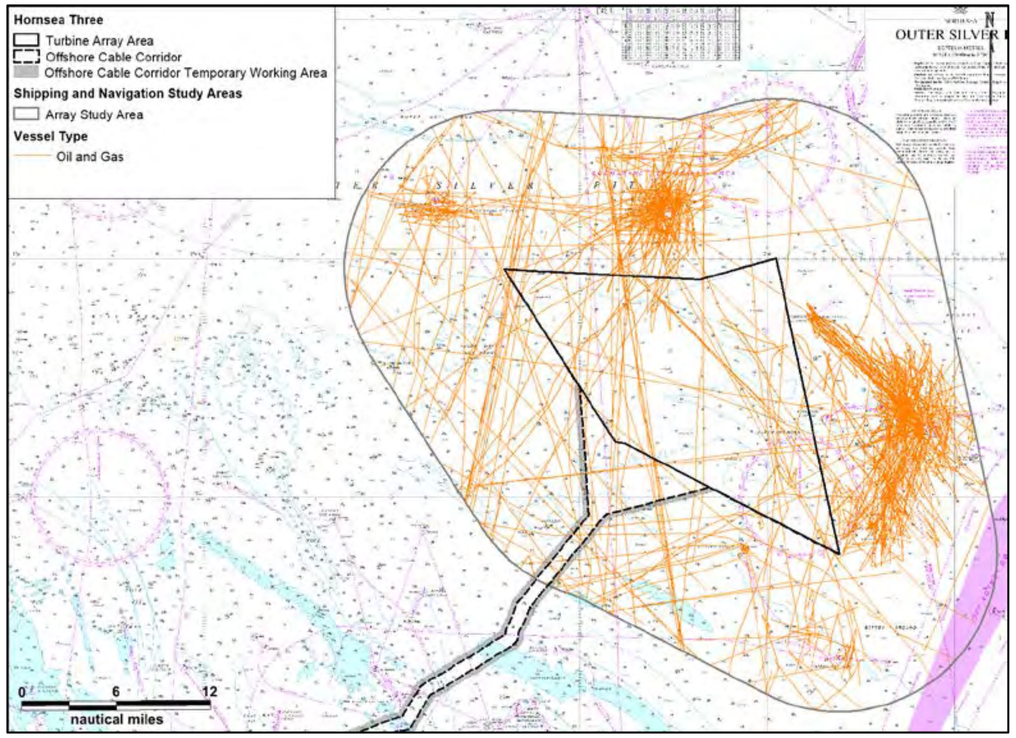


Figure 15.12: AIS, visual and Radar oil and gas affiliated vessels within the Hornsea Three array area shipping and navigation study area (40 days summer and winter 2016)

15.2.3.4 Throughout the combined summer and winter survey period, an average of 14 unique cargo vessels per day passed within the Hornsea Three array shipping and navigation study area.

15.2.3.5 Regular cargo vessels operating in the vicinity of the Hornsea Three array area shipping and navigation study area include DFDS Seaways Ro Ro vessels operating routes between Immingham (UK) and Esbjerg (Denmark) and Immingham (UK) and Cuxhaven (Germany).

15.2.3.6 Throughout the combined summer and winter survey period, an average of six unique tankers per day passed within the Hornsea Three array area shipping and navigation study area.

15.2.3.7 All of the tankers recorded throughout the survey period were on passage to oil and gas terminals throughout the UK and mainland Europe including: Immingham (UK), Rotterdam (Netherlands), Teesport (UK) and Grangemouth (UK)

15.2.3.8 Throughout the combined summer and winter survey period, an average of five unique offshore affiliated (transiting to / from oil or gas platforms) vessels per day passed within the Hornsea Three array area shipping and navigation study area. The majority of these vessels were on passage to / from offshore oil and gas installations in the vicinity of the Hornsea Three array area shipping and navigation study area.

15.2.3.9 Offshore affiliated vessels that were not transient included the *Putford Viking* and *Putford Trader* which were acting as the Emergency Response and Rescue Vessels (ERRV) for the nearby Markham and Ketch gas fields respectively. The *Glomar Endurance* was also carrying out guard duties for the J6-A platform at the Markham gas field.

15.2.4 Vessel size distribution

Maximum length overall

15.2.4.1 Vessel lengths overall (LOA) recorded throughout the survey periods ranged from 9 m (pleasure craft *Bjxrkski-2*) to a maximum of 333 m (four crude oil tankers including *Athina*, *Selene Trader*, *New Pearl* and *Argenta*). Figure 15.13 illustrates the distribution of vessel lengths recorded throughout each survey period.

15.2.4.2 The average lengths of vessels within the Hornsea Three array area shipping and navigation study area throughout the summer and winter survey periods were 104 m and 120 m, respectively. There was a greater proportion of small vessels (< 50 m) recorded throughout the summer survey within the Hornsea Three array area shipping and navigation study area.

15.2.4.3 Figure 15.14 provides an overview of AIS, visual and Radar vessel tracks (excluding temporary traffic) recorded within the Hornsea Three array area shipping and navigation study area throughout the combined 40 day summer and winter survey periods, colour-coded by vessel length.

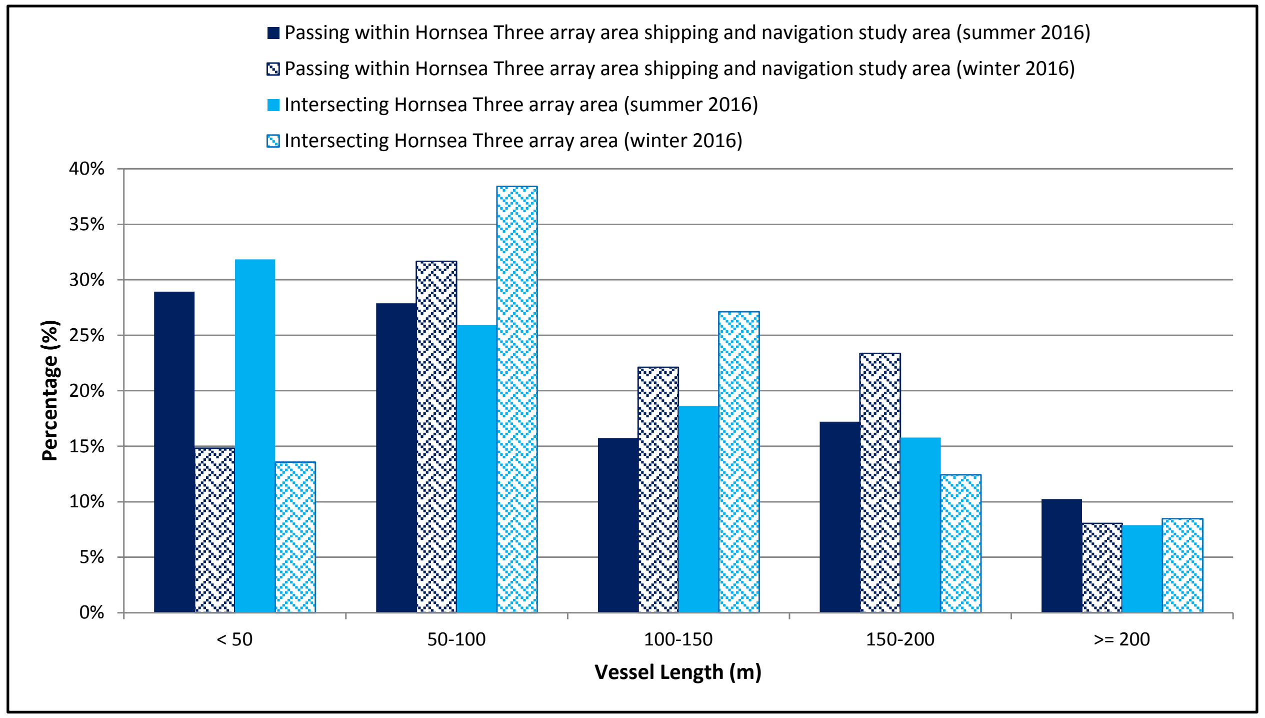


Figure 15.13:Vessel length distribution within the Hornsea Three array area shipping and navigation study area during 40 days summer and winter 2016 (AIS, visual and Radar).

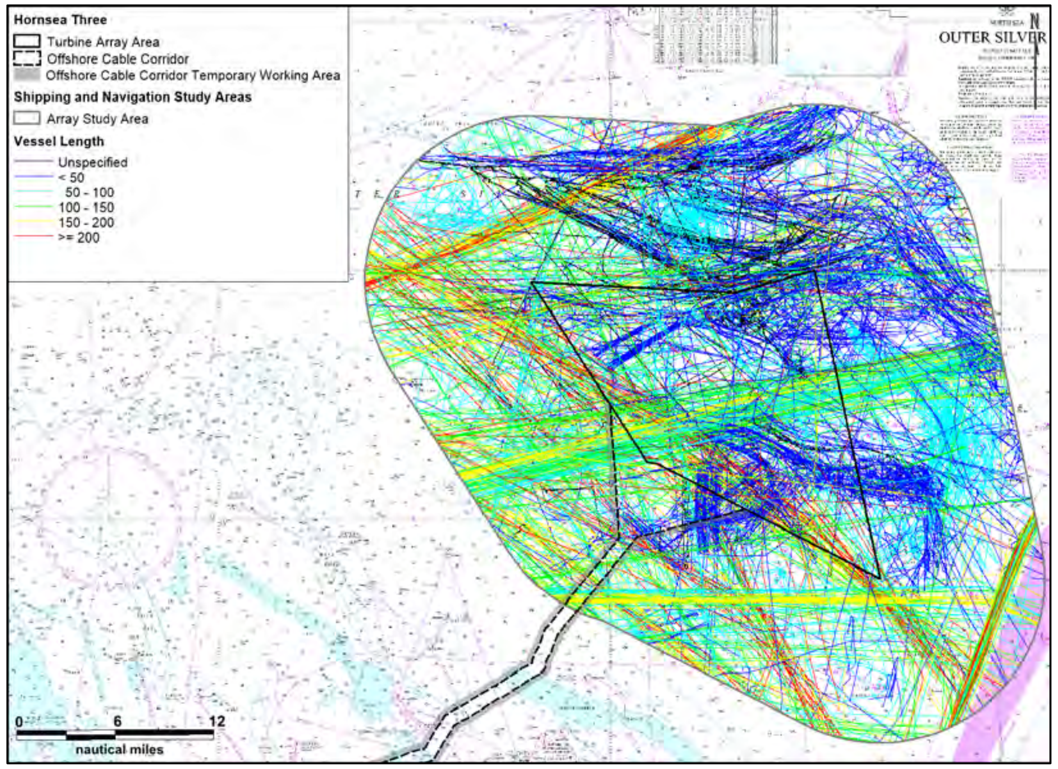


Figure 15.14:AIS, visual and Radar data within Hornsea Three array area shipping and navigation study area colour-coded by vessel length (40 days summer and winter 2016).

Vessel draught

15.2.4.4 Vessel draughts recorded throughout the survey periods ranged from 1.8 m (wind farm support vessel *MCS Blue Norther*) to a maximum of 20.6 m (oil products tanker *Victory 1*). Figure 15.15 illustrates the distribution of vessel draughts recorded throughout each survey period.

15.2.4.5 It should be noted that 10% of the total number of unique vessels recorded within the Hornsea Three array area shipping and navigation study area did not broadcast a draught on AIS and hence have been excluded from further analysis. It is assumed however that the data is an accurate reflection of the types of draughts likely to be recorded within the area.

15.2.4.6 The average draughts of vessels within the Hornsea Three array area shipping and navigation study area throughout the summer and winter survey periods were 5.1 m and 5.9 m respectively. This reflects the greater proportion of small-draught vessels (< 4 m) recorded throughout the summer survey within the Hornsea Three array area shipping and navigation study area.

15.2.4.7 Figure 15.16 provides an overview of AIS, visual and Radar vessel tracks (excluding temporary traffic) recorded throughout the combined 40 day summer and winter survey periods, colour-coded by vessel draught.

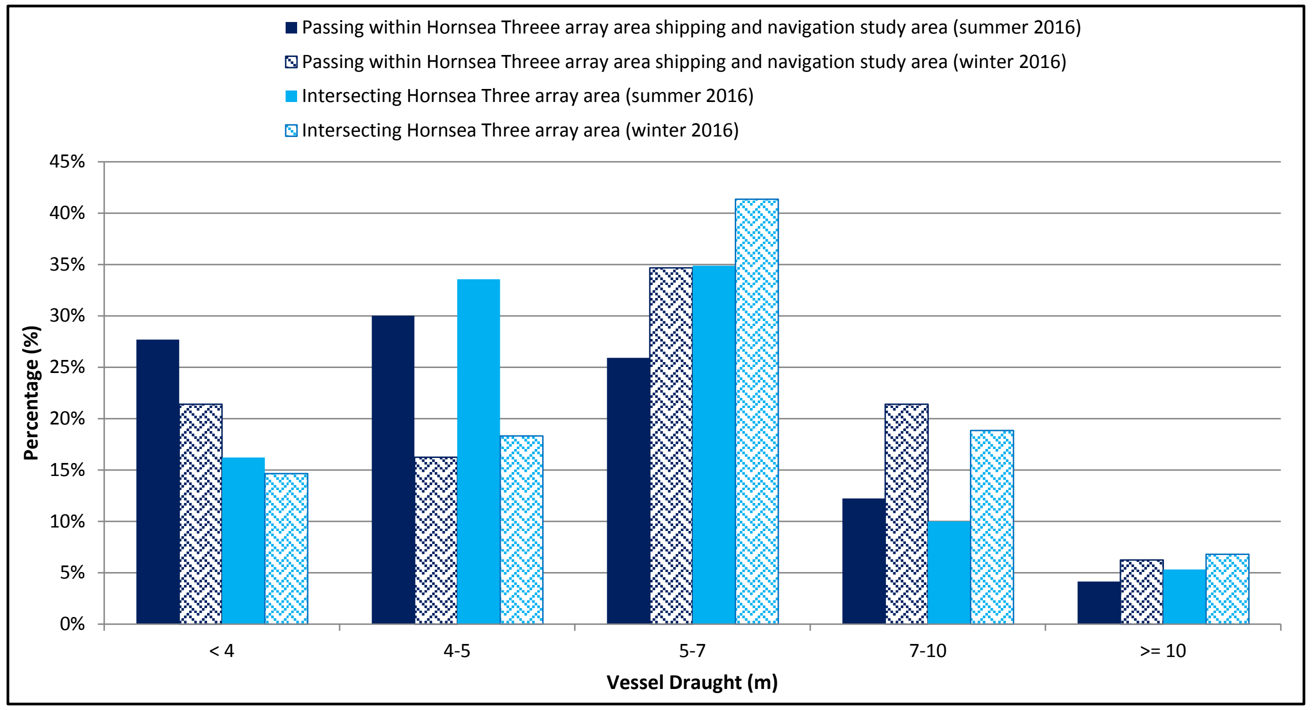


Figure 15.15:Vessel draught distribution within the Hornsea Three array area shipping and navigation study area during 40 days summer and winter 2016 (AIS, visual and Radar).

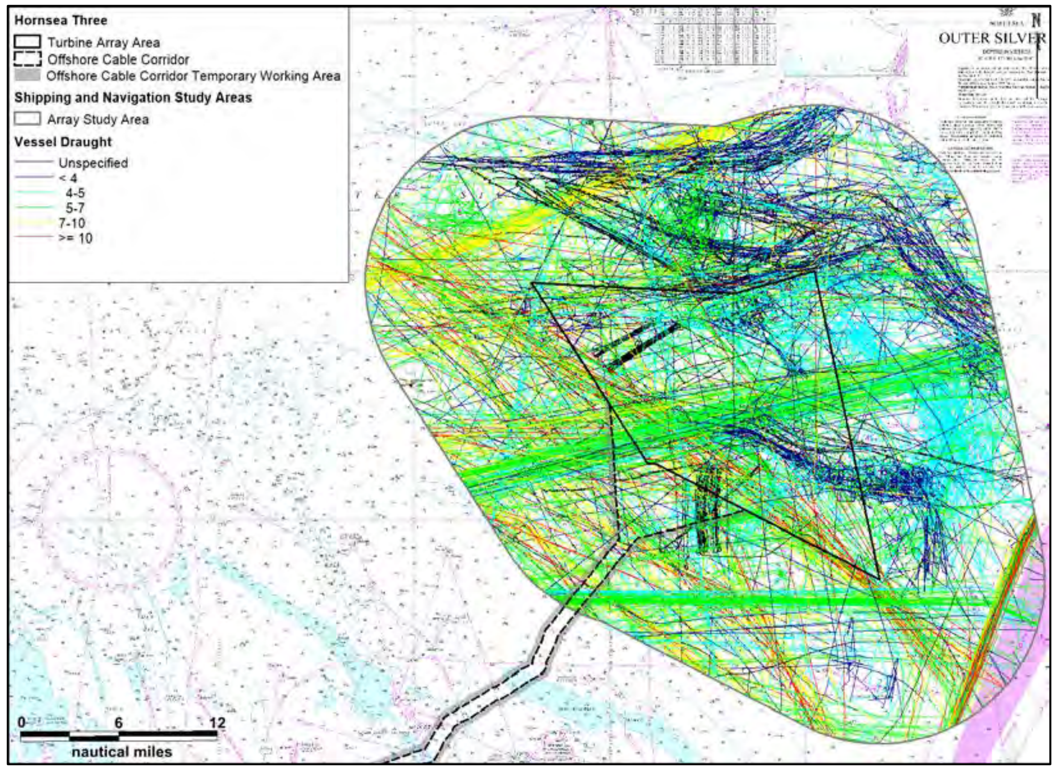


Figure 15.16: AIS, visual and Radar data within the Hornsea Three array area shipping and navigation study area colour-coded by vessel draught (40 days summer and winter 2016).

15.2.5 Anchored vessels

15.2.5.1 Anchored vessels can be identified based on the AIS navigational status which is programmed on the AIS transmitter on board a vessel. No vessels were broadcasting as "at anchor" within the Hornsea Three array shipping and navigation study area during the 40 day survey period. However, information is manually entered into the AIS; and therefore it is common for vessels not to update the navigational status if they are anchored for only a short period of time.

15.2.5.2 For this reason, those vessels which travelled at a speed of less than one knot for more than 30 minutes were assumed to be at anchor. After applying these criteria, no vessels were deemed to be at anchor. This result can be attributed to the distance between the study area and the coast, and the generally moderate water depth within the study area.

15.2.6 Definition of a main route

15.2.6.1 Main routes have been identified by principles set out in MCA guidance MGN 543 (MCA, 2016). AIS data are assessed and vessels transiting at similar headings and locations are identified as a main route. To help identify main routes, AIS data can also be interrogated to show vessels (by name and/or operator) that frequently transit those routes identifying "regular runner / operator routes". The shipping route width is then calculated using the 90th percentile rule from the median line of the potential shipping route as shown in Figure 15.17.

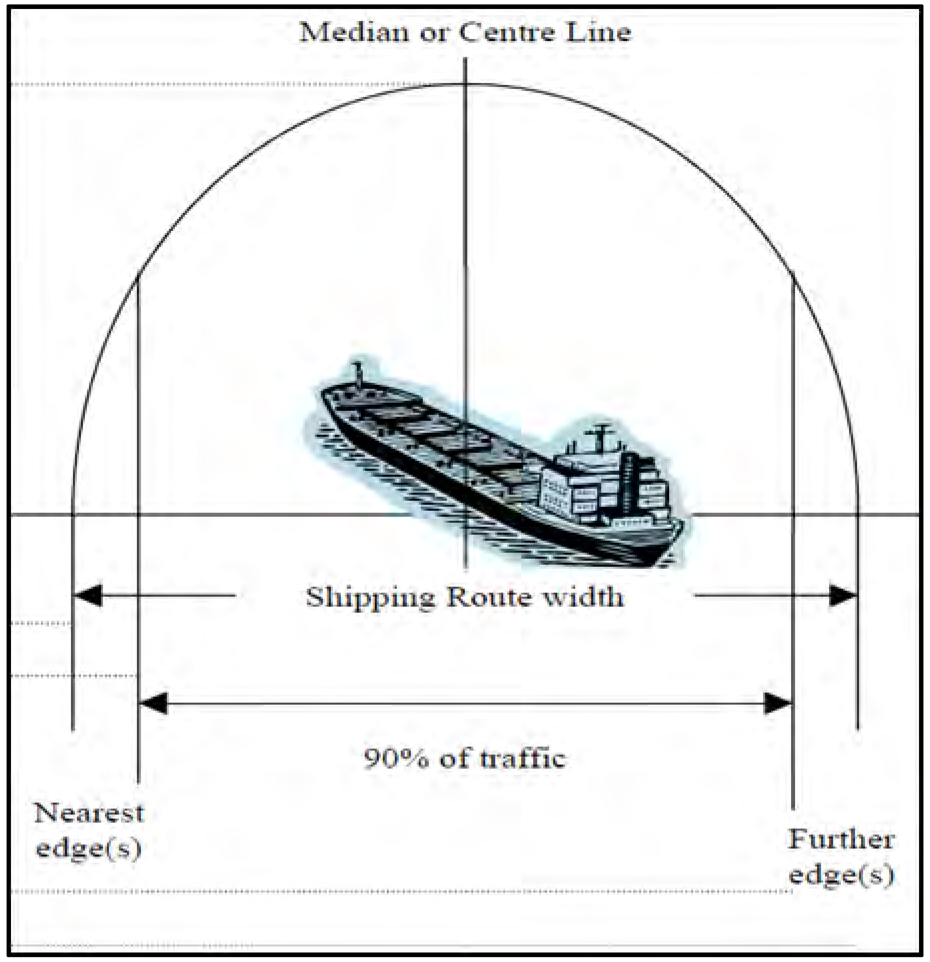


Figure 15.17: Illustration of main route calculation.

15.2.7 Base case main routes

15.2.7.1 Main route identification was undertaken for the Hornsea Three array area shipping and navigation study area. Sixteen main commercial routes have been identified as transiting through the Hornsea Three array area shipping and navigation study area. Plots of the main routes and corresponding 90th percentiles within the Hornsea Three array area shipping and navigation study area are presented in Figure 15.18.

15.2.7.2 A brief description of the traffic on each of the main routes is presented in Table 15.1.

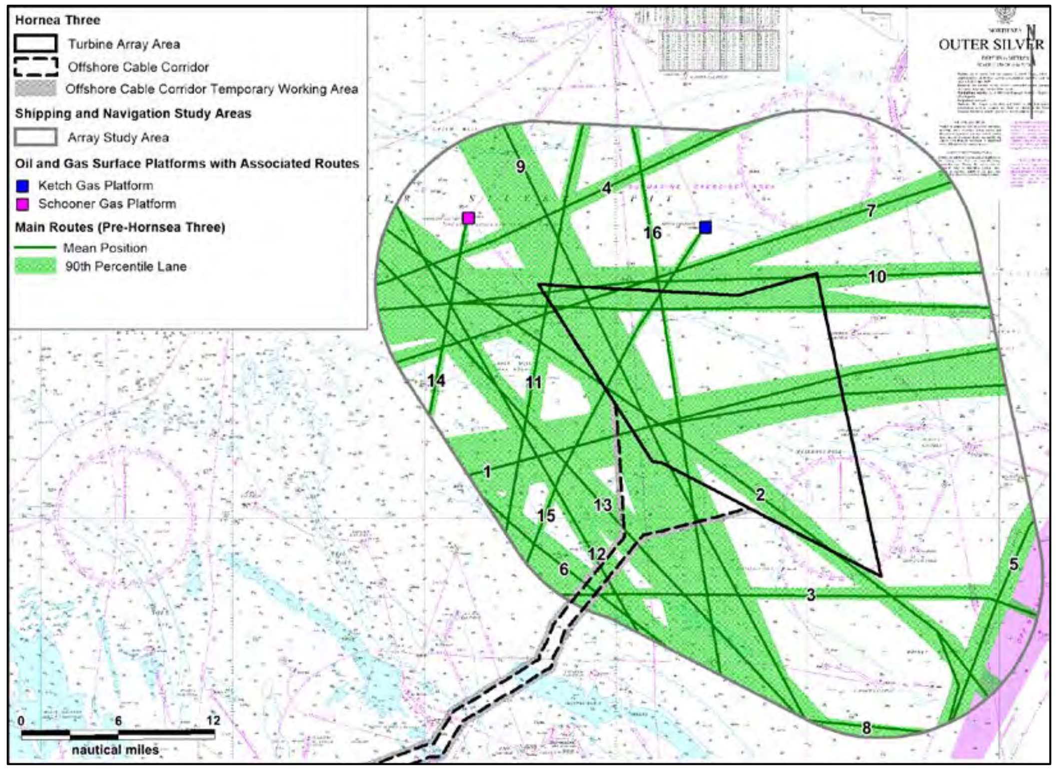


Figure 15.18: 90th percentile lanes and pre-Hornsea Three main routes within Hornsea Three array area shipping and navigation study area.

Table 15.1: Main routes details within Hornsea Three array area shipping and navigation study area.

Route number	Number of vessels per day (average)	Destinations and main vessel types identified
Route 1	3–4	Immingham (UK) to Cuxhaven (Germany). Route 1 is used by cargo vessels (90%) and tankers (10%). Route 1 is a DFDS Seaways ferry route from Immingham to Cuxhaven and splits on approach to the Off Botney Ground TSS. The main vessel operating on this route is the *Hafnia Seaways*.
Route 2	1–2	Forth Ports (UK) to Rotterdam (Netherlands). Route 2 is generally used by tankers (64%) and cargo vessels (34%).
Route 3	1–2	Immingham (UK) to Cuxhaven (Germany). Route 3 is generally used by cargo vessels (97%). Route 3 is a DFDS Seaways ferry route (as with route 1) and also includes a KESS Ro Ro freight service from Grimsby (UK) to Emden (Germany). The main vessels operating on this route are the *Jutlandia Seaways* (DFDS Seaways) and the *Neckar Highway* (KESS).
Route 4	2–3	Immingham (UK) to Esbjerg (Denmark). Route 4 is generally used by cargo vessels (96%). Route 4 is a DFDS Seaways Ro Ro freight service operated by three vessels; the *Ark Dania*, *Ark Germania* and the *Primula Seaways*.
Route 5	2	Off Botney Ground TSS southbound. Route 5 is generally used by cargo vessels (42%), tankers (42%) and passenger vessels (14%). Route 5 includes vessels transiting too many locations, particularly ports within the English Channel.
Route 6	1–2	Forth Ports (UK) to Amsterdam (Netherlands). Route 6 is generally used by tankers (53%) and cargo vessels (39%).
Route 7	0–1	Immingham (UK) to Esbjerg (Denmark). Route 7 is used by cargo vessels (67%) and tankers (33%). Route 7 is a DFDS Seaways Ro Ro freight service (as with route 4) operated by the *Ark Dania* (eastbound transits only).
Route 8	0–1	Immingham (UK) to Emden (Germany). Route 8 is used by cargo vessels (100%). Route 8 is a KESS route from Grimsby to Emden (as with Route 3) generally operated by the *Weser Highway* (westbound only).
Route 9	0–1	Icelandic Ports to Rotterdam (Netherlands). Route 9 is generally used by cargo vessels (63%) and tankers (26%).
Route 10	1	Immingham (UK) to German Ports. Route 10 is generally used by cargo vessels (56%) and tankers (42%) with German port destinations including Bremen, Hamburg and Cuxhaven.
Route 11	0–1	Great Yarmouth (UK) to Murdoch gas platform. Route 11 is used by oil and gas affiliated vessels.
Route 12	0–1	Icelandic Ports to Rotterdam (Netherlands). Route 12 is generally used by cargo vessels (87%).
Route 13	0–1	Icelandic Ports to Amsterdam (Netherlands). Route 13 is generally used by cargo vessels (48%) and tankers (34%).
Route 14	0–1	Great Yarmouth (UK) to Schooner gas platform. Route 14 is used by oil & gas affiliated vessels (100%). The main vessel using this route is the *Putford Trader*.
Route 15	0–1	Great Yarmouth (UK) to Ketch gas platform. Route 15 is used by oil & gas affiliated vessels (100%). The main vessel using this route is the *Putford Trader*.

Route number	Number of vessels per day (average)	Destinations and main vessel types identified
Route 16	0–1	Great Yarmouth (UK) to Murdoch gas platform. Route 16 is an alternative to route 11 and is used by oil & gas affiliated vessels (100%). The main vessels using this route are the *VOS Glory* and *VOS Gorgeous*.

15.2.8 Commercial ferry activity

15.2.8.1 This section reviews the commercial ferry activity in the Hornsea Three array area shipping and navigation study area based on the marine traffic surveys.

15.2.8.2 Throughout the combined summer and winter survey period, five regular commercial ferry routes were identified, with each of these included among the base case main routes outlined in section 15.2.7. Figure 15.19 presents a plot of commercial ferries recorded within the Hornsea Three array area shipping and navigation study area on AIS, visual and Radar throughout both the summer and winter survey periods.

15.2.8.3 The most frequently transited commercial ferry route was a DFDS Seaways commercial ferry route between Immingham (UK) and Esbjerg (Denmark), with the *Ark Dania*, *Primula Seaways* and *Ark Germania* making 74 transits between them within the Hornsea Three array area shipping and navigation study area throughout the summer and winter survey periods. Two other DFDS Seaways commercial ferry were also relatively prominent, with these both being between Immingham (UK) and Cuxhaven (Germany) (the *Hafnia Seaways* and *Jutlandia Seaways* each made 18 transits within the Hornsea Three array area shipping and navigation study area throughout the summer and winter survey periods).

15.2.8.4 In addition to DFDS Seaways, other commercial ferry operators with vessels passing within the Hornsea Three array area shipping and navigation study area include KESS, Hyundai Glovis, Sea-Cargo and Eckero Shipping.

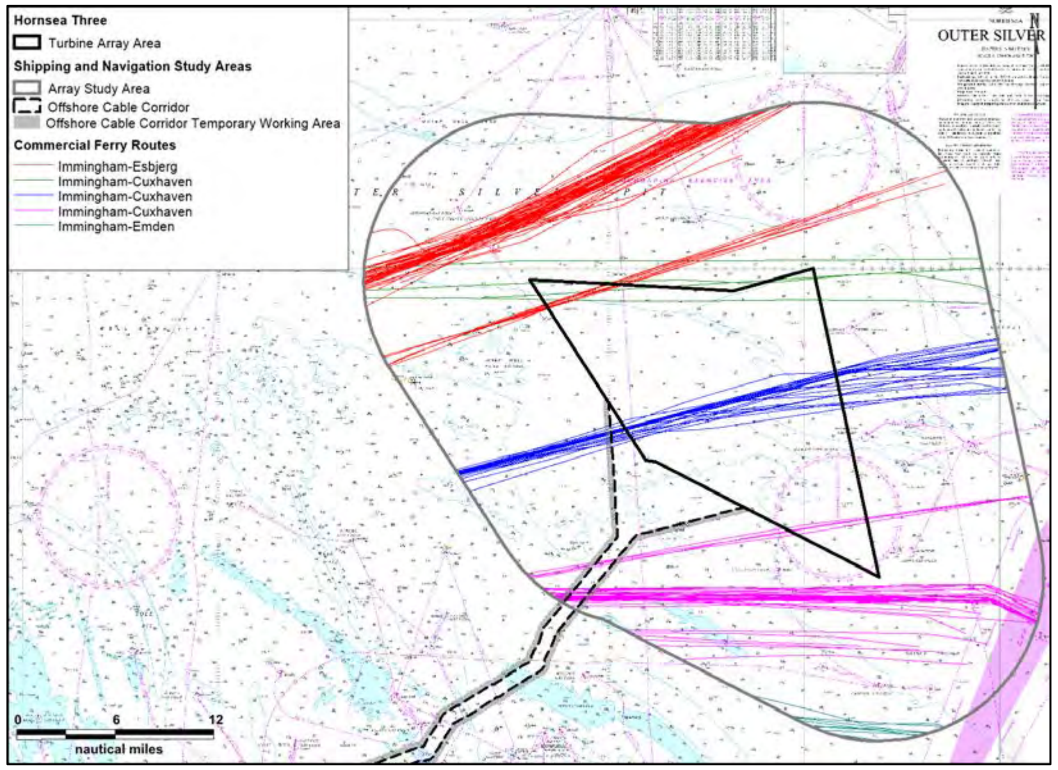


Figure 15.19: AIS, visual and Radar commercial ferries within the Hornsea Three array area shipping and navigation study area (40 days summer and winter 2016).

15.2.9 Recreational vessel activity

15.2.9.1 This section reviews recreational vessel activity in the Hornsea Three array area shipping and navigation study area based on cruising route information published by the RYA, as well as AIS, visual and Radar tracking of recreational vessels during the marine traffic surveys.

15.2.9.2 For the purposes of the NRA, recreational activity includes sailing and motor craft (including those undertaking dive and fishing charter trips) of between 2.4 and 24 m, as per EU Directive 94/95/EC.

Survey data

15.2.9.3 Figure 15.20 presents the recreational tracks recorded during the marine traffic survey.

15.2.9.4 Throughout the combined summer and winter survey period, an average of one unique recreational craft per day passed within the Hornsea Three array area shipping and navigation study area. However, 45% of all recreational activity was recorded on two days, 28 and 29 June 2016, when the annual *500 Mile North Sea Race* for sailing vessels passed through the Hornsea Three array area.

15.2.9.5 It is noted that 87% of recreational craft recorded throughout the combined summer and winter survey period were recorded on AIS; with only 13% recorded on Radar.

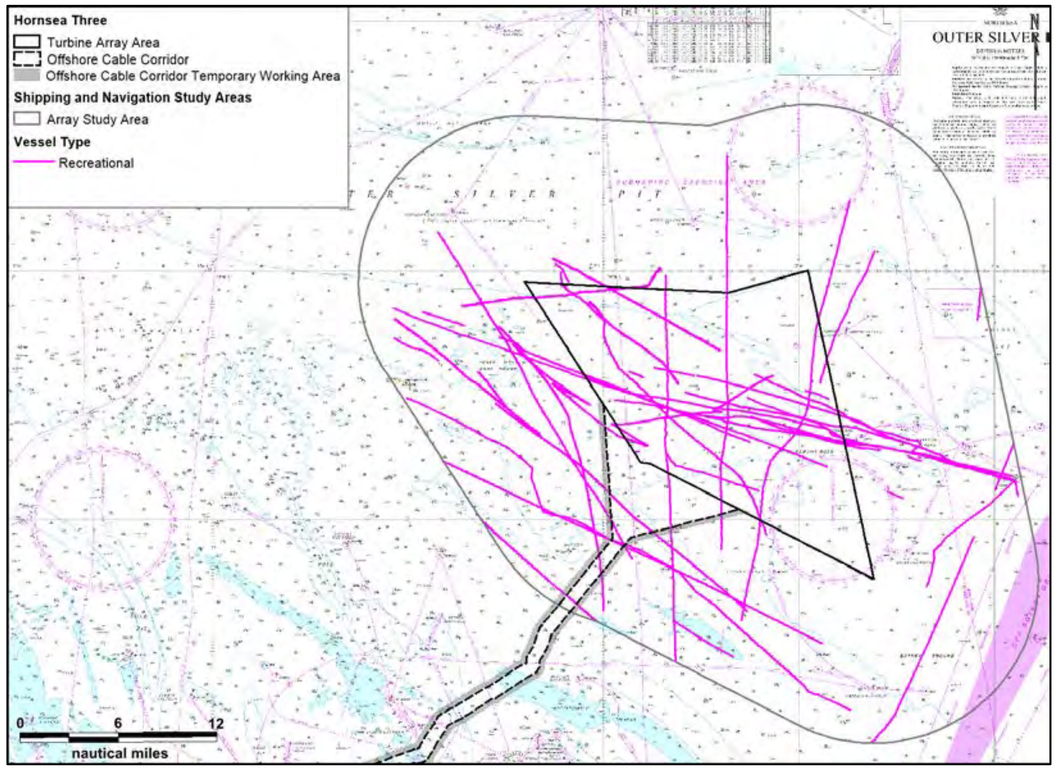


Figure 15.20: AIS, visual and Radar recreational vessels within the Hornsea Three array area shipping and navigation study area (40 days summer and winter 2016).

Recreational cruising routes

15.2.9.6 The RYA, supported by the CA, has identified recreational cruising routes, general sailing and racing areas (RYA, 2009). This work was based on extensive consultation and qualitative data collection from RYA and CA members, through the organisations' specialist and regional committees and through the RYA affiliated clubs. The consultation was also sent to berth holder associations and marinas.

15.2.9.7 The results of this work were published in Sharing The Wind (RYA and CA, 2004) and updated GIS layers were published in 2016.

15.2.9.8 The report notes that the use of recreational craft, both under sail and power, is highly seasonal and highly diurnal. The division of recreational craft routes into heavy, medium and light use is therefore based on the following classification:

- Heavy recreational routes – Very popular routes on which a minimum of six or more recreational vessels will probably be seen at all times during summer daylight hours. These also include the entrances to harbours, anchorages and places of refuge;
- Medium recreational routes – Popular routes on which some recreational craft will be seen at most times during summer daylight hours; and
- Light recreational routes – Routes known to be in common use but which do not qualify for medium or heavy classification.

15.2.9.9 These routes are not designated courses but are general indications of known recreational routes between specific destinations popular with recreational craft.

15.2.9.10 A plot of the recreational activity based on the latest RYA Cruising Routes (2016) is presented in Figure 15.21. There are no cruising routes, general sailing or racing areas within the Hornsea Three array area shipping and navigation study area. The closest passing cruising route is a medium use route running north west to south east and passing approximately 35 nm to the south west of the Hornsea Three array area.

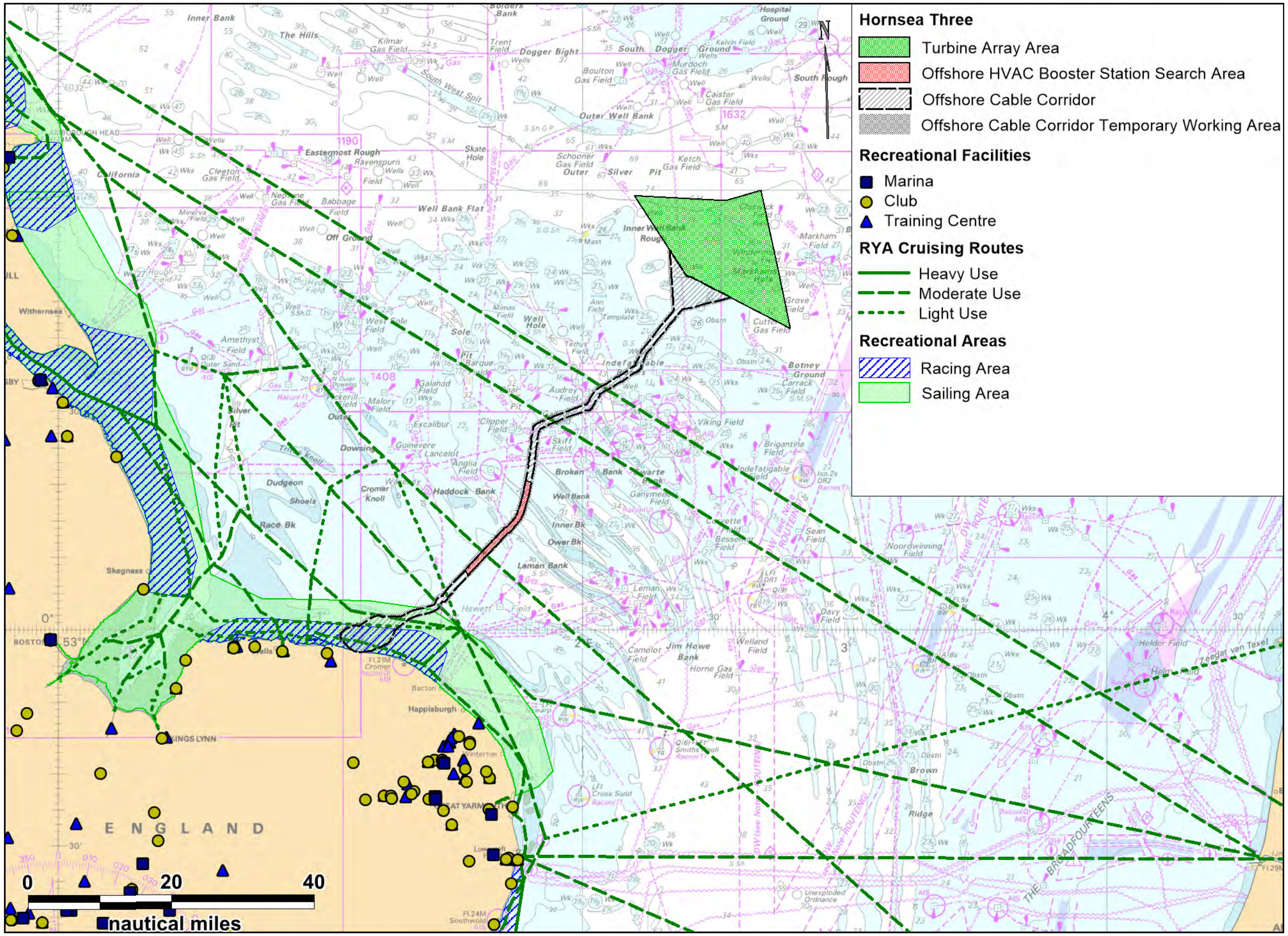


Figure 15.21:RYA cruising routes in proximity to Hornsea Three.

15.2.10 Fishing vessel activity

15.2.10.1 This section reviews the fishing vessel activity in proximity to Hornsea Three based on the marine traffic surveys and commercial fisheries study (volume 2, chapter 6: commercial fisheries).

Survey data

15.2.10.2 Fishing vessel activity was recorded during the AIS, visual and Radar marine traffic surveys and is presented in Figure 15.22. It can be seen that fishing vessel activity was recorded within the Hornsea Three array area shipping and navigation study area, with vessels tracked transiting through the Hornsea Three array area as well as actively engaged in fishing.

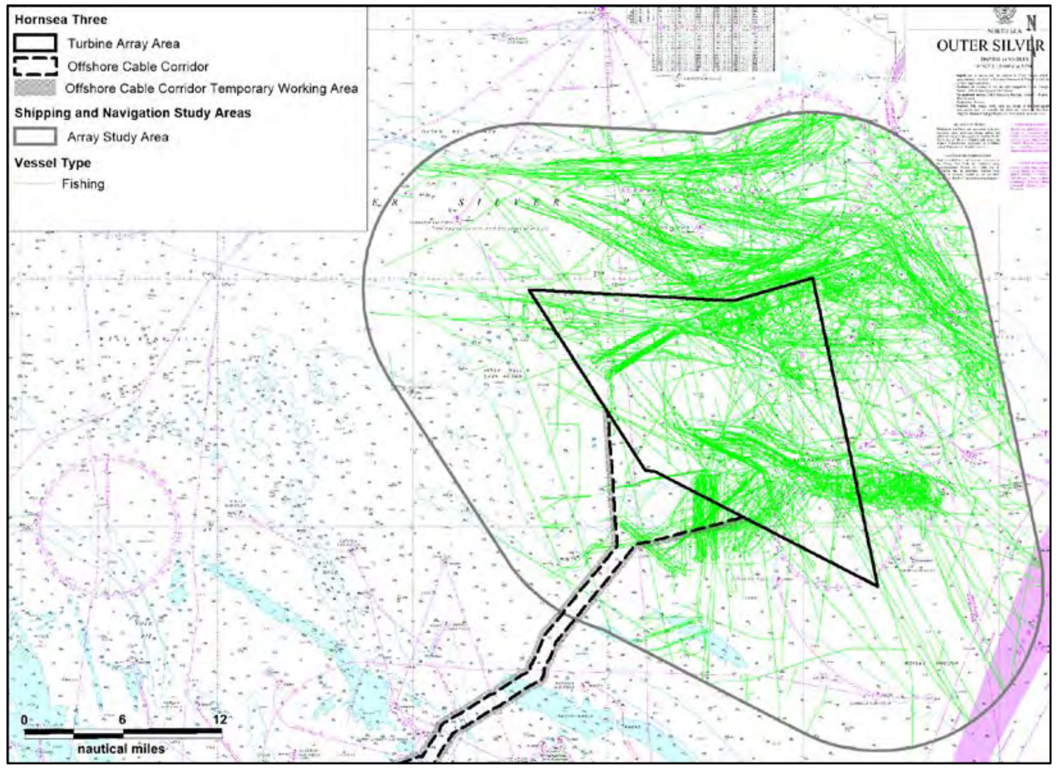


Figure 15.22: AIS, visual and Radar fishing vessels within the Hornsea Three array area shipping and navigation study area (40 days summer and winter 2016).

15.2.10.3 Flag state (nationality) information was available for approximately 85% of fishing vessels recorded on AIS, visual and Radar within the Hornsea Three array area shipping and navigation study area. Of the nationalities identified, the most common were the Netherlands (37%), UK (24%), France (15%) and Belgium (12%).

15.2.10.4 Fishing method information was available for approximately 78% of fishing vessels recorded on AIS, visual and Radar within the Hornsea Three array area shipping and navigation study area. Of the fishing methods identified, the most common were demersal stern trawlers (34%), beam trawlers (33%) and seine netters (20%). No recreational fishing vessels were identified within the survey data.

Sightings data

15.2.10.5 Fishing vessel sightings (over flight and / or vessel based) recorded between 2005 and 2009 was analysed for the Hornsea Three array area shipping and navigation study area.

15.2.10.6 The most common nationalities identified were the Netherlands (41%), UK (25%) and Belgium (14%), while the most common fishing methods identified were unspecified trawlers (43%), beam trawlers (43%) and demersal stern trawlers (10%). Both the nationality and fishing method distributions show good agreement with the corresponding distributions for the survey data.

15.2.10.7 91% of fishing vessels whose type of activity was available was actively engaged in fishing activity (7% transit and 2% laid stationary). This shows good agreement with the fishing vessel tracks shown in Figure 15.22.

Satellite data

15.2.10.8 Satellite data (from the MMO and collected for fishing vessels of 15 m length and over) recorded throughout 2009 was analysed for the Hornsea Three array area shipping and navigation study area.

15.2.10.9 The most common nationalities identified were the Netherlands (33%), UK (30%) and Germany (12%), while the most common fishing methods identified were demersal stern trawlers (47%), beam trawlers (18%) and seine netters (16%). As with the sightings data, both the nationality and fishing method distributions show good agreement with the corresponding distributions for the survey data.

15.3 Hornsea Three offshore cable corridor

15.3.1.1 AIS data collected for the Hornsea Three offshore cable corridor shipping and navigation study area between 6 June to 4 July 2016 and between 10 November and 15 December 2016 has been analysed. The Hornsea Three offshore cable corridor is crossed by a number of dense traffic routes, with the majority of these between the UK east coast and mainland Europe, including the Netherlands, Belgium, Germany and France. There are also a notable number of dense traffic routes between UK east coast ports in areas close to shore and routes associated with oil and gas affiliated vessels, with Great Yarmouth the primary base port.

15.3.1.2 Figure 15.23 presents 40 days (26 days summer and 14 days winter) AIS data of all tracks, colour-coded by vessel type, within a “Hornsea Three offshore cable corridor study area” which has been chosen to provide a sample of seasonal vessel traffic transiting in the vicinity of the Hornsea Three offshore cable corridor.

15.3.1.3 A number of tracks recorded during the survey were classified as temporary (non-routine) such as the tracks of the survey vessels and traffic associated with temporary drilling rigs and have therefore been excluded from further analysis. Oil and gas vessels supporting permanent installations were retained in the analysis.

15.3.1.4 A plot of vessel tracks recorded during the combined 40 day summer and winter survey period, colour-coded by vessel type and excluding temporary traffic (as defined above) are presented in Figure 15.24.

15.3.1.5 For the 26 days analysed in June and July 2016, there were an average of 97 unique vessels per day passing within the Hornsea Three offshore cable corridor study area and 87 through the Hornsea Three offshore cable corridor itself, recorded on AIS (excluding temporary traffic).

15.3.1.6 Figure 15.25 illustrates the daily number of unique vessels passing within the Hornsea Three offshore cable corridor study area and intersecting the Hornsea Three offshore cable corridor, during 26 days from June and July 2016.

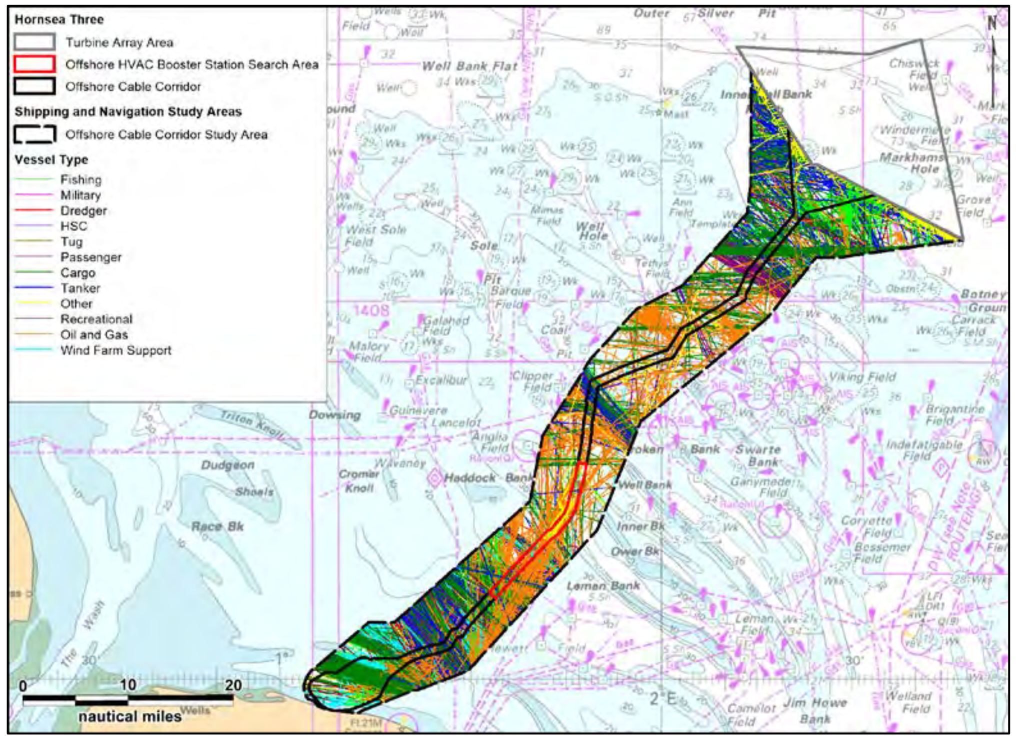


Figure 15.23: Overview of all AIS data within the Hornsea Three offshore cable corridor study area (40 days summer and winter 2016).

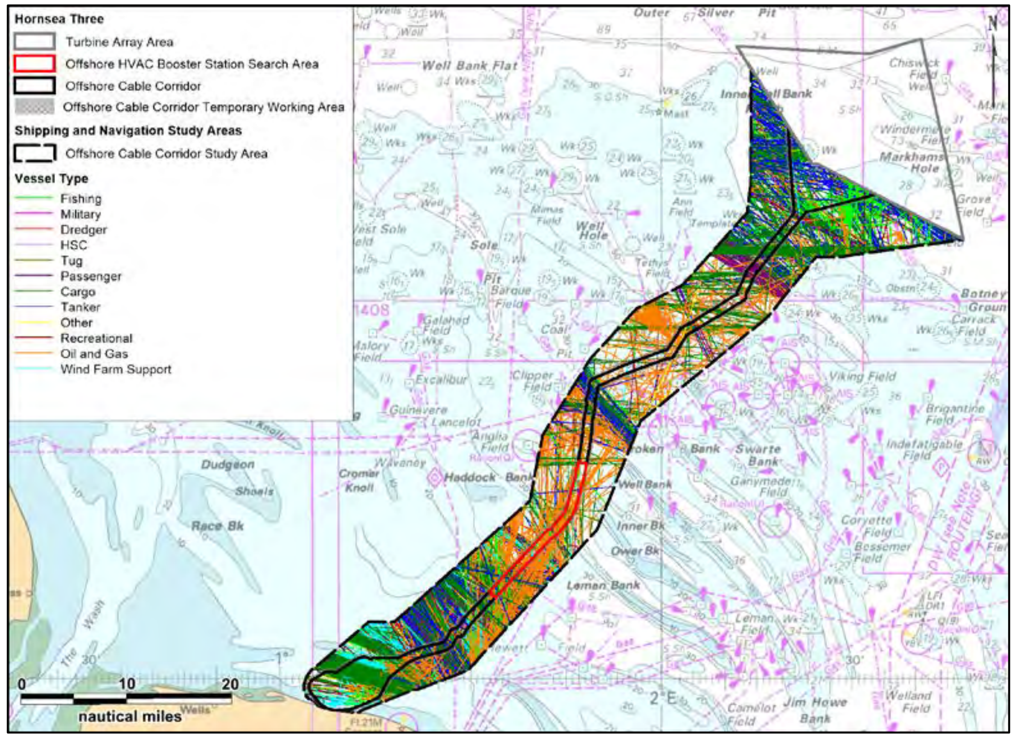


Figure 15.24: Overview of AIS data within the Hornsea Three offshore cable corridor study area excluding temporary tracks (40 days summer and winter 2016).

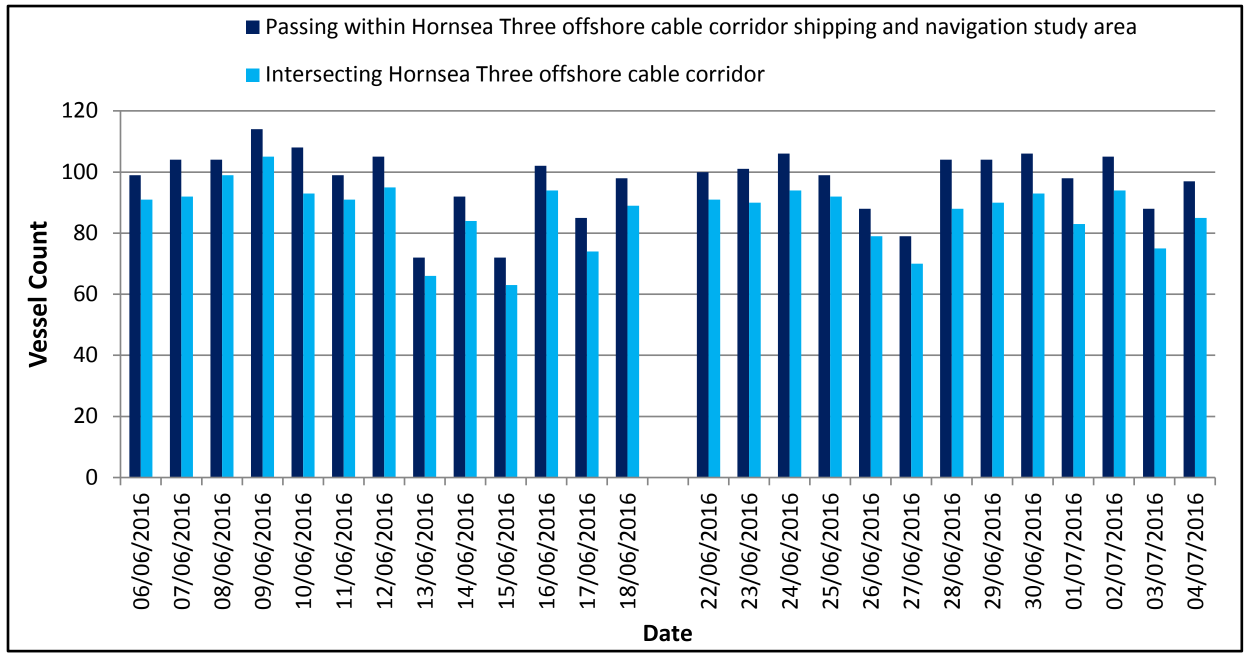


Figure 15.25: Unique vessels per day within the Hornsea Three offshore cable corridor study area during 26 days summer 2016 (AIS).

15.3.1.7 The busiest day recorded throughout the survey period was the 9 June 2016 when 114 unique vessels were recorded within the Hornsea Three offshore cable corridor study area and 105 within the Hornsea Three offshore cable corridor.

15.3.1.8 The quietest day recorded throughout the survey period was the 15 June 2016 when 72 unique vessels were recorded within the Hornsea Three offshore cable corridor study area and 63 within the Hornsea Three offshore cable corridor.

15.3.1.9 For the 14 days analysed in November to December 2016, there were an average of 97 unique vessels per day passing within the Hornsea Three offshore cable corridor study area and 86 through the Hornsea Three offshore cable corridor itself, recorded on AIS (excluding temporary traffic).

15.3.1.10 Figure 15.26 illustrates the daily number of unique vessels passing within the Hornsea Three offshore cable corridor study area and intersecting the Hornsea Three offshore cable corridor during 14 days between November and December 2016.

15.3.1.11 The busiest day recorded throughout the survey period was the 30 November 2016 when 111 unique vessels were recorded within the Hornsea Three offshore cable corridor study area and 99 within the Hornsea Three offshore cable corridor.

15.3.1.12 The quietest day throughout the survey period was the 28 November 2016 when 75 unique vessels were recorded within the Hornsea Three offshore cable corridor study area and 66 within the Hornsea Three offshore cable corridor.

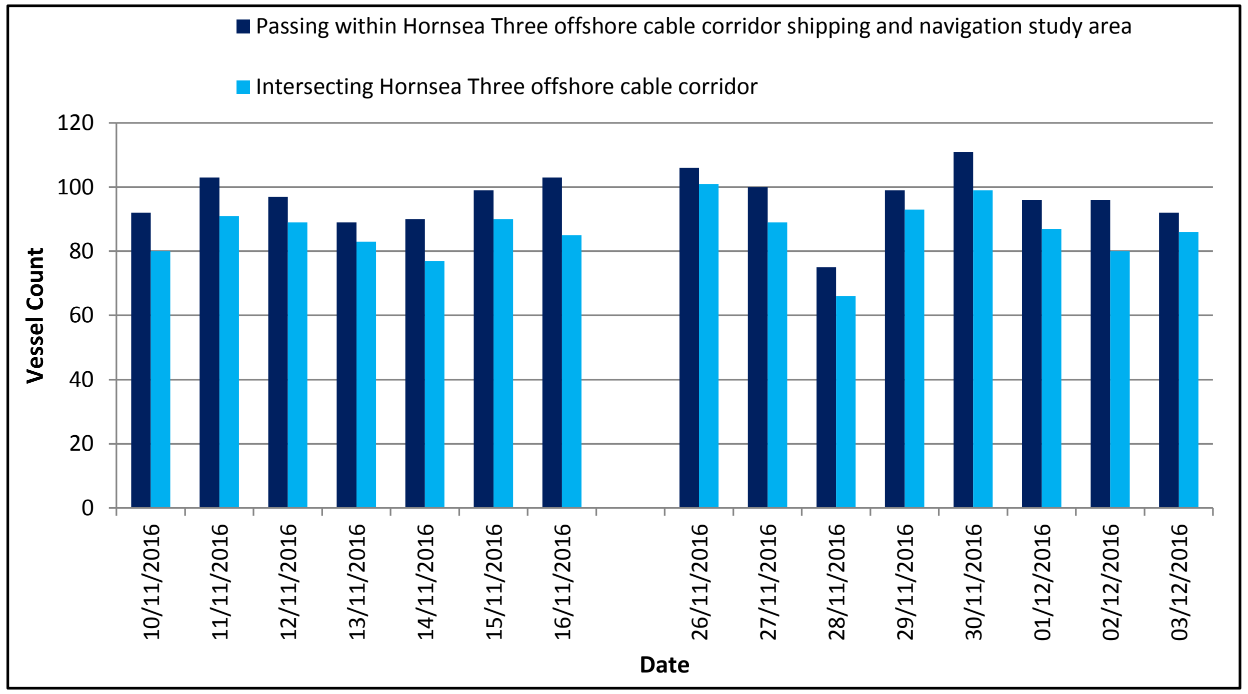


Figure 15.26: Unique vessels per day within the Hornsea Three offshore cable corridor study area during 14 days winter 2016 (AIS).

15.3.2 Vessel types

15.3.2.1 Analyses of the vessel types recorded passing within the Hornsea Three offshore cable corridor study area and intersecting the Hornsea Three offshore cable corridor throughout both survey periods are presented in Figure 15.27.

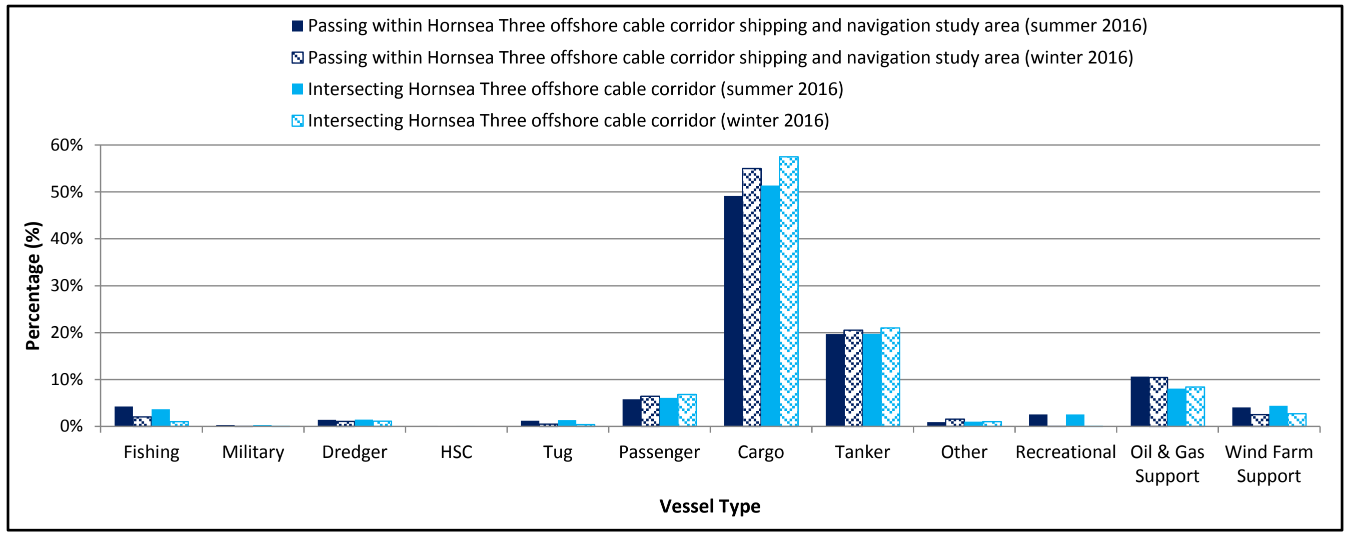


Figure 15.27: Distribution of vessel types within the Hornsea Three offshore cable corridor study area during 40 days summer and winter 2016 (AIS).

15.3.2.2 Throughout June and July 2016 (summer) the majority of tracks were cargo vessels (approximately 50% within Hornsea Three offshore cable corridor) and tankers (20%). Throughout November and December 2016 (winter) the majority of tracks were also cargo vessels (56% within Hornsea Three offshore cable corridor) and tankers (21%). It should be noted that the cargo vessel category includes commercial ferries (e.g. DFDS Seaways commercial ferries) who generally broadcast their vessel types on AIS as cargo.

15.3.2.3 Figure 15.28 presents a plot of cargo vessels recorded on AIS, including commercial ferries, throughout both the summer and winter survey periods. Plots of tankers and oil and gas affiliated vessels are presented in Figure 15.29 and Figure 15.30 respectively.

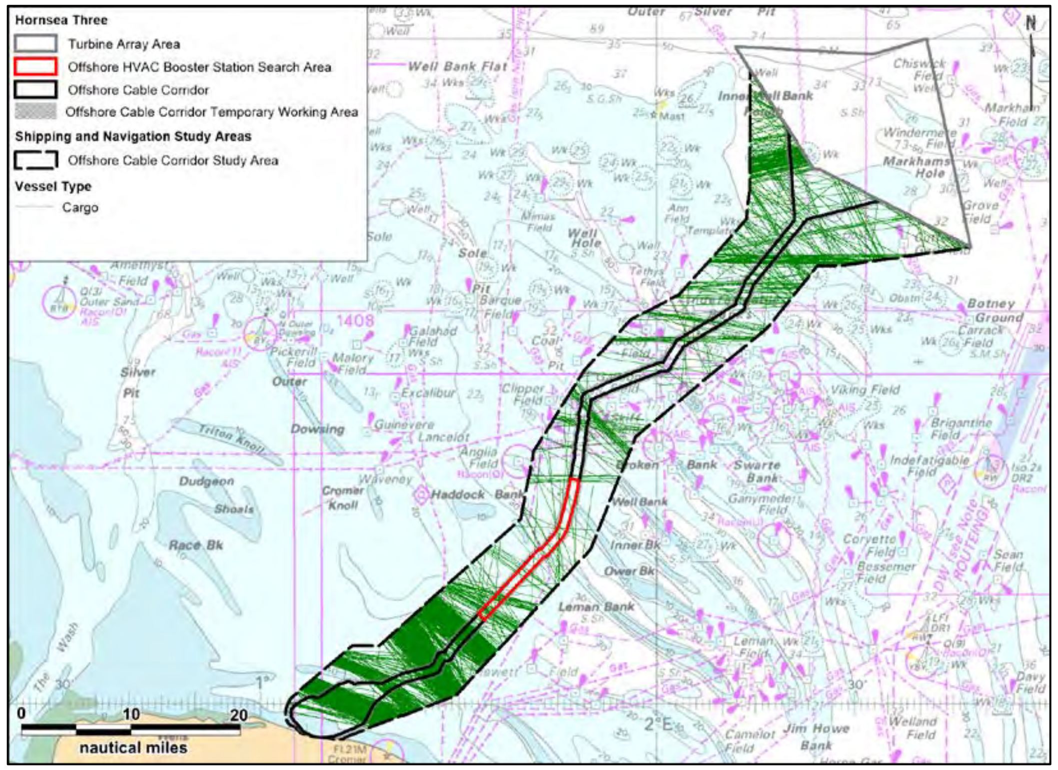


Figure 15.28: AIS cargo vessels within the Hornsea Three offshore cable corridor study area (40 days summer and winter 2016).

15.3.2.4 Throughout the combined summer and winter survey period, an average of 50 unique cargo vessels per day passed within the Hornsea Three offshore cable corridor study area and 46 within the Hornsea Three offshore cable corridor itself.

15.3.2.5 Regular cargo vessels operating in the Hornsea Three offshore cable corridor study area includes DFDS Seaways commercial Ro Ro ferries vessels operating routes between Rosyth (UK) to Zeebrugge (Belgium), Immingham (UK) to Rotterdam (Netherlands) and Immingham (UK) to Cuxhaven (Germany).

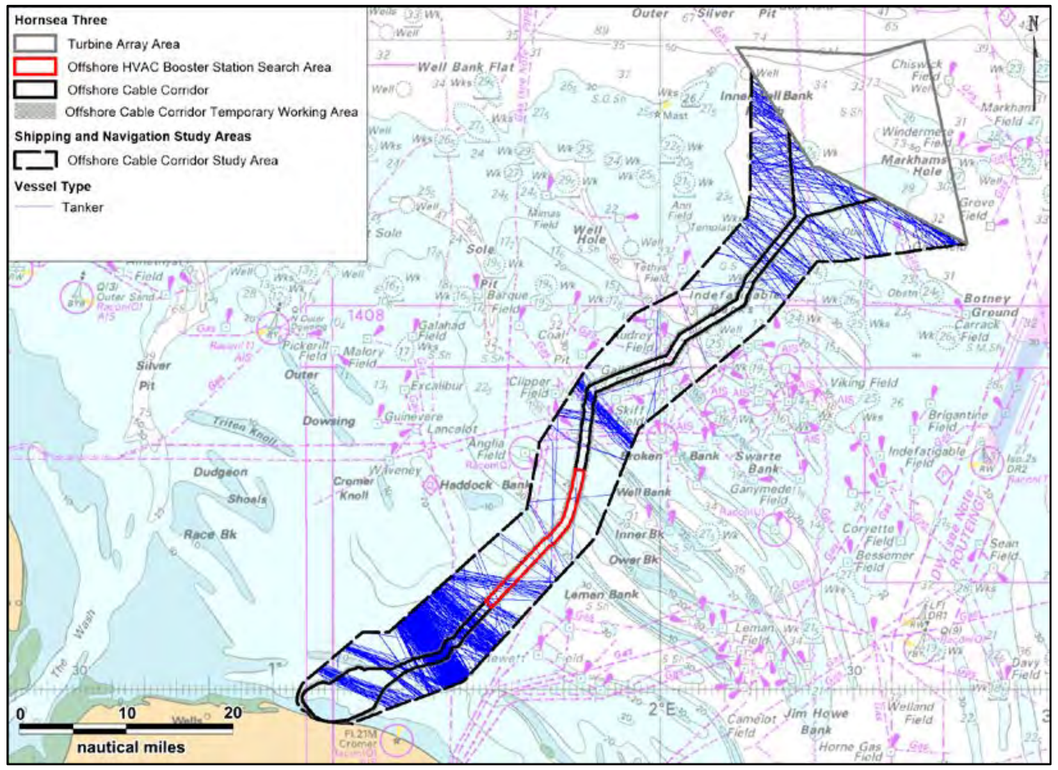


Figure 15.29: AIS tankers within the Hornsea Three offshore cable corridor study area (40 days summer and winter 2016).

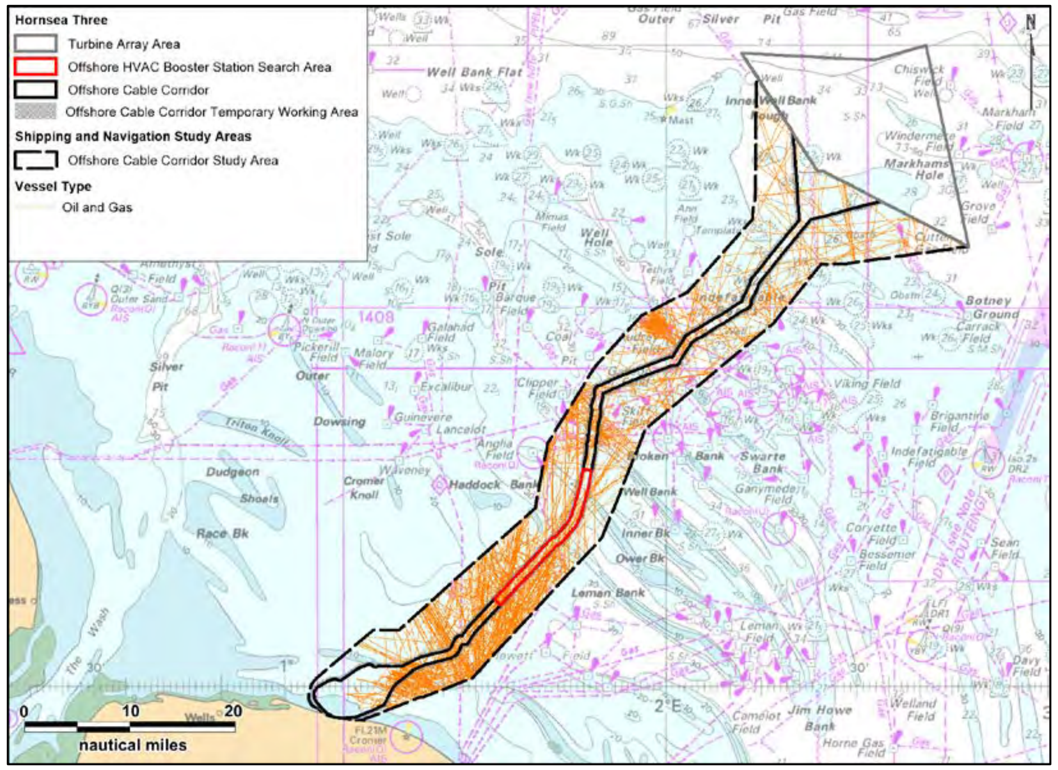


Figure 15.30: AIS oil and gas affiliated vessels within the Hornsea Three offshore cable corridor study area (40 days summer and winter 2016).

15.3.2.6 Throughout the combined summer and winter survey period, an average of 19 tankers per day passed within the Hornsea Three offshore cable corridor study area and 17 within the Hornsea Three offshore cable corridor itself.

15.3.2.7 All of the tankers recorded throughout the survey period were on passage to oil and gas terminals throughout the UK and mainland Europe including: Antwerp (Belgium), Rotterdam (Netherlands), Immingham (UK), Grangemouth (UK) and Teesport (UK).

15.3.2.8 Throughout the combined summer and winter survey period, an average of ten unique offshore oil and gas affiliated vessels per day passed within the Hornsea Three offshore cable corridor study area and seven within the Hornsea Three offshore cable corridor itself. The majority of these vessels were on passage to/from oil and gas installations in the vicinity of the Hornsea Three offshore cable corridor study area.

15.3.2.9 Offshore oil and gas affiliated vessels that were not transient included vessels which were acting as the ERRV for nearby oil and gas surface platforms in the vicinity of the Hornsea Three offshore cable corridor study area.

15.3.3 Recreational vessel activity

15.3.3.1 Figure 15.31 presents a plot of recreational vessels recorded on AIS throughout both the summer and winter survey periods.

15.3.3.2 Throughout the combined summer and winter survey period, an average of one to two recreational vessels per day passed within the Hornsea Three offshore cable corridor shipping and navigation study area and one to two within the Hornsea Three offshore cable corridor itself. The majority of these vessels were undertaking a passage alongside the shore.

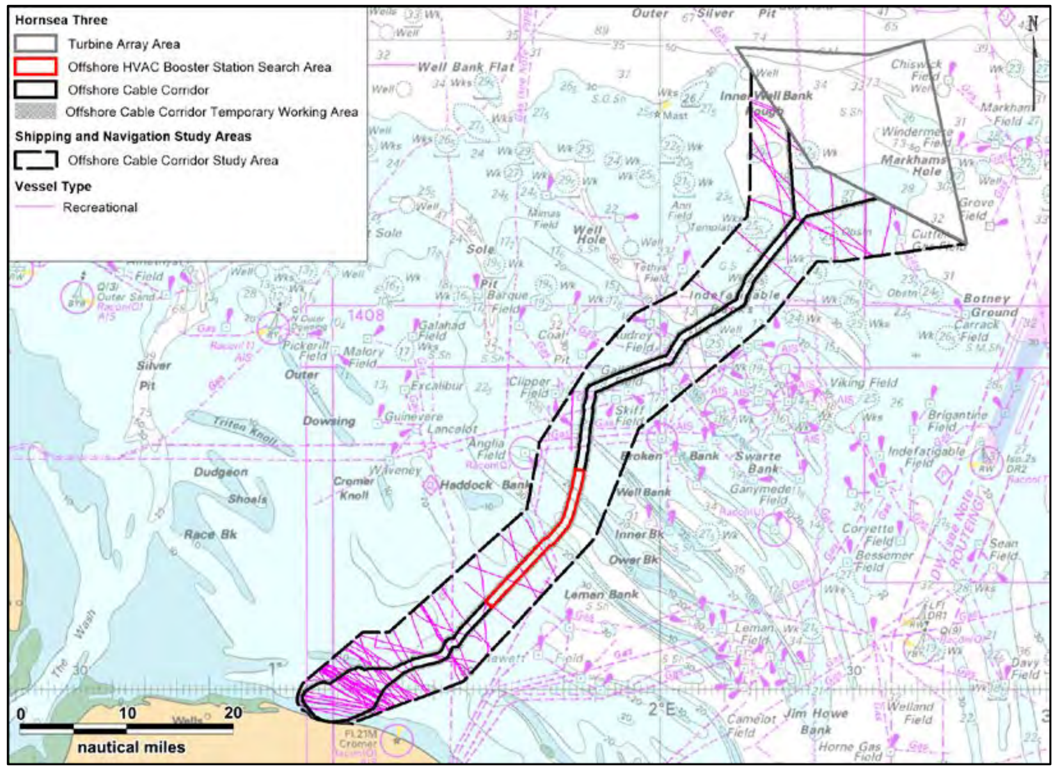


Figure 15.31: AIS recreational vessels within Hornsea Three offshore cable corridor shipping and navigation study area (40 days summer and winter 2016).

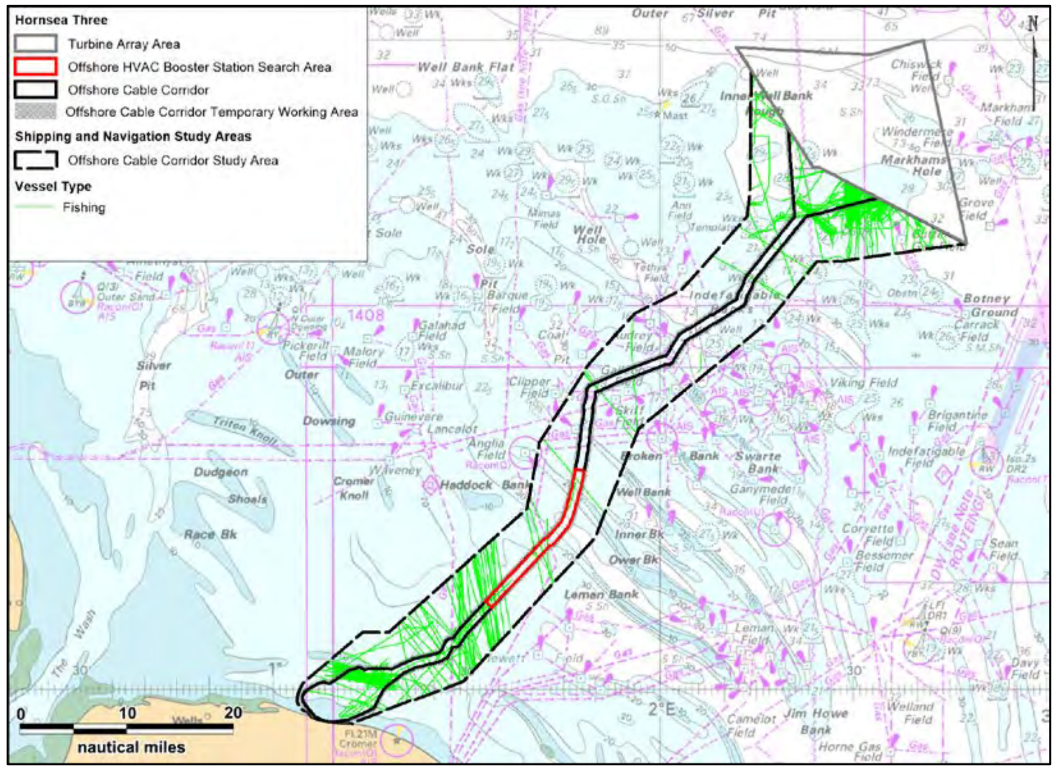


Figure 15.32: AIS fishing vessels within the Hornsea Three offshore cable corridor shipping and navigation study area (40 days summer and winter 2016).

15.3.4 Fishing vessel activity

15.3.4.1 Figure 15.32 presents a plot of fishing vessels recorded on AIS throughout both the summer and winter survey periods.

15.3.4.2 Throughout the combined summer and winter survey period, an average of three to four fishing vessels per day passed within the Hornsea Three offshore cable corridor shipping and navigation study area and two to three within the Hornsea Three offshore cable corridor itself. The majority of these vessels were either on passage in a north-south direction or actively engaged in fishing activities in the vicinity of the Hornsea Three array area or the shore.

15.3.5 Vessel size distribution

Maximum Length Overall (LOA)

15.3.5.1 LOAs recorded throughout the survey periods ranged from 5 m (recreational sailing vessel *Wolfies Toy* and *RNLI Lifeboat D-734*) to a maximum of 333 m (crude oil tanker *Selene Trader*). Figure 15.33 illustrates the distribution of vessel lengths throughout each survey period.

15.3.5.2 The average length of vessels within the Hornsea Three offshore cable corridor study area throughout the summer and winter survey periods were 108 m and 115 m respectively. This reflects the greater proportion of small vessels (<50 m) recorded throughout the summer survey within the Hornsea Three offshore cable corridor study area.

15.3.5.3 Figure 15.34 provides an overview of AIS vessel tracks (excluding temporary traffic) recorded throughout the combined 40 day summer/winter survey period colour-coded by vessel length.

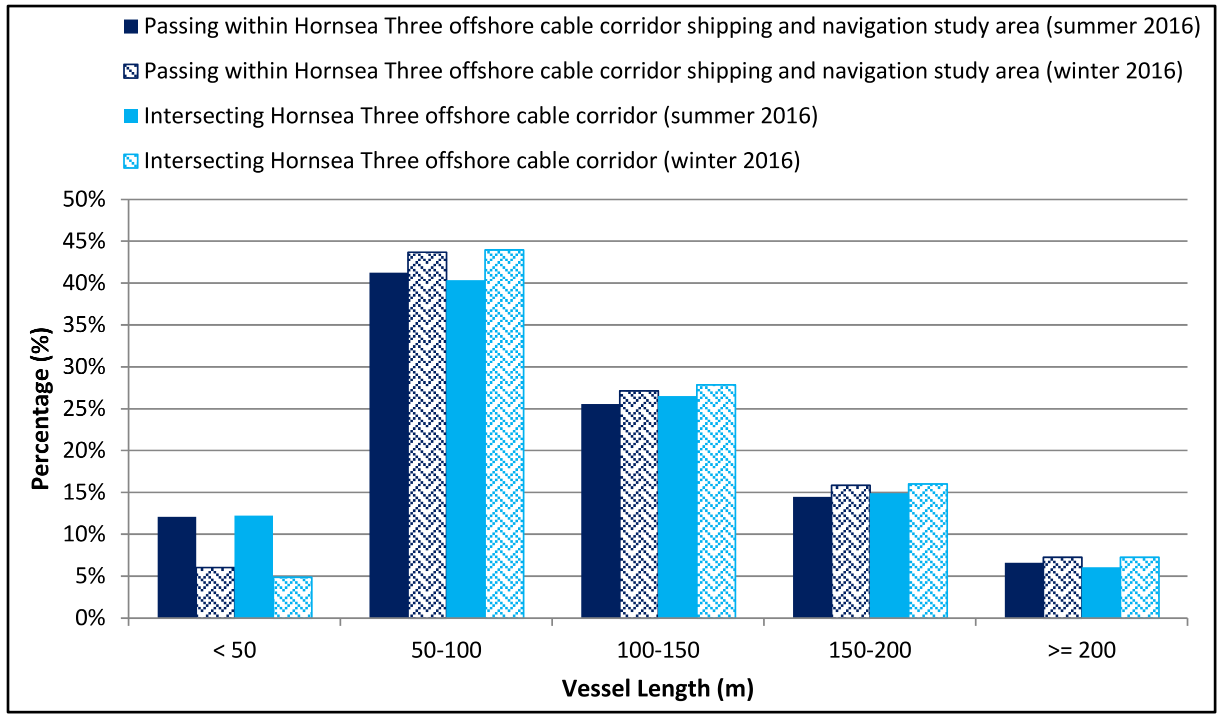


Figure 15.33: Vessel length distribution within the Hornsea Three offshore cable corridor study area during 40 days summer and winter 2016 (AIS).

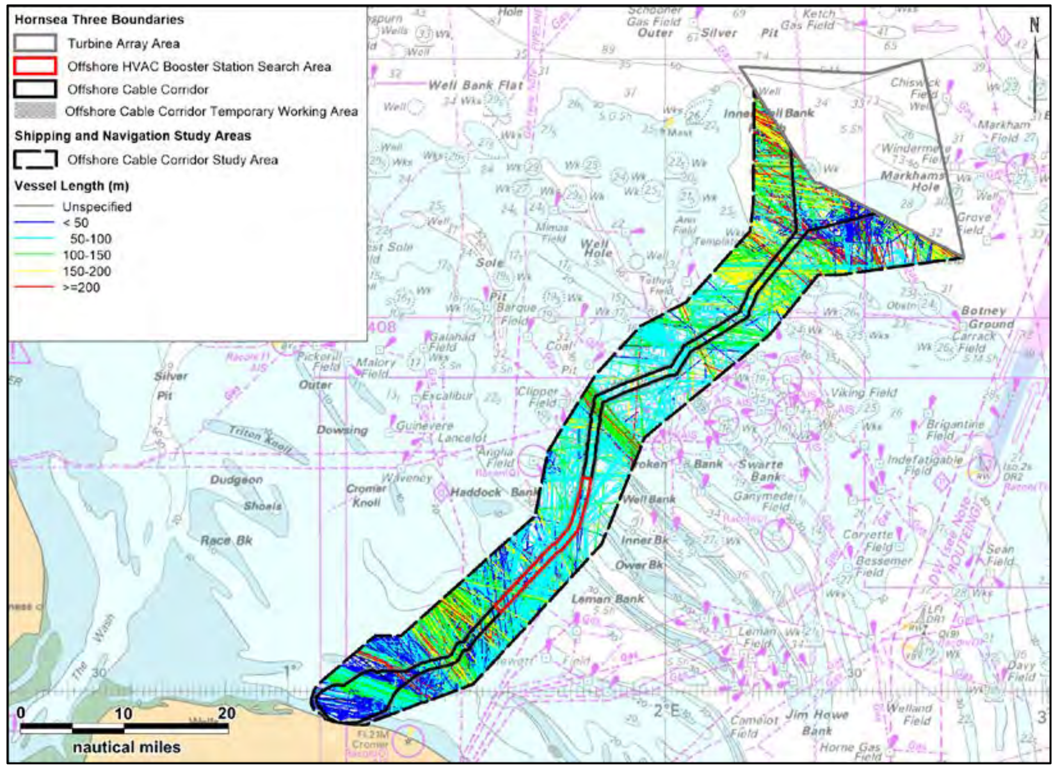


Figure 15.34: AIS data within the Hornsea Three offshore cable corridor study area colour-coded by vessel length (40 days summer and winter 2016).

Vessel draught

15.3.5.4 Vessel draughts recorded throughout the survey periods ranged from 0.9 m (wind farm support vessel *Eastern Aura*) to 20.6 m (oil products tanker *Victory 1*). Figure 15.35 illustrates the distribution of vessel draughts recorded throughout each survey period.

15.3.5.5 A small minority (10% of the total number of unique vessels within the Hornsea Three offshore cable corridor study area) did not broadcast a draught on AIS and hence have been excluded from further analysis.

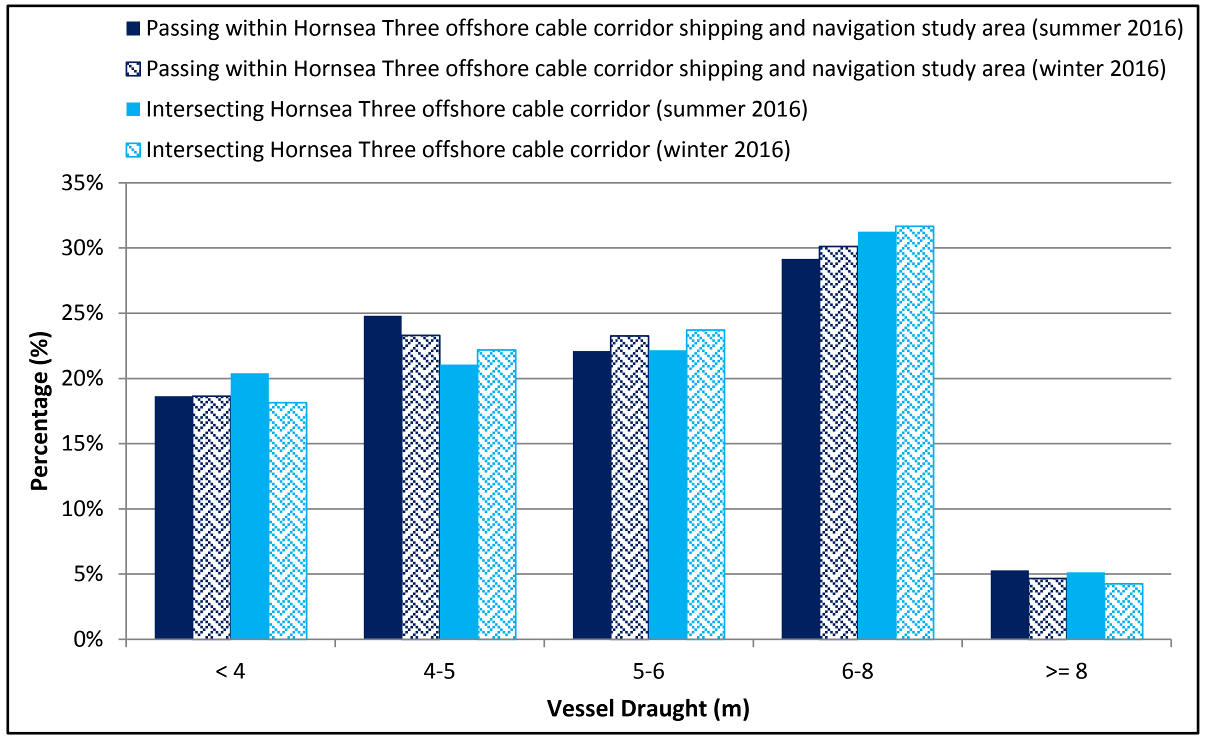


Figure 15.35: Vessel draught distribution within offshore cable corridor study area during 40 days summer and winter 2016 (AIS).

15.3.5.6 The average draughts of vessels within the Hornsea Three offshore cable corridor study area throughout the summer and winter survey periods were 5.3 m.

15.3.5.7 Figure 15.36 provides an overview of AIS vessel tracks (excluding temporary traffic) recorded throughout the combined 40 day summer/winter survey period colour-coded by vessel draught.

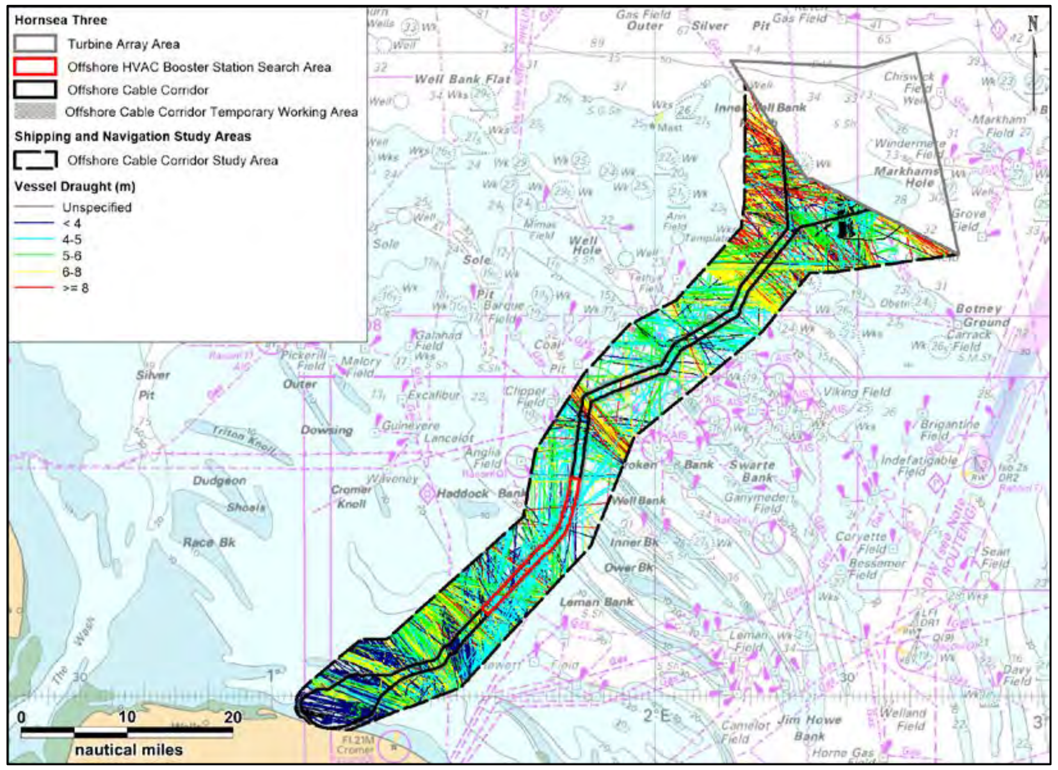


Figure 15.36: AIS data within the Hornsea Three offshore cable corridor study area colour-coded by vessel draught (40 days summer and winter 2016).

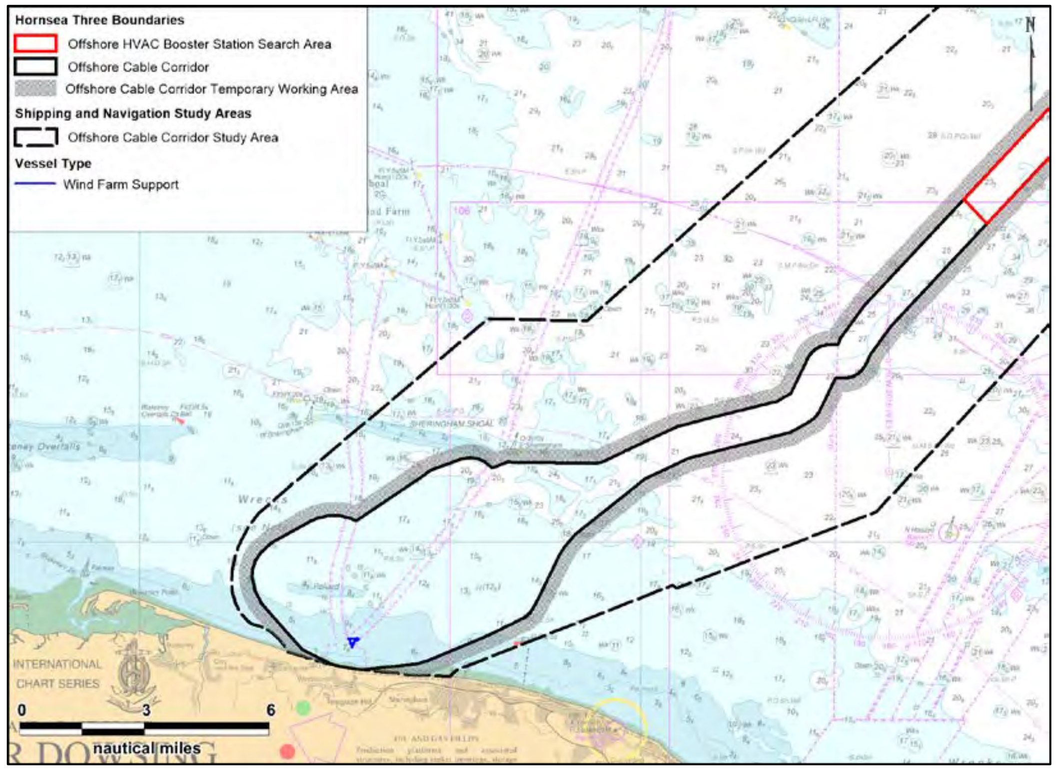


Figure 15.37: AIS anchored vessels within the Hornsea Three offshore cable corridor study area.

15.3.6 Anchored vessels

15.3.6.1 Anchored vessels can be identified based on the AIS navigational status which is programmed on the AIS transmitter on-board a vessel. An overview of vessels that broadcast their navigational status as “at anchor” within the Hornsea Three offshore cable corridor study area, colour-coded by vessel type is presented in Figure 15.37.

15.3.6.2 Throughout the 40 day period analysed, only one vessel was recorded broadcasting “at anchor” which was the wind farm support vessel *Yvonne W*.

15.3.6.3 However, as information is manually entered into the AIS; it is common for vessels not to update the navigational status if they are anchored for only a short period of time. For this reason, those vessels which travelled at a speed of less than one knot for more than 30 minutes are assumed to be at anchor.

15.3.6.4 After applying these criteria, no further vessels were deemed to be at anchor.

15.4 Hornsea Three offshore HVAC booster station search area survey analysis

15.4.1.1 A plot of all the vessel tracks recorded within the offshore HVAC booster station shipping and navigation study area during a 14 day survey period from 16 to 29 September 2016 (summer), colour-coded by vessel type, is presented in Figure 15.38. A plot of all the tracks recorded within the offshore HVAC booster station shipping and navigation study area during a further 14 day survey during November and December 2016 (winter) is presented in Figure 15.39.

15.4.1.2 These figures include tracks for the survey vessels *Willing Lad* and *RV Aora* as well as offshore support vessels operating at temporary (mobile) drilling rigs (such drilling operations typically only last four to six weeks).

15.4.1.3 As with the Hornsea Three array area marine traffic survey, a number of tracks recorded during the summer and winter Hornsea Three offshore HVAC booster station search area survey were classified as temporary (non-routine), such as the tracks of the survey vessels and traffic associated with temporary drilling rigs. This includes the survey vessel *Bibby Athena* which was carrying out survey operations along the Hornsea Three offshore cable corridor during the summer period. These tracks have therefore been excluded from further analysis. Oil and gas affiliated vessels supporting permanent installations were retained in the analysis.

15.4.1.4 Plots of vessels tracks recorded during each respective survey period, colour-coded by vessel type and excluding temporary traffic (as defined above), are presented in Figure 15.40 and Figure 15.41 respectively, with corresponding density grids presented in Figure 15.42 and Figure 15.43 respectively. All figures exclude temporary traffic.

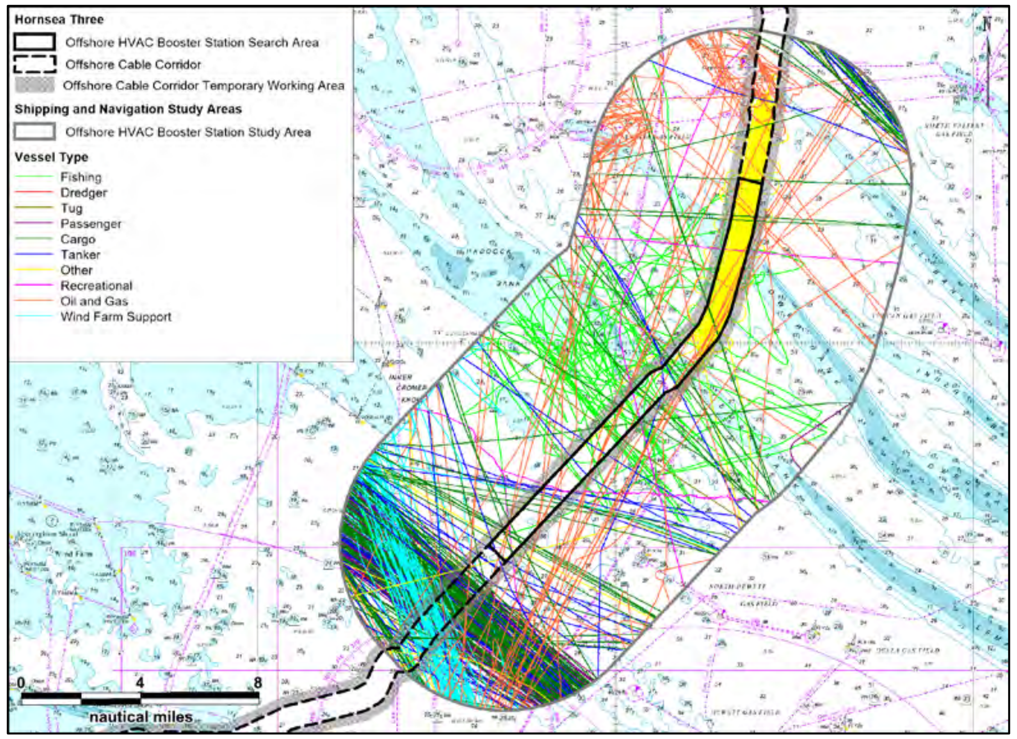


Figure 15.38: AIS, visual and Radar data within Hornsea Three offshore HVAC booster station shipping and navigation study area (14 days summer 2016).

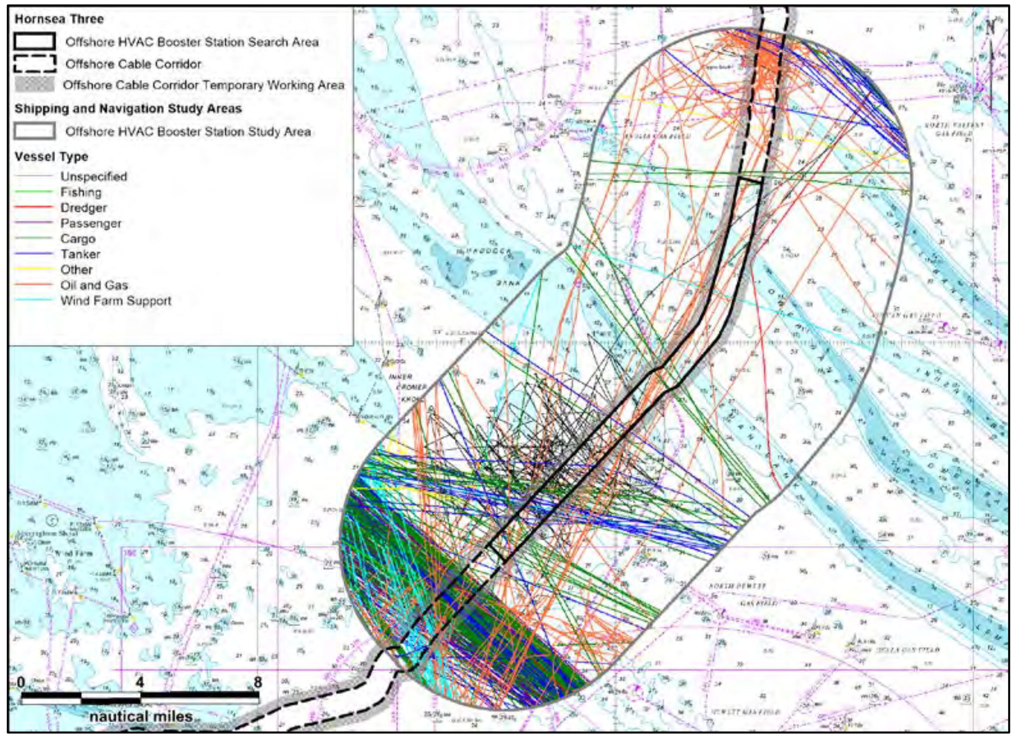


Figure 15.39: AIS, visual and Radar data within Hornsea Three offshore HVAC booster station search area shipping and navigation study area (14 days winter 2016).

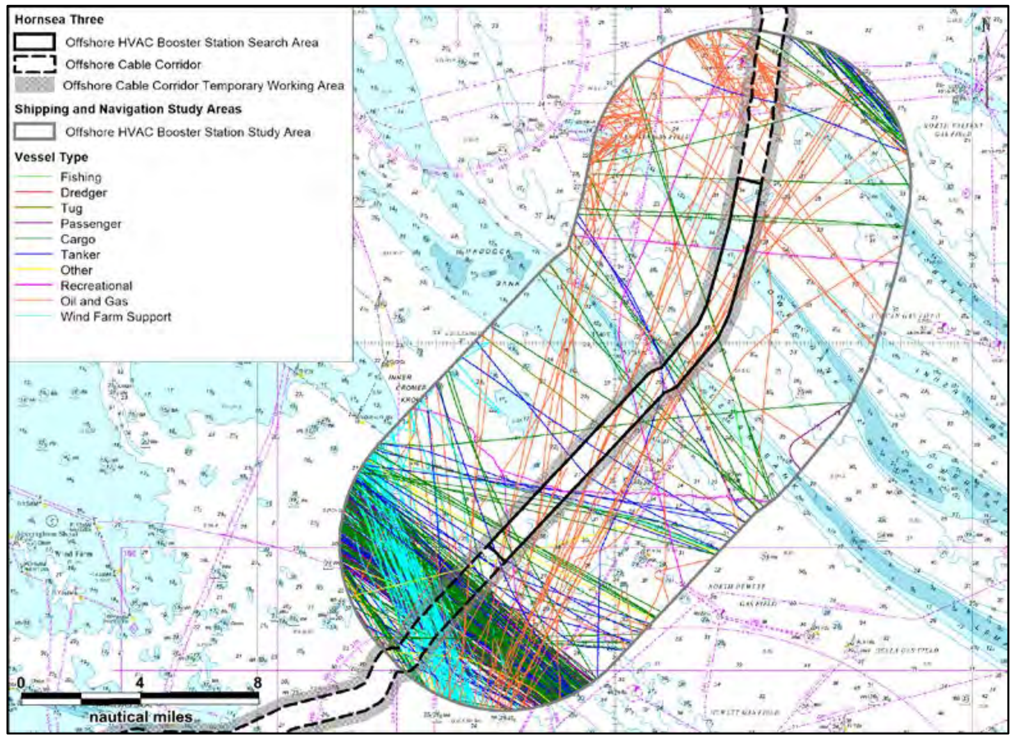


Figure 15.40: AIS, visual and Radar data within Hornsea Three offshore HVAC booster station search area shipping and navigation study area excluding temporary traffic (14 days summer 2016).

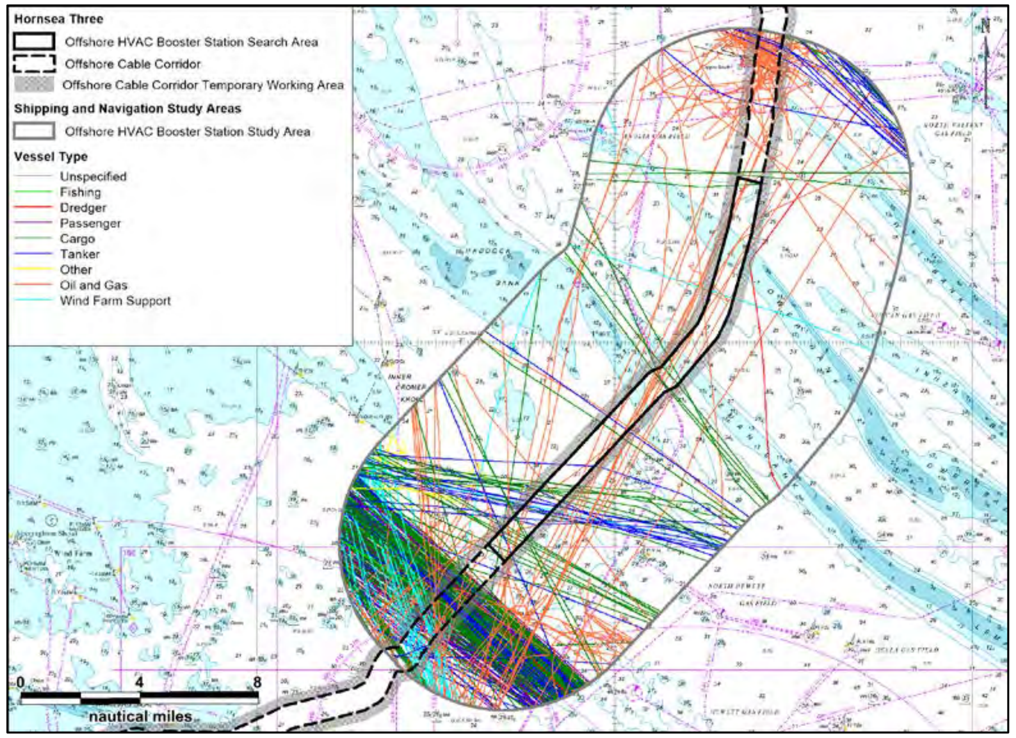


Figure 15.41: AIS, visual and Radar data within Hornsea Three offshore HVAC booster station search area shipping and navigation study area excluding temporary traffic (14 days winter 2016).

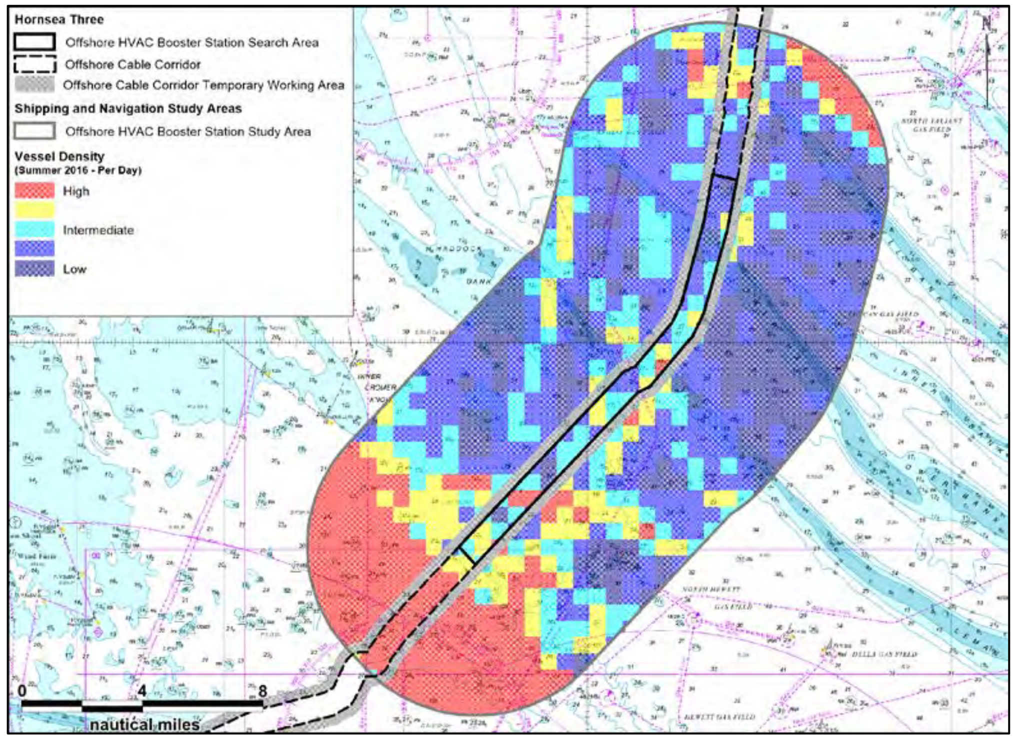


Figure 15.42: Vessel density from AIS, visual and Radar within Hornsea Three offshore HVAC booster station search area shipping and navigation study area excluding temporary traffic (14 days summer 2016).

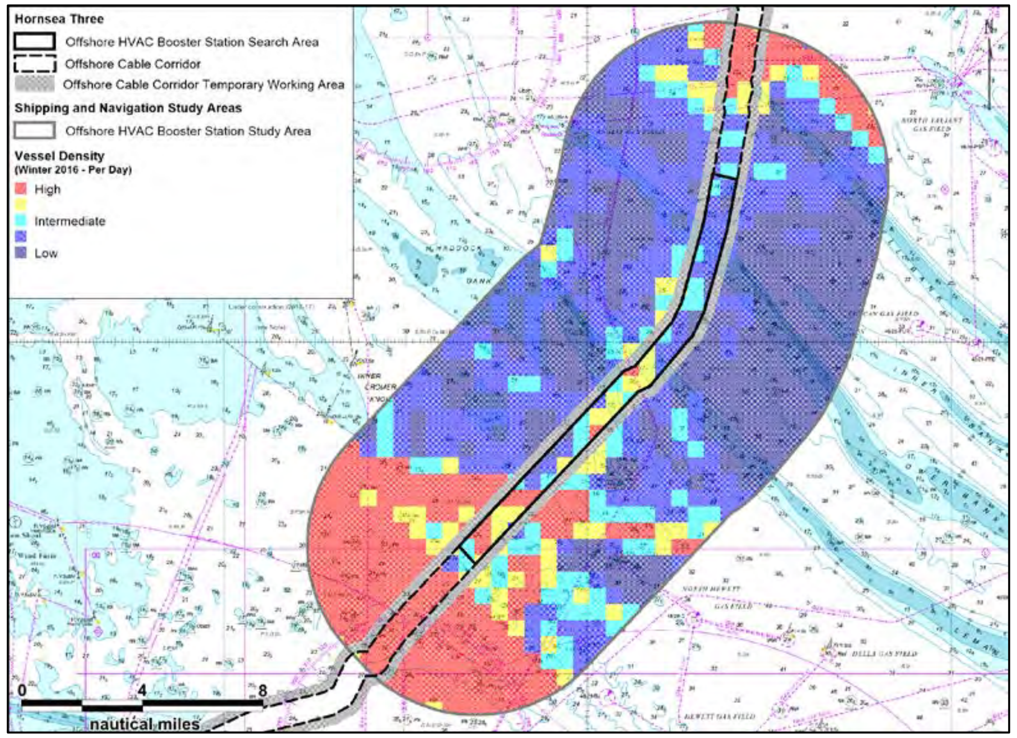


Figure 15.43: Vessel density from AIS, visual and Radar within Hornsea Three offshore HVAC booster station search area shipping and navigation study area excluding temporary traffic (14 days winter 2016).

15.4.2 Vessel counts

15.4.2.1 For the 14 days analysed in summer 2016, there were an average of 28 unique vessels per day passing within the offshore HVAC booster station shipping and navigation study area, recorded on AIS, visual and Radar. In terms of vessels intersecting the Hornsea Three offshore HVAC booster station search area, there was an average of five unique vessels per day.

15.4.2.2 For the 14 days analysed in winter 2016, there were an average of 29 unique vessels per day passing within the offshore HVAC booster station shipping and navigation study area, recorded on AIS, visual and Radar. In terms of vessels intersecting the Hornsea Three offshore HVAC booster station search area, there was an average of four unique vessels per day.

15.4.2.3 Figure 15.44 illustrates the daily number of unique vessels passing through the offshore HVAC booster station shipping and navigation study area and intersecting the Hornsea Three offshore HVAC booster station search area throughout the survey period.

15.4.2.4 The busiest day recorded throughout the survey period, excluding partial days, was 8 December 2016 when 39 unique vessels were recorded within the offshore HVAC booster station shipping and navigation study area and five unique vessels intersected the Hornsea Three offshore HVAC booster station search area.

15.4.2.5 The quietest day throughout the survey period, excluding partial days, was 11 December 2016 when 19 unique vessels were recorded within the offshore HVAC booster station shipping and navigation study area and only one unique vessel intersected the Hornsea Three offshore HVAC booster station search area.

15.4.2.6 Throughout the survey period only 13% of traffic recorded within the offshore HVAC booster station shipping and navigation study area intersected the Hornsea Three offshore HVAC booster station search area.

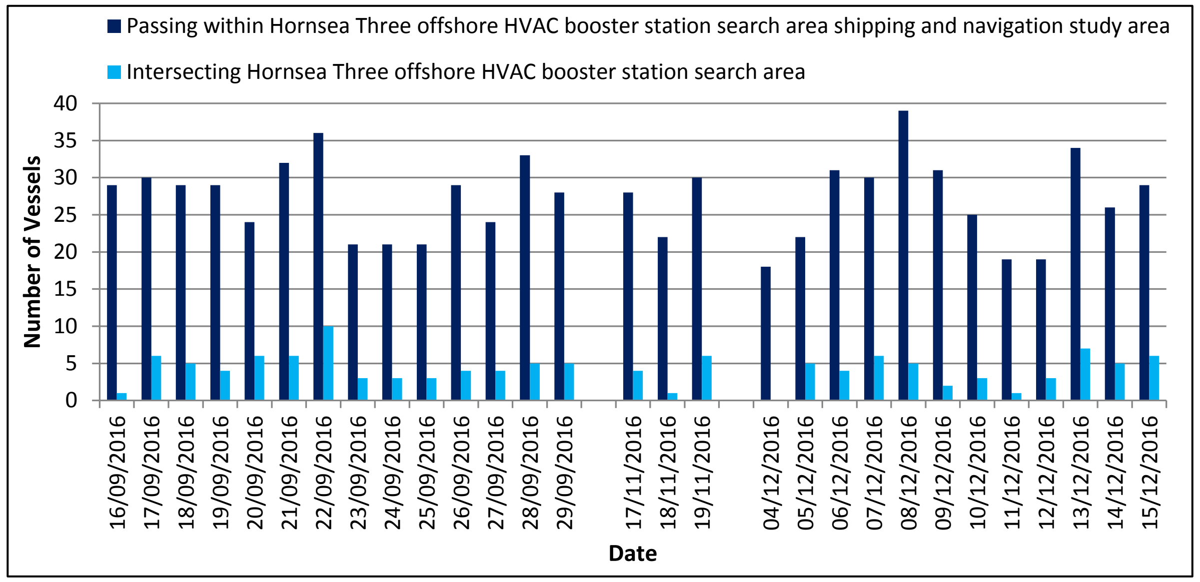


Figure 15.44: Unique vessels per day within offshore HVAC booster station shipping and navigation study area during 28 days summer and winter 2016 (AIS, visual and Radar).

15.4.3 Vessel types

15.4.3.1 Analyses of the vessel types recorded passing within the Hornsea Three offshore HVAC booster station search area shipping and navigation study area and intersecting the Hornsea Three offshore HVAC booster station search area throughout both survey periods are presented in Figure 15.45.

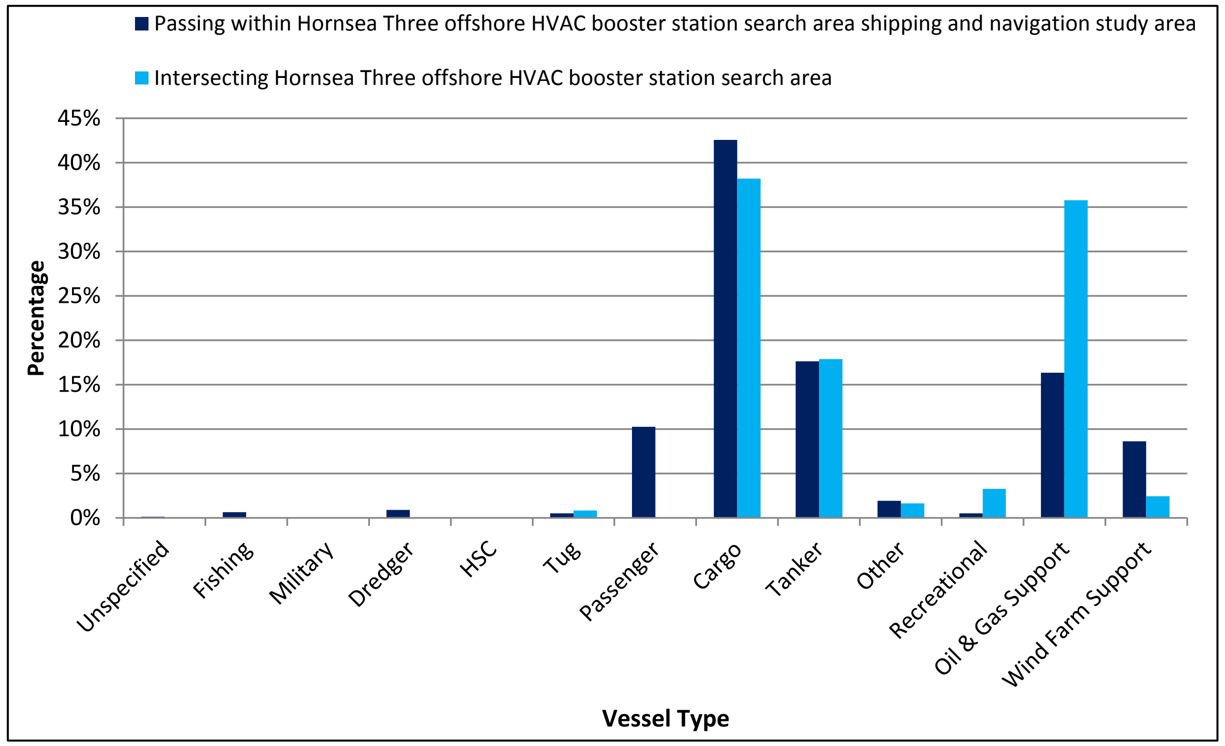


Figure 15.45: Distribution of vessel types within offshore HVAC booster station shipping and navigation study area during 28 days summer and winter 2016 (AIS, visual and Radar).

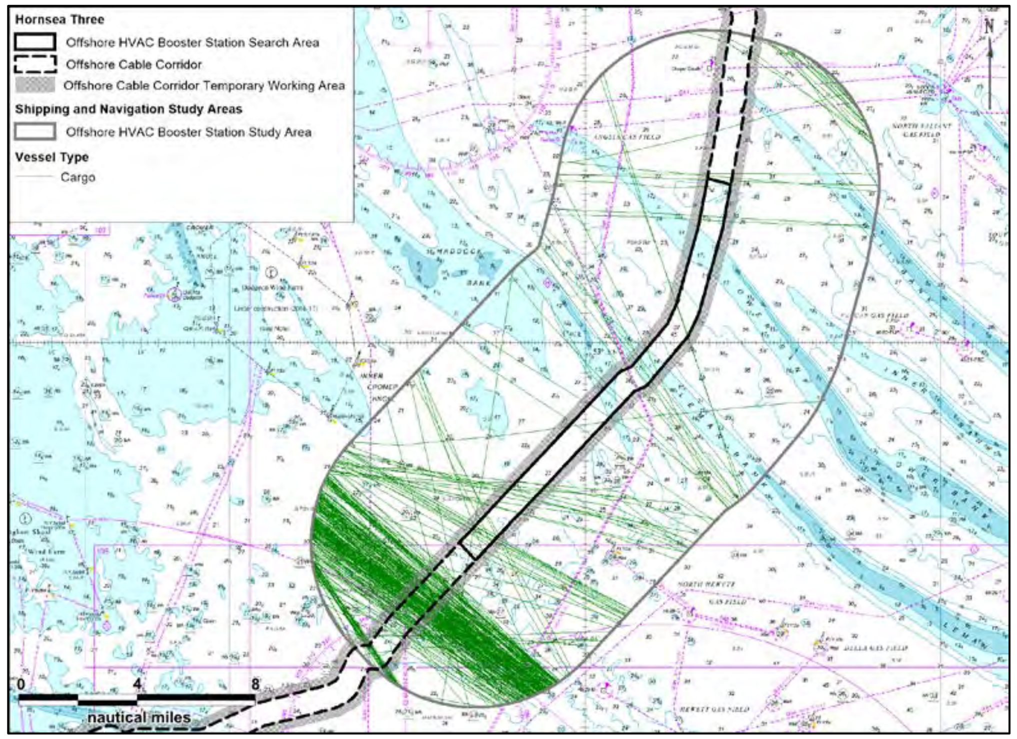


Figure 15.46: AIS, visual and Radar cargo vessels within offshore HVAC booster station shipping and navigation study area (28 days summer and winter 2016).

15.4.3.2 Throughout the survey periods the majority of tracks were cargo vessels (38% within the Hornsea Three offshore HVAC booster station search area) and tankers (18%). However, less than 10% of tracks intersecting the Hornsea Three offshore HVAC booster station search area were wind farm support vessels transiting to and from Dudgeon Offshore Wind Farm, this traffic is temporary and associated with the construction of the site however it remains within the assessment given the potential for operational routeing. It should be noted that the cargo vessel category includes commercial ferries (e.g. DFDS Seaways ferries) operating in the area who generally broadcast their vessel types on AIS as cargo.

15.4.3.3 Figure 15.46 presents a plot of cargo vessels, including commercial ferries, recorded within the offshore HVAC booster station shipping and navigation study area on AIS, visual and Radar throughout both the summer and winter survey periods. Equivalent plots of tankers and oil and gas affiliated vessels are presented in Figure 15.47 and Figure 15.48 respectively.

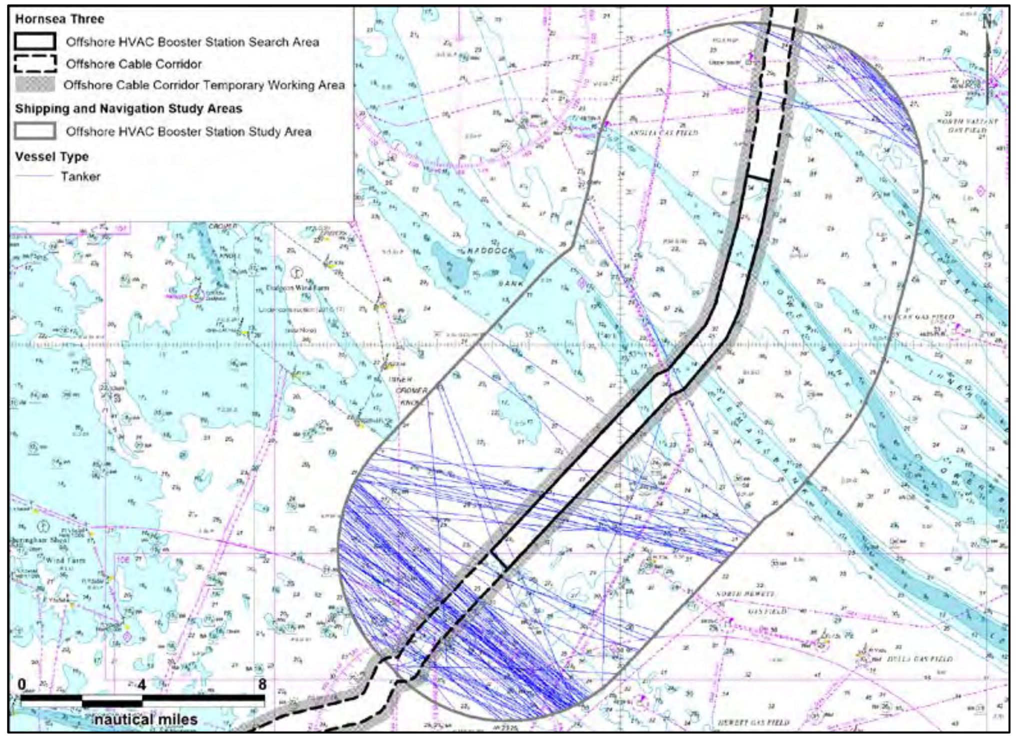


Figure 15.47: AIS, visual and Radar tankers within offshore HVAC booster station shipping and navigation study area (28 days summer and winter 2016).

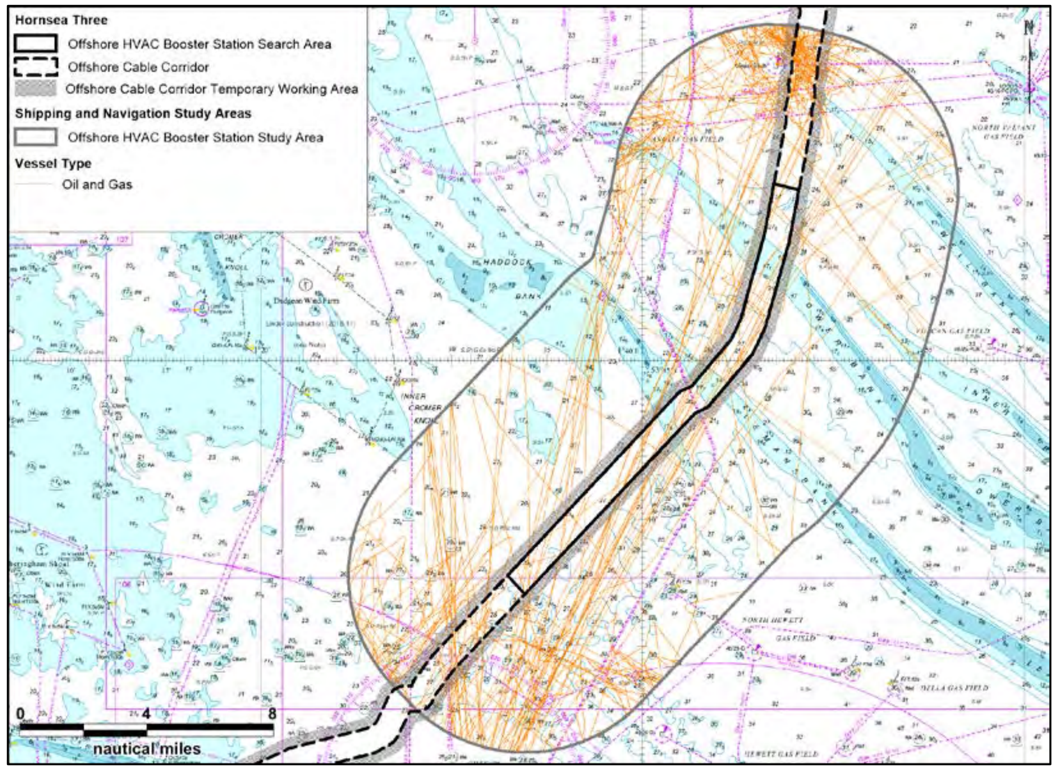


Figure 15.48: AIS, visual and Radar oil and gas affiliated vessels within offshore HVAC booster station shipping and navigation study area (28 days summer and winter 2016).

15.4.3.4 Throughout the combined summer and winter survey period, an average of 12 unique cargo vessels per day (excluding partial days) passed within the offshore HVAC booster station shipping and navigation study area.

15.4.3.5 Regular cargo vessels operating in the vicinity of the Hornsea Three offshore HVAC booster station shipping and navigation study area include DFDS Ro Ro vessels operating routes between Killingholme and Rotterdam (Netherlands) and Tees and Zeebrugge (Belgium).

15.4.3.6 Throughout the combined summer and winter survey period, an average of five unique tankers per day passed within the offshore HVAC booster station shipping and navigation study area.

15.4.3.7 All of the tankers recorded throughout the survey period were on passage to oil and gas terminals throughout the UK and mainland Europe including: Immingham, Teesport, Antwerp and Rotterdam.

15.4.3.8 Throughout the combined summer and winter period, an average of four to five unique oil and gas affiliated vessels per day passed within the offshore HVAC booster station shipping and navigation study area. The majority of these vessels were on passage to/from offshore oil and gas installations in the vicinity of Hornsea Three.

15.4.3.9 Offshore affiliated vessels that were not transient included the *Forties Sentinel* which was acting as the ERRV for the nearby Clipper South gas platform.

15.4.4 Vessel size distribution

Maximum length overall

15.4.4.1 LOAs recorded throughout the survey periods ranged from 13 m (sailing vessel *Mae West*) to a maximum of 292 m (bulk carrier *KSL San Francisco*). Figure 15.49 illustrates the distribution of vessel lengths recorded throughout each survey period.

15.4.4.2 The average lengths of vessels within the offshore HVAC booster station shipping and navigation study area throughout the summer and winter survey periods were 116 m and 125 m, respectively. There was a greater proportion of smaller vessels (< 50 m) recorded throughout the summer survey period than throughout the winter survey period.

15.4.4.3 Figure 15.50 provides an overview of AIS, visual and Radar vessel tracks (excluding temporary traffic) recorded within the offshore HVAC booster station shipping and navigation study area throughout the combined 28 day summer and winter survey periods, colour-coded by vessel length.

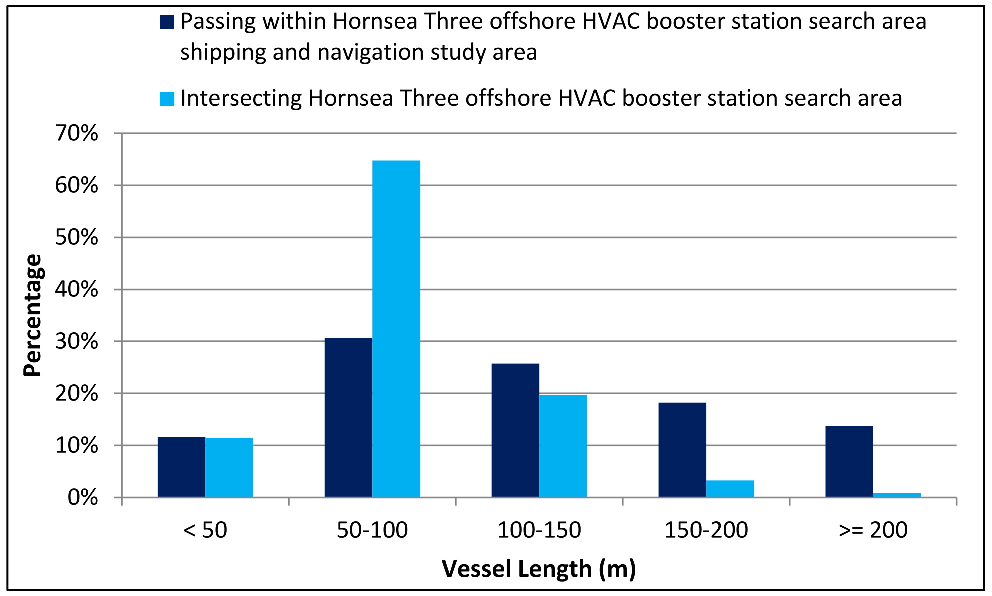


Figure 15.49: Vessel length distribution within offshore HVAC booster station shipping and navigation study area during 28 days summer and winter 2016 (AIS, visual and Radar).

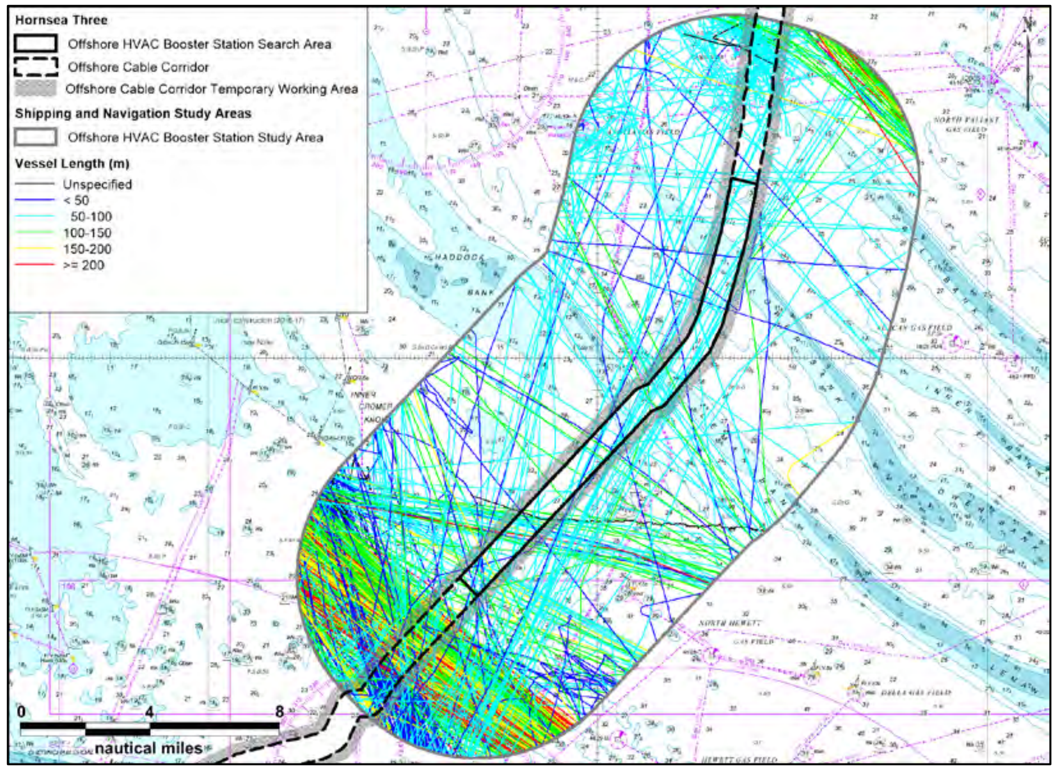


Figure 15.50: AIS, visual and Radar data within offshore HVAC booster station shipping and navigation study area colour-coded by vessel length (28 days summer and winter 2016).

Vessel draught

15.4.4.4 Vessel draughts recorded throughout the survey periods ranged from 1.1 m (wind farm support vessel *Dalby Don*) to a maximum of 13 m (bulk carrier *KSL San Francisco*). Figure 15.51 illustrates the distribution of vessel draughts recorded throughout the survey period.

15.4.4.5 It should be noted that 4% of the total number of unique vessels within the offshore HVAC booster station shipping and navigation study area did not broadcast a draught on AIS and hence have been excluded from further analysis.

15.4.4.6 The average draughts of vessels within the offshore HVAC booster station shipping and navigation study area throughout the summer and winter survey periods were both 5.3 m.

15.4.4.7 Figure 15.52 provides an overview of AIS, visual and Radar vessel tracks (excluding temporary traffic) recorded throughout the combined 28 day summer and winter survey periods, colour-coded by vessel draught.

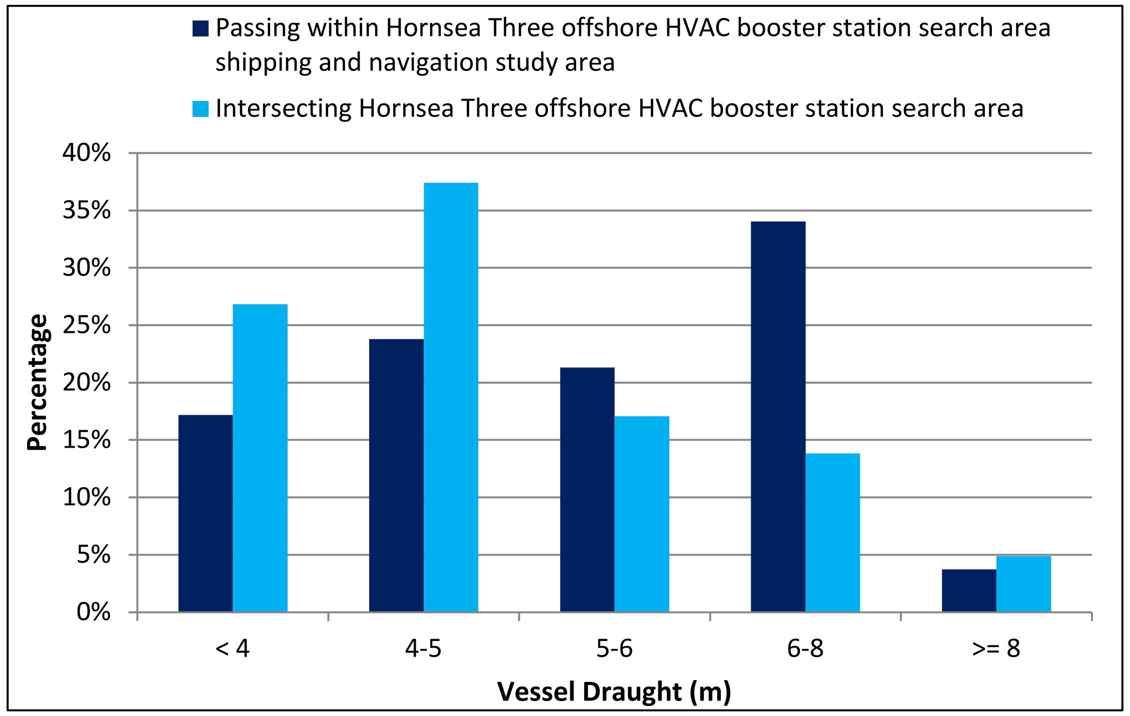


Figure 15.51: Vessel draught distribution within offshore HVAC booster station shipping and navigation study area during 28 days summer and winter 2016 (AIS, visual and Radar).

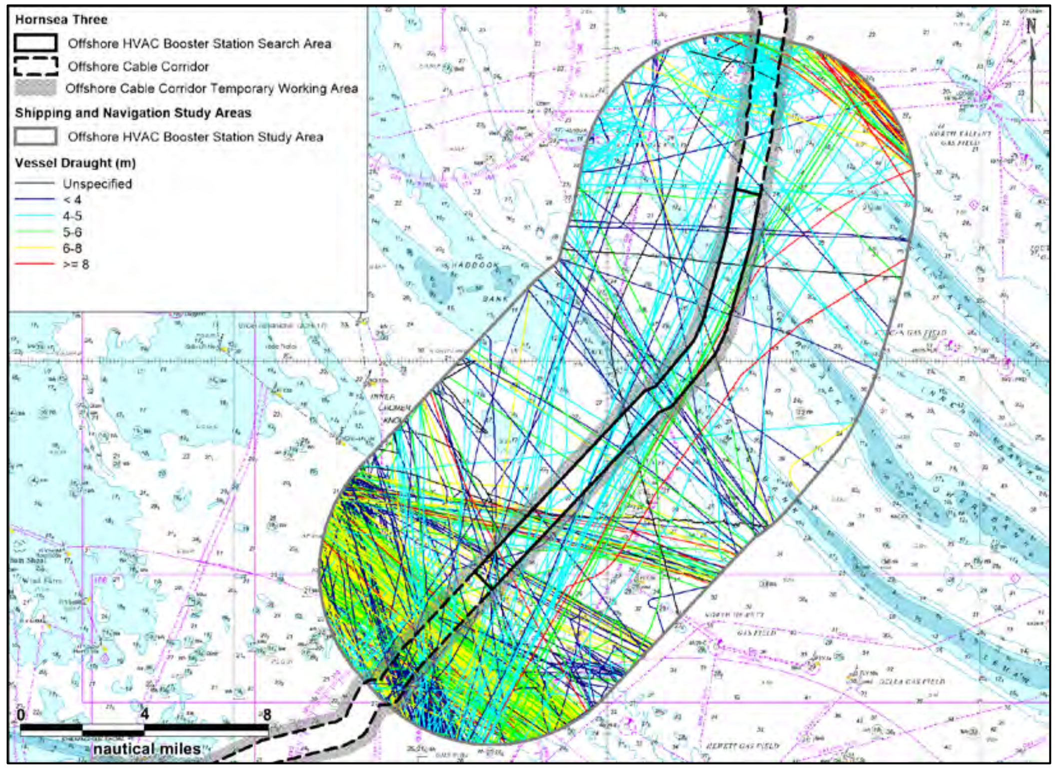


Figure 15.52: AIS, visual and Radar data within offshore HVAC booster station shipping and navigation study area colour-coded by vessel draught (28 days summer and winter 2016).

15.4.5 Base case main routes

15.4.5.1 Main route identification was undertaken for the Hornsea Three offshore HVAC booster station shipping and navigation search area. Nine main commercial routes have been identified as transiting through or in close proximity to the Hornsea Three offshore HVAC booster station search area. Plots of the main routes and corresponding 90th percentiles within the offshore HVAC booster station shipping and navigation study area are presented in Figure 15.53.

15.4.5.2 A brief description of the traffic on each of the main routes is presented in Table 15.2.

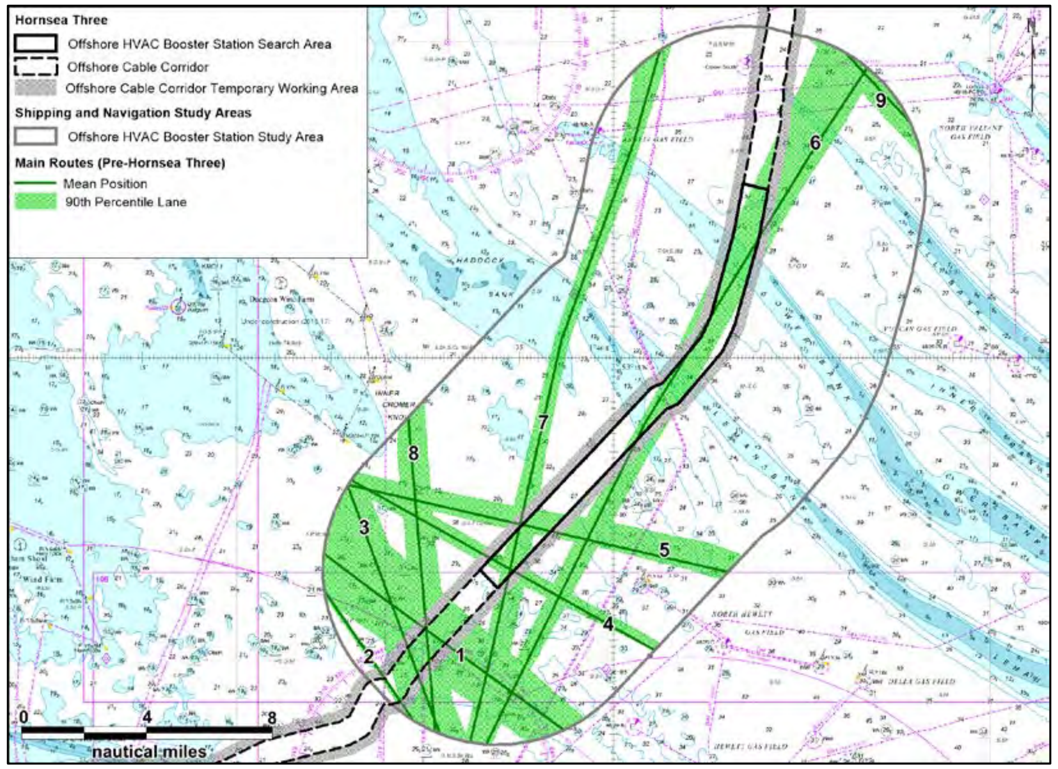


Figure 15.53: 90th percentile lanes and pre-Hornsea Three main routes within offshore HVAC booster station shipping and navigation study area.

Table 15.2: Main routes, average numbers and destination within Hornsea Three offshore HVAC booster station search area.

Route number	Number of vessels per day (average)	Destinations and main vessel types identified
Route 1	13–14	Immingham (UK) to Rotterdam (Netherlands). Route 1 is generally used by cargo vessels (57%), passenger vessels (22%) and tankers (20%). Route 1 is a commercial ferry route (used by DFDS Seaways, Stena Line and Cobelfret) from Immingham and Killingholme to Rotterdam and Vlarrdingen. Vessels operating on this route include the *Fionia Seaways*, *Stena Transporter* and *Amandine*.
Route 2	1	Forth Ports (UK) to Zeebrugge (Belgium). Route 2 is used by cargo vessels (100%). Route 2 is a DFDS Seaways Ro-Ro freight service from Rosyth to Zeebrugge operated by the *Finlandia Seaways*.
Route 3	2	Great Yarmouth (UK) to Dudgeon Offshore Wind Farm. Route 3 is used by wind farm support vessels (100%) visiting the nearby Dudgeon site.
Route 4	0–1	Immingham (UK) to Rotterdam (Netherlands). Route 4 is generally used by cargo vessels (78%) and tankers (17%). Route 4 includes a small number of adverse weather transits by DFDS Seaways vessels between Immingham and Cuxhaven.
Route 5	1	Immingham (UK) to Rotterdam (Netherlands). Route 5 is generally used by tankers (52%) and cargo vessels (39%).
Route 6	1	Great Yarmouth (UK) to Audrey gas platform. Route 6 is used by oil and gas affiliated vessels visiting a number of surface platforms to the north of the Hornsea Three offshore HVAC booster station search area.
Route 7	0–1	Great Yarmouth (UK) to Clipper gas platform. Route 7 is used by oil and gas affiliated vessels visiting a number of surface platforms to the north of the Hornsea Three offshore HVAC booster station search area.
Route 8	0–1	Great Yarmouth (UK) to Babbage gas platform. Route 8 is used by oil and gas affiliated vessels visiting a number of surface platforms to the north of the Hornsea Three offshore HVAC booster station search area.
Route 9	1–2	Tees (UK) to Rotterdam (Netherlands). Route 9 is generally used by tankers (49%) and cargo vessels (37%).

15.4.6 Recreational vessel activity

15.4.6.1 For the purposes of the NRA, recreational activity includes sailing and motor craft (including those undertaking dive and fishing charter trips) of between 2.4 and 24 m, as per EU Directive 2013/53/EU. 2

Survey data

15.4.6.2 Figure 15.54 presents a plot of recreational vessels recorded within the Hornsea Three offshore HVAC booster station search area shipping and navigation study area on AIS, visual and Radar throughout both the summer and winter survey periods.

15.4.6.3 Throughout the combined summer and winter survey period, only four recreational vessel tracks were recorded, all on AIS.

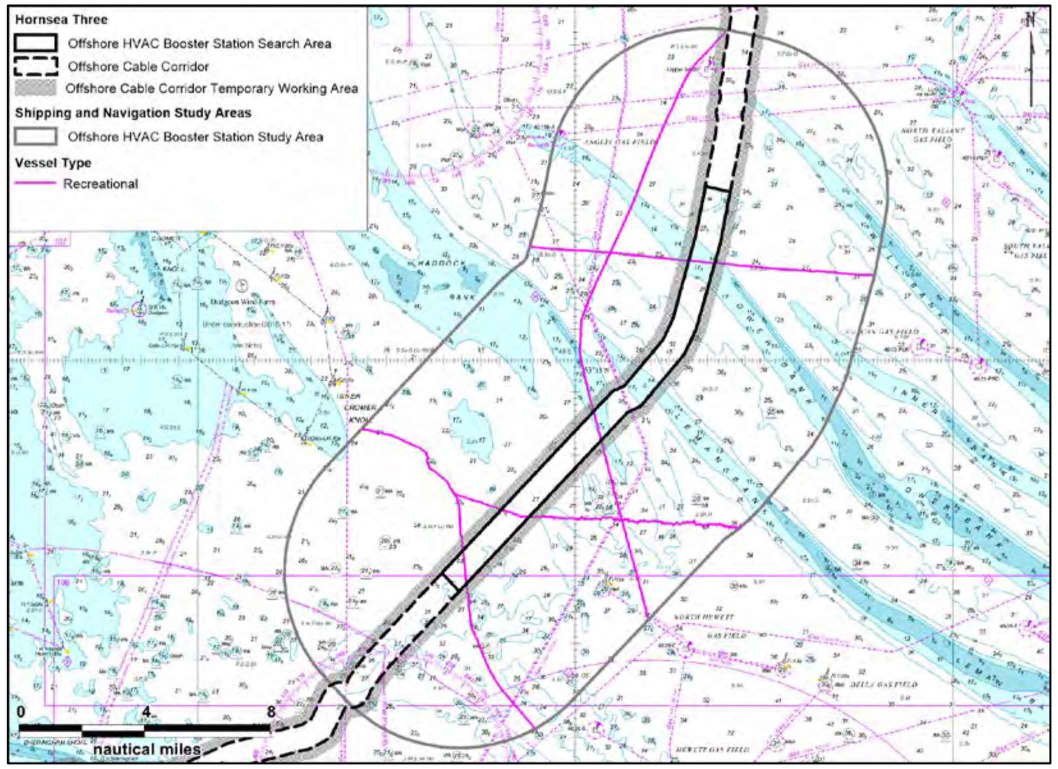


Figure 15.54: AIS, visual and Radar recreational vessels within Hornsea Three offshore HVAC booster station search area shipping and navigation study area (28 days summer and winter 2016).

15.4.7 Fishing vessel activity

15.4.7.1 Figure 15.55 presents a plot of fishing vessels recorded within the Hornsea Three offshore HVAC booster station search area shipping and navigation study area on AIS, visual and Radar throughout both the summer and winter survey periods.

15.4.7.2 Throughout the combined summer and winter survey period, only five fishing vessel tracks were recorded, all on AIS.

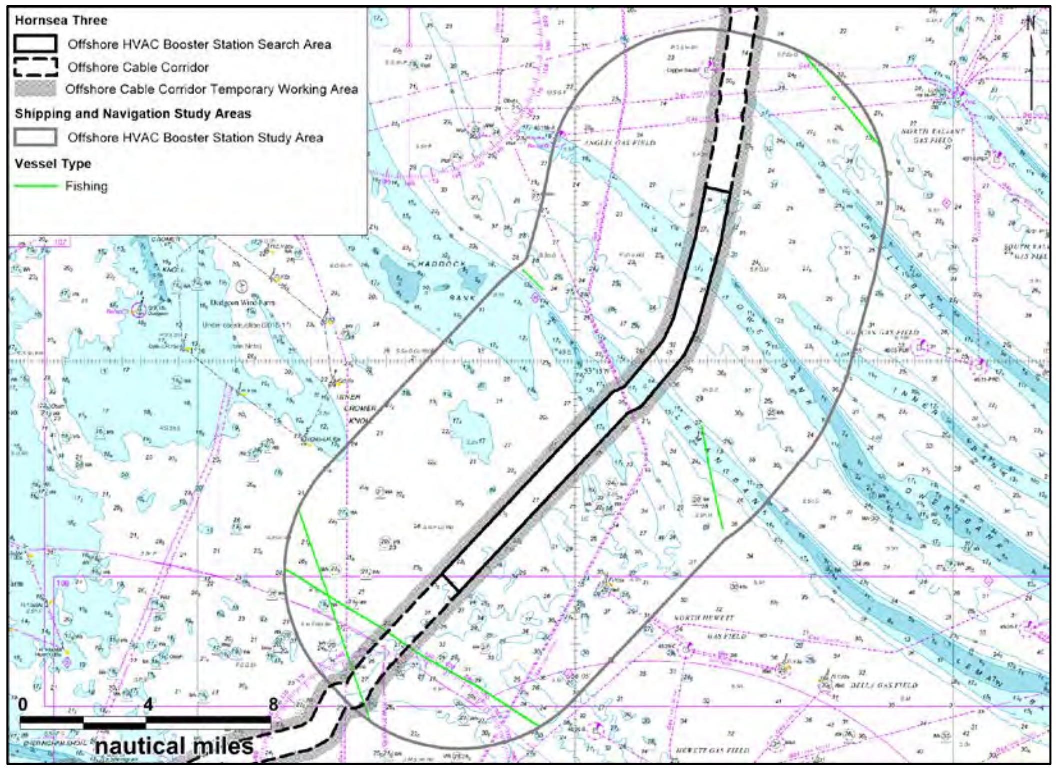


Figure 15.55: AIS, visual and Radar fishing vessels within Hornsea Three offshore HVAC booster station search area shipping and navigation study area (28 days summer and winter 2016).

16. Adverse Weather Impacts on Routeing

16.1.1.1 No adverse weather impacts on routeing were identified within the marine traffic survey data for commercial routes in general, recreational or fishing vessels with regards to route deviations. Collision and allision impacts are considered in section 18.

16.1.1.2 Adverse weather includes wind, wave and tidal conditions as well as reduced visibility due to fog that can hinder a vessel's normal 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 kinds 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 on the actual stability parameters, hull geometry, vessel type, vessel size and speed.

16.1.1.3 Following the Hazard Workshop where concerns were raised about commercial ferry adverse weather routes, an additional assessment was undertaken in liaison with DFDS Seaways to ensure that their adverse weather routes were considered. Four commercial routes which altered their course to account for adverse weather conditions are presented in Figure 16.1; all routes are operated by DFDS Seaways who provided way point information used in the assessment.

16.1.1.4 Two adverse weather routes were identified in proximity to the Hornsea Three array area shipping and navigation study area for the Cuxhaven (Germany) to Immingham (UK) operated by DFDS Seaways, one of which (westbound) intersects the Hornsea Three array area. The adverse weather routes and standard routes are presented in more detail in Figure 16.1.

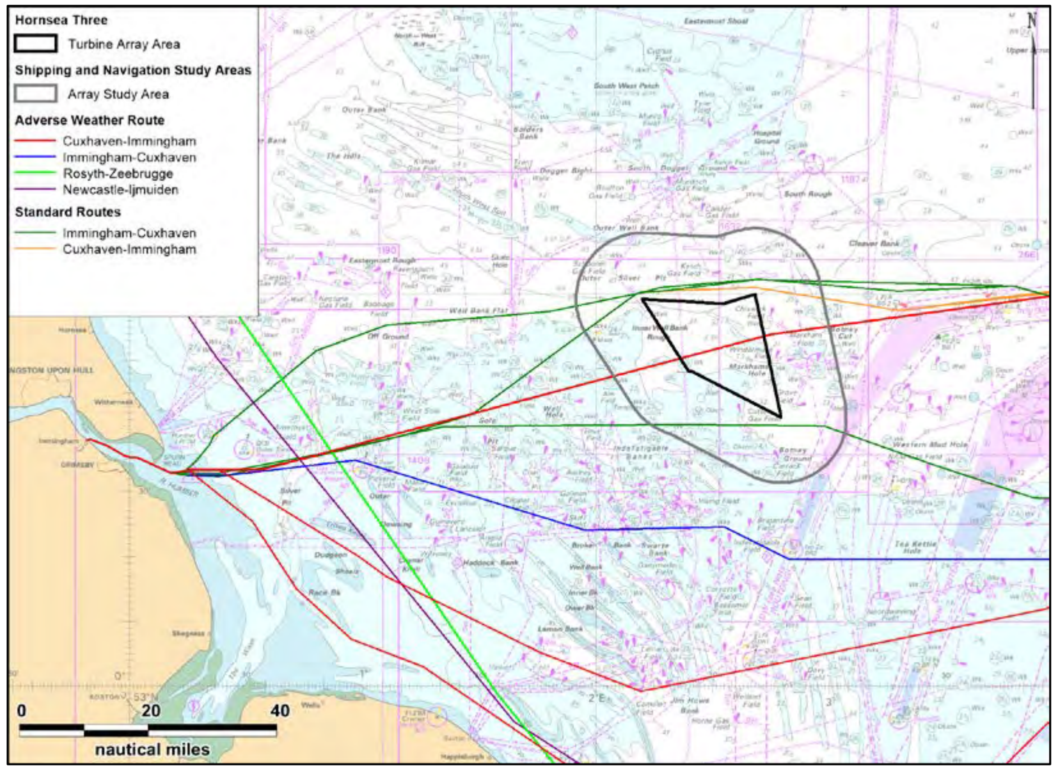


Figure 16.1: Overview of adverse weather Routes and standard routes –DFDS Seaways.

16.1.1.5 When compared with shore based AIS data, additional adverse weather routes for the Ro Ro vessel, *Hafnia Seaways* were recorded to the northwest of the Hornsea Three array area. These routes do not intersect the Hornsea Three array area. They are presented in Figure 16.2.

16.1.1.6 The roll on roll off (Ro Ro) vessel *Hafnia Seaways* operates the various passages between Cuxhaven (Germany) and Immingham (UK). It is noted that the Ro Ro is a commercial ferry and carries mostly containerised cargo and a maximum of 12 passengers plus crew. Figure 16.3 presents an image of the *Hafnia Seaways*.

16.1.1.7 The Rosyth (UK) to Zeebrugge (Belgium) and the Newcastle (UK) to Ijmuiden (Netherlands) adverse weather routes operate to the west of the Hornsea Three array area shipping and navigation study area and do not pass through the Hornsea Three array area. The Newcastle (UK) to Ijmuiden (Germany) route is transited by a cruise ferry and the coastal Rosyth (UK) to Zeebrugge (Belgium) route is operated by a Ro Ro. Again the Ro Ro is commercial and carries mostly containerised cargo and a maximum of 12 passengers plus crew.

16.1.1.8 No adverse weather routeing was identified in relation to Hornsea Three offshore HVAC booster station search area,

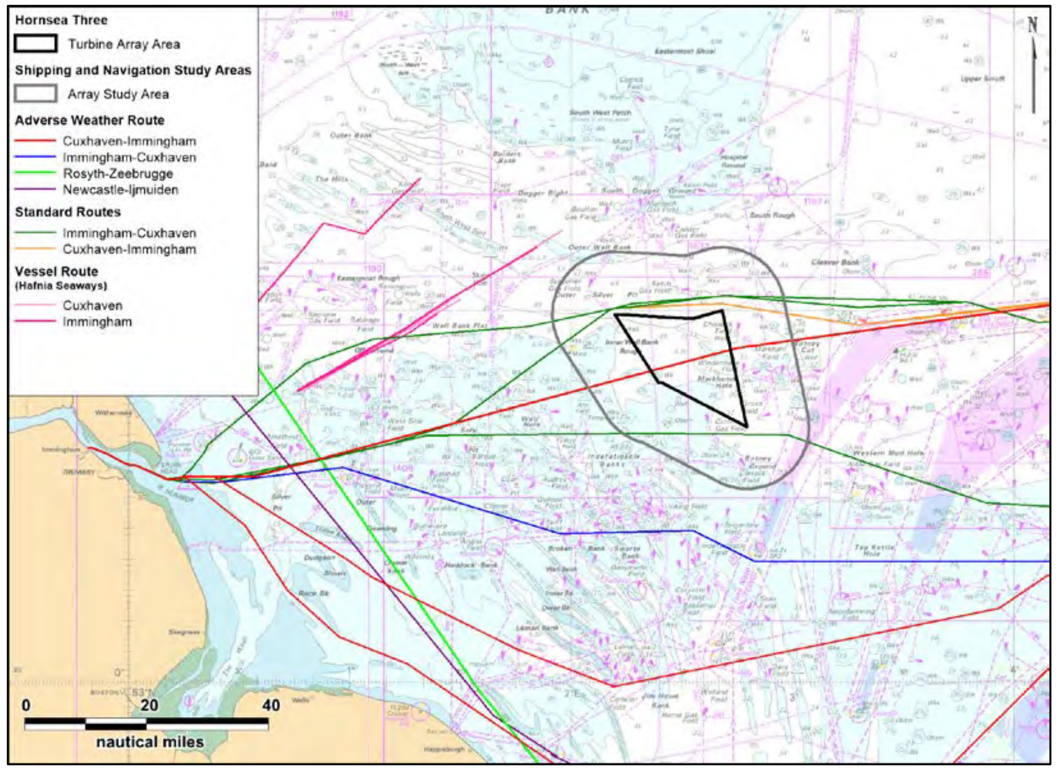


Figure 16.2: Overview of adverse weather routes, standard routes and AIS tracks – DFDS Seaways.

Figure 16.3: *Hafnia Seaways* – Copyright DFDS Seaways.