Hornsea Project Four: Environmental Statement (ES)

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Volume A5, Annex 7.1: Navigational Risk Assessment (Part 1)

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Hornsea Project Four Offshore Wind Farm – Navigational Risk Assessment

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00	05 July 2021	Initial draft for ES
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Glossary of Terms

Term	Definition
Allision	The act of striking or collision of a moving vessel against a stationary object.
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity, key statistics including location, destination, length, speed and current status, e.g., under power. Most commercial vessels and United Kingdom (UK)/European Union (EU) fishing vessels over 15 m length are required to carry AIS.
Cable Burial Risk Assessment (CBRA)	Risk assessment to determine suitable burial depths for cables, based upon hazards such as anchor strike, fishing gear interaction and seabed mobility.
Collision	The act or process of colliding (crashing) between two moving objects.

Term	Definition
Commitment	A term used interchangeably with mitigation and enhancement measures. The purpose of Commitments is to reduce and/or eliminate Likely Significant Effects (LSEs), in Environmental Impact Assessment (EIA) terms. Primary (Design) or Tertiary (Inherent) are both embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, Preliminary Environmental Information Report (PEIR) or Environmental Statement (ES)). Secondary commitments are incorporated to reduce LSE to environmentally acceptable levels following initial assessment i.e. so that residual effects are acceptable.
Design Envelope	A description of the range of possible elements that make up the Hornsea Four design options under consideration, as set out in detail in **Volume A1, Chapter 4: Project Description**. This envelope is used to define Hornsea Four for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the 'Rochdale Envelope' approach.
Environmental Statement (ES)	A document reporting the findings of the Environmental Impact Assessment (EIA) and produced in accordance with the EIA Directive as transposed into United Kingdom (UK) law by the EIA Regulations.
Flotel	A portmanteau of the terms floating and 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.
Former Hornsea Zone	The former Hornsea Zone was one of nine offshore wind generation zones around the United Kingdom (UK) coast identified by The Crown Estate (TCE) during its third round of offshore wind licensing. In March 2016, the Hornsea Zone Development Agreement was terminated and project specific agreements, Agreement for Leases (AfLs), were agreed with The Crown Estate (TCE) for the Hornsea Project One Offshore Wind Farm, Hornsea Project Two Offshore Wind Farm, Hornsea Project Three Offshore Wind Farm and Hornsea Four. The Hornsea Zone has therefore been dissolved and is referred to throughout as the former Hornsea Zone.
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.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
International Maritime Organization (IMO) Routeing	Predetermined shipping routes established by the IMO.
Layout Principles	A set of rules relating to the final array layout designed to ensure that post consent the array layout chosen for Hornsea Four satisfactorily meets both navigational and Search and Rescue (SAR) requirements (see **Volume A4, Annex 4.7: Layout Principles**).
Main Route	Defined transit route (mean position) of commercial vessels identified within the specified shipping and navigation study area.

Term	Definition
Marine Environmental High Risk Area (MEHRA)	Areas in United Kingdom (UK) coastal waters where vessel 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 commercial shipping.
Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency (MCA) which provide significant advice relating to the improvement of the safety of shipping at sea, and to prevent or minimise pollution from shipping.
Maximum Design Scenario (MDS)	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment but within the range of the Design Envelope.
Mitigation	A term used interchangeably with Commitment(s) by Hornsea Four. Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the Environmental Impact Assessment (EIA) process (e.g. at Scoping, Preliminary Environmental Information Report (PEIR) or Environmental Statement (ES)).
Navigational Risk Assessment (NRA)	A document which assesses the overall impact to shipping and navigation of a proposed Offshore Renewable Energy Installation (OREI) based upon Formal Safety Assessment (FSA).
Offshore Renewable Energy Installation (OREI)	As defined by Marine Guidance Note 654 (Merchant and Fishing) *Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response* (Maritime and Coastguard Agency (MCA), 2021). For the purposes of this report and in keeping with the consistency of the Environmental Impact Assessment (EIA), OREI can mean offshore Wind Turbine Generators (WTG) and the associated electrical infrastructure such as offshore transformer substations, offshore High Voltage Direct Current (HVDC) converter substations, accommodation platforms and High Voltage Alternating Current (HVAC) booster stations.
Orsted Hornsea Project Four Limited	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Radio Detection and Ranging (Radar)	An object-detection system which uses radio waves to determine the range, altitude, direction or speed of objects.
Regular Operator	Commercial operator whose vessel(s) are observed to transit through a particular region on a regular basis.
Traffic Separation Scheme (TSS)	A traffic management route system ruled by the International Maritime Organization (IMO). The traffic lanes (or clearways) indicate the general direction of the vessels in that zone; vessels navigating within a TSS all sail in the same direction or they cross the lane at an angle as close to 90 degrees (°) as possible.
Unique Vessel	An individual vessel identified on any particular calendar day, irrespective of how many tracks were recorded for that vessel on that day. This prevents vessels being over counted. Individual vessels are identified using their Maritime Mobile Service Identity (MMSI).
Vessel Traffic Service (VTS)	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.

Abbreviations Table

Abbreviation	Definition
ABP	Associated British Ports
AC	Alternating Current
AfL	Agreement for Lease
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ALB	All-Weather Lifeboat
ARPA	Automatic Radar Plotting Aid
ATBA	Area to Be Avoided
BBC	British Broadcasting Corporation
BMAPA	British Marine Aggregate Producers Association
BSU	Federal Bureau of Maritime Casualty Investigation
BWEA	British Wind Energy Association
CA	Cruising Association
CAA	Civil Aviation Authority
CBA	Cost Benefit Analysis
CBRA	Cable Burial Risk Assessment
CCTV	Closed Circuit Television
CD	Chart Datum
CEA	Cumulative Effect Assessment
CHIRP	Confidential Human Factors Incident Reporting Programme
COLREGs	Convention on International Regulations for Preventing Collisions at Sea
CPA	Closest Point of Approach
CRO	Coastguard Rescue Officer
CRT	Coastguard Rescue Team
CTV	Crew Transfer Vessel
dB	Decibel
DC	Direct Current
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
DF	Direction Finding
DfT	Department for Transport
DSC	Digital Selective Calling
ECA	Easington Catchment Area

Abbreviation	Definition
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ERCoP	Emergency Response Cooperation Plan
ERRV	Emergency Response and Rescue Vessel
ES	Environmental Statement
ESRI	Environmental Systems Research Institute
ETRS89	European Terrestrial Reference System 1989
EU	European Union
FRB	Fast Rescue Boat
FSA	Formal Safety Assessment
GCAF	Gross Cost of Averting a Fatality
GIS	Geographic Information System
GLA	General Lighthouse Authority
GMDSS	Global Maritime Distress and Safety System
GMT	Greenwich Meridian Time
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
GT	Gross Tonnage
HAT	Highest Astronomical Tide
HMCG	Her Majesty's Coastguard
HMSO	Her Majesty's Stationary Office
HRA	Helicopter Refuge Area
HSC	High Speed Craft
HSE	Health, Safety and Environment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ILB	Inshore Lifeboat
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
IPS	Intermediate Peripheral Structure
ITAP	Institut für technische und angewandte Physik

Abbreviation	Definition
ITOPF	International Tanker Owners Pollution Federation
JRCC	Joint Rescue Coordination Centre
kHz	Kilohertz
km	Kilometre
km^2	Square Kilometre
kt	Knot
LAT	Lowest Astronomical Tide
LMP	Lighting and Marking Plan
LOA	Length Overall
LSE	Likely Significant Effect
m	Metre
MAIB	Maritime Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MEHRA	Marine Environmental High Risk Area
MEPC	Marine Environment Protection Committee
MGN	Marine Guidance Note
MHCC	Marine Helicopter Coordination Centre
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
mm	Millimetre
MMO	Marine Management Organisation
MMSI	Maritime Mobile Service Identity
MOD	Ministry of Defence
MRCC	Marine Rescue Coordination Centre
MSC	Maritime Safety Committee
MSI	Maritime Safety Information
MSL	Mean Sea Level
MSN	Merchant Shipping Notice
MW	Megawatt
NAVTEX	Navigational Telex
NFFO	National Federation of Fishermen's Organisations
nm	Nautical Mile
nm^2	Square Nautical Mile

Abbreviation	Definition
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NSA	Norwegian Shipowners' Association
NSIP	Nationally Significant Infrastructure Project
ODA	Offshore Development Area
ODE	Offshore Design Engineering
OOW	Officer of the Watch
OREI	Offshore Renewable Energy Installation
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
PIANC	Permanent International Association of Navigation Congresses'
PINS	Planning Inspectorate
PLA	Port of London Authority
PLL	Potential Loss of Life
PNT	Positioning, Navigation and Timing
POB	People on Board
QHSE	Quality, Health, Safety and Environment
Racon	Radar Beacon
Radar	Radio Detecting and Ranging
RAF	Royal Air Force
REZ	Renewable Energy Zone
Ro Ro	Roll On Roll Off
RNLI	Royal National Lifeboat Institution
RIB	Rigid-hulled Inflatable Boat
RYA	Royal Yachting Association
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SNSOWF	Southern North Sea Offshore Wind Forum
SOLAS	International Convention for the Safety of Life at Sea
SONAR	Sound Navigation Ranging
SOV	Service Operation Vessel
SPS	Significant Peripheral Structure
TCE	The Crown Estate

Abbreviation	Definition
TSS	Traffic Separation Scheme
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
UKMPG	UK Major Ports Group
UNCLOS	United Nations Convention on the Law of the Sea
US	United States
VHF	Very High Frequency
VTS	Vessel Traffic Service
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator
µPa	Micropascal

1 Introduction

1.1 Background

1. Anatec was commissioned by Orsted Hornsea Project Four Limited (hereafter the 'Applicant') to undertake a Navigational Risk Assessment (NRA) for the proposed Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four') consisting of the array area (located within the former Hornsea Zone), offshore export cable corridor (ECC) and High Voltage Alternating Current (HVAC) booster station search area. This NRA presents information on the proposed development relative to the existing and estimated future navigational activity and forms an annex to **Volume A2, Chapter 7: Shipping and Navigation**.

1.2 Navigational Risk Assessment

2. An Environmental Impact Assessment (EIA) is a process which identifies the environmental effects of a project, both negative and positive. An important requirement of the EIA for offshore projects is the NRA. Following the Maritime and Coastguard Agency's (MCA) Marine Guidance Note (MGN) 654 (MCA, 2021), this NRA includes:

- Overview of existing environment;
- Vessel traffic surveys;
- Implications of offshore wind farms including position of wind turbine generators (WTG);
- Assessment of navigational risk pre and post development of Hornsea Four;
- Implications for marine navigation and communication equipment;
- Identification of mitigation measures;
- Emergency response; and
- Any required monitoring.

3. It is noted that a Formal Safety Assessment (FSA) has not been undertaken within the NRA; instead the FSA has been undertaken within **Volume A2, Chapter 7: Shipping and Navigation** to ensure a proportionate approach towards the assessment with consideration for the FSA approach required by the MCA. Assessment has been undertaken for each phase of development as follows:

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

4. The assessment of Hornsea Four is based on a design envelope, an approach which is recognised in the Overarching National Policy Statement (NPS) for Energy (EN-1) (Department of Energy and Climate Change (DECC), 2011) and the NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011). The design envelope includes conservative assumptions to form a Maximum Design Scenario (MDS)

which is considered and assessed for all impacts. Further details on the design envelope are provided in **Volume A1, Chapter 4: Project Description**.

2 Guidance and Legislation

2.1 Legislation

5. Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIP), specifically in relation to shipping and navigation is contained in the NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011). **Volume A2, Chapter 7: Shipping and Navigation** summarises the relevant matters within NPS EN-3 and where they are considered in the Environmental Statement (ES).

2.2 Primary Guidance

6. The primary guidance documents used during the assessment are the following:

- *MGN 654 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response* (MCA, 2021); and
- *Revised Guidelines for FSA for Use in the Rule-Making Process* (International Maritime Organization (IMO), 2018).

7. MGN 654 highlights issues that shall be considered when assessing the effect on navigational safety from offshore renewable energy developments, proposed in United Kingdom (UK) internal waters, territorial sea or Renewable Energy Zones (REZ). It is noted that at the time of publication of the Preliminary Environmental Information Report (PEIR) (September 2019), MGN 543 was the primary MCA guidance document, with MGN 654 superseding this in April 2021. Subsequently, this updated NRA is compliant with MGN 654 rather than MGN 543 (which the NRA submitted as part of the PEIR was compliant with).

8. Additionally, the MCA require that their methodology – *Methodology for Assessing the Marine Navigational Safety and Emergency Response Risks of Offshore Renewable Energy Installations (OREI)* – (which serves as Annex 1 of MGN 654) is used as a template for preparing NRAs. 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. Across **Volume A2, Chapter 7: Shipping and Navigation** and the NRA, both base and future case levels of risk have been identified and what measures are required to ensure the future case remains broadly acceptable or tolerable.

2.3 Other Guidance

9. Other guidance documents used during the assessment are as follows:

- *MGN 372*[1] *(Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs* (MCA, 2008);
- *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures* (IALA, 2013);
- *The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy* (RYA, 2019);
- *Standard Marking Schedule for Offshore Installations* (DECC, 2011); and
- *Guidance on the Interaction between Offshore Wind Farms and Maritime Navigation* (Permanent International Association of Navigation Congresses' (PIANC), 2018).

[1] MCA consultation ongoing; revision of MGN 372 expected in 2021.

3 Navigational Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

10. 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. The assessments presented herein for shipping and navigation receptors have considered the following criteria:

- Baseline data and assessment;
- Expert opinion;
- Outputs of the Hazard Workshops;
- 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.

11. It is noted that, with regards to commercial fishing vessels, the methodology and assessment has been applied to impacts considering commercial fishing vessels in transit. A separate methodology and assessment has been applied in **Volume A2, Chapter 6: Commercial Fisheries** to consider commercial impacts on fishing vessels including safety impacts which are directly related to fishing activity rather than fishing vessels in transit.

3.2 Formal Safety Assessment Process

12. The IMO FSA process (IMO, 2018) approved by the IMO in 2018 under Maritime Safety Committee (MSC) – Marine Environment Protection Committee (MEPC).2/Circ. 12/Rev.2 was applied within the Hazard Workshops by using the five steps outlined below and subsequently within the matrices used to assess the sensitivity and magnitude of impacts identified within **Volume A2, Chapter 7: Shipping and Navigation**.

13. The FSA is a structured and systematic methodology based upon risk analysis and Cost Benefit Analysis (CBA) (if applicable) to reduce impacts to As Low as Reasonably Practicable (ALARP). There are five basic steps within this process as illustrated in Figure 3.1 and summarised in the following list:

- Step 1 – identification of hazards (a list is produced of hazards prioritised by risk level specific to the problem under review);
- Step 2 – risk analysis (investigation of the causes and initiating events and consequences of the more important hazards identified in step 1);
- Step 3 – risk control options (identification of measures to control and reduce the identified hazards);

- Step 4 – CBA (identification and comparison of the benefits and costs associated with the risk control options identified in step 3); and
- Step 5 – recommendations for decision-making (defining of recommendations based upon the outputs of steps 1 to 4).

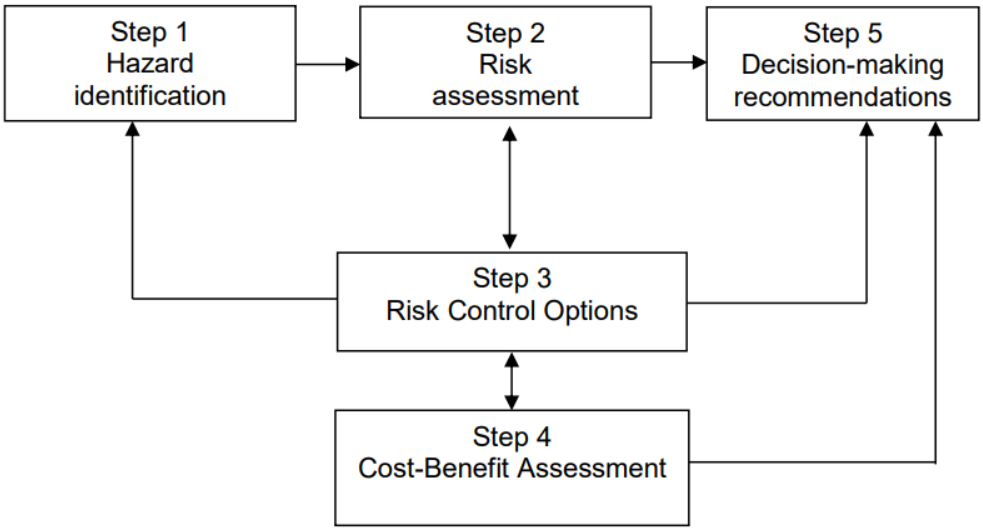


Figure 3.1 Flow chart of the FSA methodology (IMO, 2018)

3.2.1 Hazard Workshop Methodology

14. A key tool used in the NRA process is the Hazard Workshop which ensures that all risks are identified and qualified in agreement with Interested Parties prior to assessment within the EIA matrices contained within **Volume A2, Chapter 7: Shipping and Navigation**. Table 3.1 and Table 3.2 identify how the severity of consequence and the frequency of occurrence have been defined within the hazard log, respectively. It is noted that these rankings are the same as those used for the previous Hornsea projects to ensure comparison is possible.

Table 3.1 Severity of consequence ranking definitions

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)	Minor damage to property, i.e. superficial damage	Tier 1 local assistance required	Minor reputational impacts – limited to users
3	Moderate	Multiple minor or single serious injury	Damage not critical to operations	Tier 2 limited external assistance required	Local reputational impacts

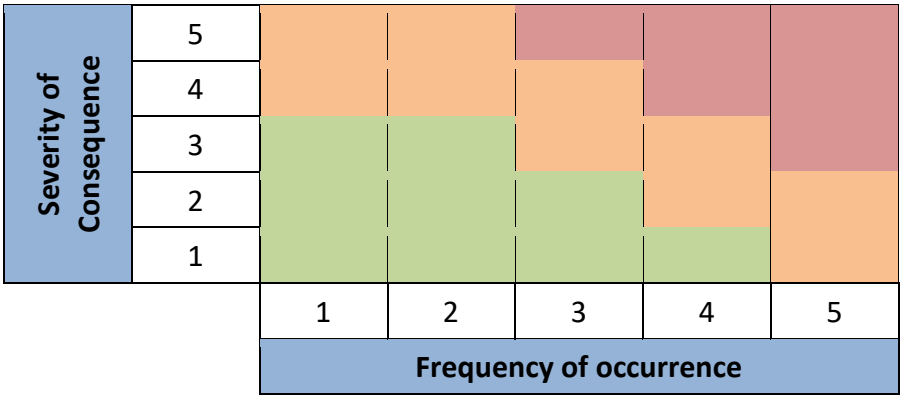
Rank	Description	Definition			
		People	Property	Environment	Business
4	Serious	Multiple serious injuries or single fatality	Damage resulting in critical impact on operations	Tier 2 regional assistance required	National reputational impacts
5	Major	More than one fatality	Total loss of property	Tier 3 national assistance required	International reputational impacts

Table 3.2 Frequency of occurrence ranking definitions

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

15. The severity of consequence and frequency of occurrence are then considered collectively using the ranking system to provide the level of tolerability of an impact; the tolerability matrix is presented in Table 3.3. The tolerability of an impact is defined as Broadly Acceptable (low risk), Tolerable (intermediate risk) or Unacceptable (high risk).

Table 3.3 Tolerability matrix and risk rankings



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

16. Once identified, the tolerability of an impact is assessed to ensure it is ALARP. Further risk control measures may be required to further mitigate an impact in accordance with ALARP principles. Unacceptable risks are not considered to be ALARP.

17. Outputs of the hazard log have been used as evidence to support and refine the impact assessment contained within **Volume A2, Chapter 7: Shipping and Navigation.**

3.3 Methodology for Cumulative Effect Assessment

18. The impacts identified in the FSA are also assessed for cumulative effects with the inclusion of other projects and proposed developments – the Cumulative Effect Assessment (CEA) (see **Volume A4, Annex 5.3: Offshore Cumulative Effects**). Given the varying status and location of developments, a tiered approach to cumulative assessment has been undertaken, which splits developments into tiers depending upon project status, proximity to Hornsea Four and the level to which they are anticipated to cumulatively impact relevant users. It also considers data confidence i.e. whether a project may be decommissioned prior to or after the development of Hornsea Four. This is a more systematic approach than was undertaken for the previous Hornsea developments which relied heavily upon the outcome of assessment undertaken as part of the Southern North Sea Offshore Wind Forum (SNSOWF) (Anatec, 2011/13).

19. The tiers are summarised in Table 3.4, with the level of assessment undertaken for each tier included. It is noted that only one criterion needs to be satisfied for a

project to be included in a particular tier, e.g. if an offshore wind farm is consented and located within 50 kilometres (km) of the Hornsea Four array area it would be allocated to Tier 1 irrespective of main route interaction or consultation responses.

Table 3.4 Cumulative development screening summary

Tier	Minimum Project Status	Criterion	Data Confidence Level	Level of CEA
1	Under construction, consented or under determination	▪ May impact a main route passing within 1 nautical mile (nm) of the Hornsea Four array area or HVAC booster station search area and/or interacts with traffic which may be directly displaced by the Hornsea Four array area (including use of the gap between Hornsea Four and the Hornsea Project Two Offshore Wind Farm (hereafter 'Hornsea Project Two') or HVAC booster station search area. ▪ Raised as having possible cumulative effect during consultation undertaken for Hornsea Four. *Offshore wind farms:* ▪ Up to 50 km from the Hornsea Four array area, offshore ECC or HVAC booster station search area. *Oil, gas or carbon capture infrastructure (surface piercing):* ▪ Up to 10 km from the Hornsea Four array area or HVAC booster station search area; or ▪ Up to 5 km from the Hornsea Four offshore ECC.	High or medium	Quantitative cumulative re-routeing of main routes around surface piercing infrastructure
2	Under construction, consented or under determination	▪ May impact a main route passing within 1 nm of the Hornsea Four array area or HVAC booster station search area and/or interacts with traffic which may be directly displaced by the Hornsea Four array area (including use of the gap between Hornsea Four and Hornsea Project Two) or HVAC booster station search area. *Offshore wind farms:* ▪ Between 50 and 100 km from the Hornsea Four array area, offshore ECC or HVAC booster station search area. *Oil, gas or carbon capture infrastructure (surface piercing):* ▪ Between 10 and 20 km from the Hornsea Four array area or HVAC booster station search area; or ▪ Between 5 and 10 km from the Hornsea Four offshore ECC.	High or medium	Qualitative cumulative re-routeing of main routes around surface piercing infrastructure

Tier	Minimum Project Status	Criterion	Data Confidence Level	Level of CEA
3	Pre-planning application, scoped or under examination	▪ Does not impact a main route passing within 1 nm of the Hornsea Four array area or HVAC booster station search area and does not interact with traffic which may be directly displaced by the Hornsea Four array area (including use of the gap between Hornsea Four and Hornsea Project Two) or HVAC booster station search area. *Offshore wind farms:* ▪ Up to 100 km from the Hornsea Four array area, offshore ECC or HVAC booster station search area. *Oil, gas or carbon capture infrastructure (surface piercing):* ▪ Up to 20 km from the Hornsea Four array area or HVAC booster station search area; or ▪ Up to 10 km from the Hornsea Four offshore ECC.	Low	Qualitative assumptions of routeing only

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

21. Similarly, oil, gas or carbon capture infrastructure is screened out if over 20 km from the Hornsea Four array area or HVAC booster station search area or over 10 km from the Hornsea Four offshore ECC or within these parameters but not yet scoped.

22. These distances represent a conservative approach, noting that beyond these distances it is not considered feasible that a cumulative effect would be present. This is a typical approach undertaken for the CEA in NRAs.

23. It is noted that operational projects are considered as part of the baseline and therefore are not scoped into the CEA.

3.4 Assumptions

24. The shipping and navigation baseline and impact identification has been undertaken based upon the information available and responses received at the time of preparation. It was assessed based upon a conservative scenario, in particular noting that the locations of structures will not be finalised until post consent but will follow the Layout Principles provided in **Volume A4, Annex 4.7: Layout Principles** which are a commitment included as part of Hornsea Four (see Section 23). Details of data limitations are provided in Section 5.3.

4 Consultation

4.1 Types of Stakeholder

25. There are various stakeholder types; these are outlined in Table 4.1 and are as per the descriptions defined in Annex 1 of MGN 654 (MCA, 2021).

Table 4.1 Description of stakeholder types

Type of Stakeholder	Description
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	Includes those who benefit from imposing or taking a risk.
Risk payer	Includes those who pay for the management of a risk.
Risk sufferer	Includes those who suffer the consequence of a risk.
Risk observer	Includes those aware of a risk but not affected directly by the risk.

26. 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 that have different roles including:

- Proposers who are proposing the development;
- Approvers who are responsible for giving the 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 in the Navigational Risk Assessment Process

27. Key shipping and navigation stakeholders have been consulted in the NRA process. The following stakeholders have been consulted via dedicated meetings:

- MCA;
- Trinity House;
- UK Chamber of Shipping;
- RYA;
- Cruising Association (CA);
- Vissers Met Toekomst (VISNED);
- DFDS Seaways;
- Boston Putford Offshore Safety;

- Associated British Ports (ABP);
- UK Major Ports Group (UKMPG);
- Danish Shipping; and
- National Grid and Energinet (Viking Link Interconnector).

28. The Marine Management Organisation (MMO) has also been consulted as part of the wider Planning Act 2008 pre-application consultation process (informally and formally through the Section 42 consultation). Consultation with Regular Operators has also been undertaken during the pre-application phase informally, via the Section 42 and Section 47 consultations and through the Hazard Workshops. Consultation has also been undertaken with commercial fishery organisations as part of **Volume A2, Chapter 6: Commercial Fisheries**. A summary of the key consultation for Hornsea Four is provided in Section 14.

29. Stakeholders that attended the Hazard Workshops are covered in Section 18.1.

5 Data Sources

30. This section summarises the main data sources used in assessing the shipping and navigation baseline relative to Hornsea Four.

5.1 Summary of Data Sources

31. The main data sources used in assessing the shipping and navigation baseline relative to Hornsea Four are outlined in Table 5.1.

Table 5.1 Data sources used to inform shipping and navigation baseline

Data	Source(s)	Purpose
Vessel traffic	Automatic Identification System (AIS), visual and Radio Detection and Ranging (Radar) winter survey data for the Hornsea Four array area shipping and navigation study area (14 days February/March 2021).	Characterising vessel traffic movements within and in proximity to the Hornsea Four array area.
	AIS summer data for the Hornsea Four array area shipping and navigation study area (14 days July/August 2020).	
	AIS summer and winter data for the Hornsea Four offshore ECC shipping and navigation study area (28 days July/August 2020 and February/March 2021).	Characterising vessel traffic movements within and in proximity to the Hornsea Four offshore ECC.
	AIS, visual and Radar winter survey data for the Hornsea Four HVAC booster station search area shipping and navigation study area (14 days March 2021).	Characterising vessel traffic movements within and in proximity to the Hornsea Four array area.
	AIS summer data for the Hornsea Four HVAC booster station search area shipping and navigation study area (14 days June 2020).	
	AIS, visual and Radar winter and summer survey data for the Hornsea Four array area shipping and navigation study area (28 days January/February and July/August 2019).	Secondary source for characterising vessel traffic movements within and in proximity to the Hornsea Four array area.
	AIS winter and summer data for the Hornsea Four offshore ECC shipping and navigation study area (28 days February and August 2019).	Secondary source for characterising vessel traffic movements within and in proximity to the Hornsea Four offshore ECC.
	AIS, visual and Radar winter and summer survey data for the Hornsea Four HVAC booster station search area shipping and navigation study area (28 days January/ February and August 2019).	Secondary source for characterising vessel traffic movements within and in proximity to the Hornsea Four HVAC booster station search area.

Data	Source(s)	Purpose
	AIS, visual and Radar winter and summer survey data for the Hornsea Four array area shipping and navigation study area (14 days June 2021).	Secondary source used for validation exercise of AIS summer data for Hornsea Four array area.
	AIS, visual and Radar winter and summer survey data for the Hornsea Four HVAC booster station search area shipping and navigation study area (14 days June/July 2021).	Secondary source used for validation exercise of AIS summer data for Hornsea Four HVAC booster station search area.
	AIS data featuring commercial ferries for the central and southern North Sea (12 months September 2018 to August 2019).	Characterising commercial ferry movements in normal and adverse weather within and in proximity to the Hornsea Four array area.
	AIS data featuring commercial vessels considered potential users of the gap between Hornsea Four and Hornsea Project Two (12 months January 2019 to February 2020).	Characterising the movements of commercial vessels considered to be potential users of the gap between Hornsea Four and Hornsea Project Two.
	Hornsea Offshore Wind Farm Project One Environmental Statement: Volume 5, Annex 5.8.1 – Subzone 1 & Offshore Cable Route Navigational Risk Assessment (Anatec, 2013).	Secondary source for characterising cumulative vessel traffic movements within and in proximity to the Hornsea developments.
	Hornsea Offshore Wind Farm Project Two Environmental Statement: Volume 5, Annex 5.7.1 – Subzone 2 and Offshore Cable Route Navigational Risk Assessment (Anatec, 2015).	
	Hornsea Project Three Offshore Wind Farm Environmental Statement: Volume 5, Annex 7.1 – Navigational Risk Assessment (Anatec, 2018).	
	SNSOWF Cumulative Navigational Issues in the Southern North Sea (Anatec, 2013).	
	Anatec's ShipRoutes database (2021).	
	UK ports: ship arrivals (DtT, 2020)	Characterising vessel traffic movements in relation to ports local to Hornsea Four.
Maritime incidents	Maritime Accident Investigation Branch (MAIB) marine accidents database (2010 to 2019).	Review of historical maritime incidents within and in proximity to the Hornsea Four array area, offshore ECC and HVAC booster station search area.
	Royal National Lifeboat Institution (RNLI) incident data (2010 to 2019).	
	Department for Transport (DfT) UK civilian Search and Rescue (SAR) helicopter taskings (April 2015 to March 2020).	
Marine aggregate dredging	Marine aggregate dredging areas (licenced and active) (The Crown Estate (TCE), 2021).	Characterising marine aggregate dredging areas within and in proximity to the Hornsea

Data	Source(s)	Purpose
	Transit routes (British Marine Aggregate Producers Association (BMAPA), published 2009, downloaded 2020).	Four array area, offshore ECC and HVAC booster station search area.
Recreational traffic density and features	*UK Coastal Atlas of Recreational Boating 2.0* (RYA, 2019).	Characterising recreational activity within and in proximity to the Hornsea Four array area, offshore ECC and HVAC booster station search area.
Other navigational features	Admiralty Charts 121, 129, 266, 1187, 1190, 1191 and 2182A (United Kingdom Hydrographic Office (UKHO), 2021).	Characterising other navigational features in proximity to the Hornsea Four array area, offshore ECC and HVAC booster station search area.
	Admiralty Sailing Directions North Sea (West) Pilot NP54 (UKHO, 2016).	
Weather	Met Office UK weather stations data for Bridlington, Donna Nook, Loftus, Wainfleet and Weybourne (12 months September 2018 to August 2019).	Identifying periods of adverse weather in proximity to the Hornsea Four array area, offshore ECC and HVAC booster station search area.

32. The winter and summer vessel traffic survey data recorded from a dedicated vessel on site and used in the NRA is summarised in Table 5.2 and Table 5.3, respectively. Key vessel characteristics for the survey vessel are provided in Section 7.1.

Table 5.2 Summary of dedicated vessel traffic survey data (winter 2021)

Survey Feature	Survey Period	
	24th February to 10th March 2021	**10th to 24th March 2021**
Location	Hornsea Four array area	Hornsea Four HVAC booster station search area
Data Type	AIS, visual and Radar	AIS, visual and Radar
Data Capture (Full Days)	14 days	14 days
Vessel	*Karima*	*Karima*
AIS System Type	JRC LHS-183	JRC LHS-183
Radar System Type	JRC JMA 5300Mk2	JRC JMA 5300Mk2
Personnel	Bridge crew (dedicated)	Bridge crew (dedicated)

Table 5.3 Summary of dedicated vessel traffic survey data (summer 2021)

Survey Feature	Survey Period	
	6th to 20th July 2021	22nd June to 6th July 2021
Location	Hornsea Four array area	Hornsea Four HVAC booster station search area
Data Type	AIS, visual and Radar	AIS, visual and Radar
Data Capture (Full Days)	14 days	14 days
Vessel	*Karima*	*Karima*
AIS System Type	JRC LHS-183	JRC LHS-183
Radar System Type	JRC JMA 5300Mk2	JRC JMA 5300Mk2
Personnel	Bridge crew (dedicated)	Bridge crew (dedicated)

5.2 Study Areas

5.2.1 Hornsea Four Array Area Shipping and Navigation Study Area

33. A minimum 10 nm buffer has been applied around the Hornsea Four array area, as shown in Figure 5.1. This study area has been defined in order to provide local context to the analysis of risks by capturing the relevant routes and vessel traffic movements within and in proximity to the proposed Hornsea Four array area. A 10 nm study area has been used within the majority of UK offshore wind farm NRAs including those for the previous Hornsea developments.

5.2.2 Hornsea Four Offshore Cable Corridor Shipping and Navigation Study Area

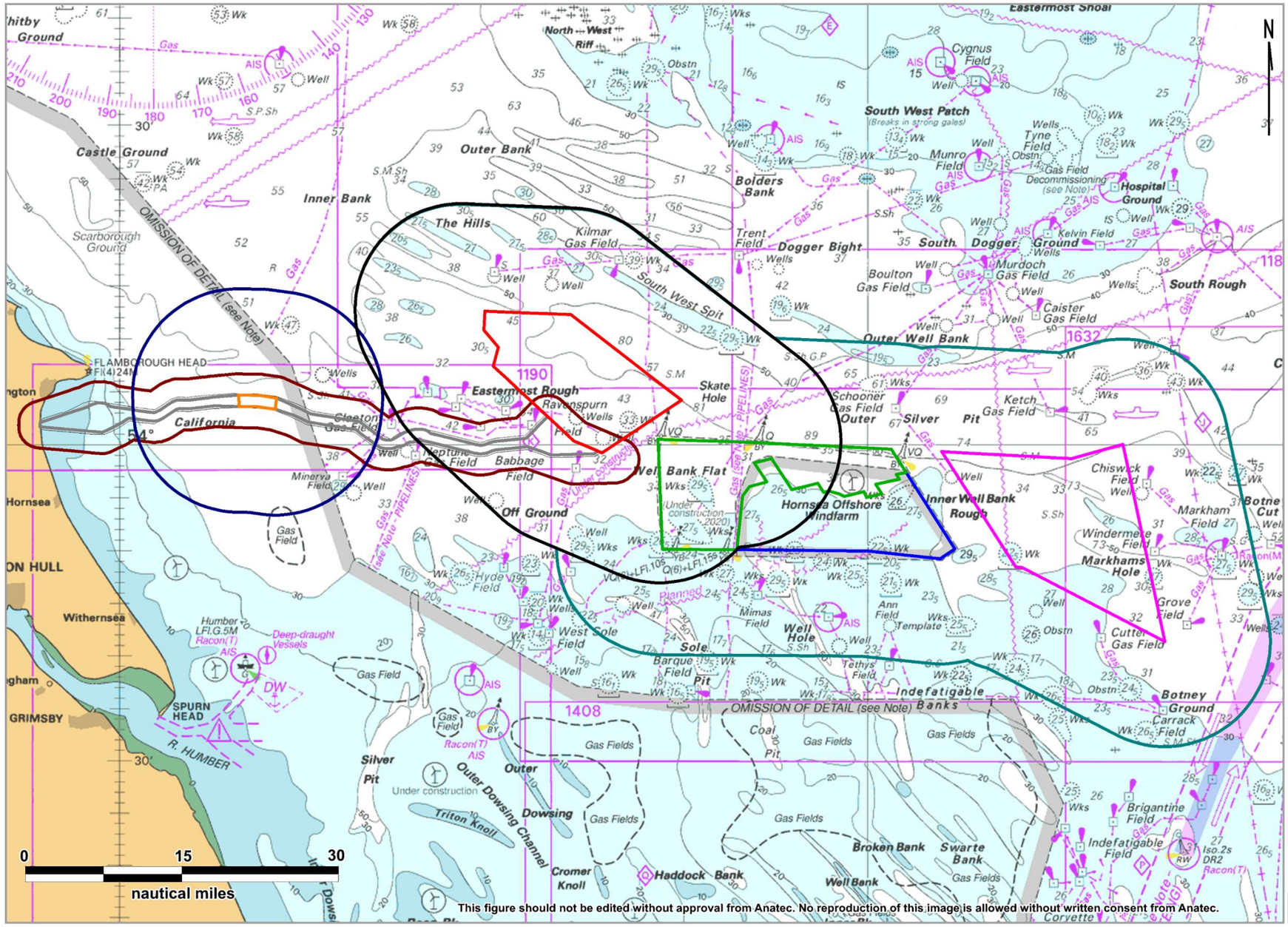
34. A minimum 2 nm buffer has been applied around the Hornsea Four offshore ECC, as shown in Figure 5.1. As with the Hornsea Four array area shipping and navigation study area, this study area has been defined in order to capture relevant receptors and their movements within and near the Hornsea Four offshore ECC. The study area covers the area between the Mean Low Water Springs (MLWS) and the boundary of the Hornsea Four array area.

5.2.3 Hornsea Four HVAC Booster Station Search Area Shipping and Navigation Study Area

35. A minimum 10 nm buffer has been applied around the Hornsea Four HVAC booster station search area within the Hornsea Four offshore ECC, as shown in Figure 5.1. Again, this study area has been defined in order to capture relevant receptors and their movements within and near the Hornsea Four HVAC booster station search area.

5.2.4 Hornsea Four Cumulative Shipping and Navigation Study Area

36. Changes to routeing at a cumulative level have been assessed in detail within a 10 nm buffer of the array area for each of the four Hornsea developments, as shown in Figure 5.1. Details of the methodology used to identify cumulative receptors are given in Section 3.3, noting that the receptors considered extend well beyond the Hornsea Four cumulative shipping and navigation study area.



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Offshore Export Cable Corridor
- Temporary Working Area

Other Hornsea Developments
- Hornsea Project One
- Hornsea Project Two
- Hornsea Project Three

Study Areas
- Array Area Study Area
- Offshore Export Cable Corridor Study Area
- HVAC Booster Station Search Area Study Area
- Cumulative Study Area

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Shipping and Navigation Study Areas

REVISION: REV 05 | **DATE:** 29/06/2021

CO-ORDINATE SYSTEM
Mercator WGS84

DRAWN: AB | **CHECKED:** JM

Figure 5.1 Shipping and navigation study areas

5.3 Data Limitations

5.3.1 Vessel Traffic Survey Data Compliance with MGN 654

37. MGN 654 (MCA, 2021) states that:

> *AIS data alone will not constitute an appropriate traffic survey; Radar, manual observations, other data sources (e.g. for fishing and recreation) and stakeholder consultation will ensure those vessels that are not required to carry and operate AIS are included.*

38. Additionally, MGN 654 requires that, allowing for the need to "*cover seasonal variations, peak times or perceived future traffic trends*", the vessel traffic survey data should be collected within 24 months of the ES submission.

39. The vessel traffic survey data for the Hornsea Four array area and HVAC booster station search area presented in Section 15 does not fully comply with these requirements since the summer dataset consists of AIS only. Summer vessel traffic surveys incorporating AIS, visual observations and Radar were previously undertaken in July and August 2019 (analogous to the February and March 2021 winter vessel traffic surveys) but fall outside of the 24-month window required by MGN 654. Nevertheless, these surveys are considered a useful secondary source for characterising vessel traffic movements within and in proximity to the Hornsea Four array area and HVAC booster station search area and analysis of these datasets is included in Appendix E.

40. In order to ensure compliance with MGN 654, new summer vessel traffic surveys were undertaken in June and July 2021 with the data used to validate the vessel traffic survey data presented in Section 15. The validation exercise is presented in Appendix F.

41. The Applicant consulted with the MCA in February 2021 with regard to this approach, with the MCA content with the methodology. Moreover, given the low level of non-AIS vessel activity established from the on-site vessel traffic surveys undertaken to date, the AIS only datasets used provide a high level of confidence in the baseline that they demonstrate, which is confirmed in Appendix F.

5.3.2 Hornsea Four Offshore ECC Vessel Traffic Data

42. It is noted that specific agreement was given by the MCA and Trinity House (see Table 7.4 in **Volume 2, Chapter 7: Shipping and Navigation**) for the use of an AIS only dataset for characterising vessel movements within the Hornsea Four offshore ECC shipping and navigation study area (excluding where this intersects the Hornsea Four HVAC booster station search area shipping and navigation study area). Consequently, there are limitations with the data associated with non-AIS targets.

5.3.3 Effects of COVID-19

43. It is widely accepted that COVID-19 has had a substantial effect on shipping movements globally. Therefore, the vessel traffic survey data collected may be influenced by COVID-19. However, in line with *Advice Note Seven: Environmental Impact Assessment* (Planning Inspectorate (PINS), 2020), the Applicant has agreed the approach to data collection with relevant stakeholders including the MCA.

44. Additionally, a range of additional datasets predating the COVID-19 pandemic have been used as secondary sources for characterising vessel traffic movements. Most notably, this includes dedicated vessel traffic surveys undertaken in January/February and July/August 2019 which included AIS, visual observations and Radar data (see Appendix E).

5.3.4 Historical Incident Data

45. Although 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 within 12 nm territorial waters or carrying passengers to a UK port. There are also no requirements for non-commercial recreational craft to report accidents to the MAIB.

46. The RNLI incident data cannot be considered comprehensive of all incidents in the shipping and navigation study areas. Although hoaxes and false alarms are excluded, any incident to which an RNLI resource was not mobilised has not been accounted for in this dataset.

5.3.5 United Kingdom Hydrographic Office Admiralty Charts

47. The UKHO Admiralty charts are updated periodically and therefore the information shown may not reflect the real time features within the region with total accuracy. However, during consultation input has been sought from relevant stakeholders regarding the navigational features baseline.

6 Lessons Learnt

48. There is considerable benefit for the Applicant in the sharing of lessons learnt within the offshore industry. The NRA, and in particular the impact assessment, includes general consideration for lessons learnt and expert opinion from previous offshore wind farm developments and other sea users, capitalising upon the UK's position as a leading generator of offshore wind power.

49. Data sources for lessons learnt include the following:

- *Sharing the Wind – Recreational Boating in the Offshore Wind Strategic Areas* (RYA & CA, 2004);
- *Results of the Electromagnetic Investigations* (MCA & QinetiQ, 2004);
- *Offshore Wind and Marine Energy Health and Safety Guidelines* (RenewableUK, 2014);
- *Offshore Wind Farm Helicopter Search and Rescue Trials Undertaken at the North Hoyle Wind Farm* (MCA, 2005);
- *Interference to Radar Imagery from Offshore Wind Farms* (Port of London Authority (PLA), 2005);
- *Hornsea Offshore Wind Farm Project One Environmental Statement: Volume 2, Chapter 7 – Shipping and Navigation* (SMartWind, 2013);
- *Hornsea Offshore Wind Farm Project Two Environmental Statement: Volume 2, Chapter 7 – Shipping and Navigation* (SMartWind, 2015);
- *Hornsea Three Offshore Wind Farm Environmental Statement Volume 2, Chapter 7: Shipping and Navigation* (Orsted Energy, 2018);
- *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* (Anatec & TCE, 2012); and
- *G+ Global Offshore Wind Health & Safety Organisation 2019 Incident Data Report* (G+, 2020).

7 Vessel Traffic Survey Methodology

50. This section describes the survey methodology used when recording vessel traffic data for the Hornsea Four array area, offshore ECC and HVAC booster station search area shipping and navigation study areas.

7.1 Baseline Survey Methodology

51. For the winter vessel traffic surveys, baseline shipping activity for the Hornsea Four array area and HVAC booster station search area was assessed using AIS, visual observations and Radar track data recorded from the *Karima* survey vessel located at the Hornsea Four array area and HVAC booster station search area. An image of the *Karima* and key vessel characteristics are provided in Figure 7.1 and Table 7.1, respectively. It is noted that the Radar scanner height was 10 m throughout the surveys (greater than typical for vessel traffic surveys) to ensure sufficient coverage of non-AIS targets.

Figure 7.1 Image of the survey vessel *Karima* (MarineTraffic, 2020)

Table 7.1 Key vessel characteristics for *Karima* survey vessel

Parameter	Specification
Name	*Karima*
Maritime Mobile Service Identity (MMSI)	232,006,310
IMO Number	7,427,403
Callsign	MPKV5
Length Overall (LOA)	26 m
Flag State	UK

52. As agreed with the MCA (see Table 7.4 in **Volume A2, Chapter 7: Shipping and Navigation**), and in line with standard practice, a vessel-based traffic survey of the sections of the Hornsea Four offshore ECC outside of the Hornsea Four HVAC booster station search area shipping and navigation study area was not required.

53. Additional summer vessel traffic surveys were undertaken in June and July 2021 using the same methodology as described for the winter vessel traffic surveys with analysis of the data collected presented as a validation exercise in Appendix F. With both datasets (2020 and 2021 summer datasets) considered collectively, it is possible to consider seasonal variations in shipping activity (i.e. summer/winter) more comprehensively than the requirements of MGN 654.

7.2 AIS Carriage Requirements and Coverage

54. The carriage of AIS is required on board all vessels of greater than 300 Gross Tonnage (GT) engaged on international voyages, cargo vessels of more than 500 GT not engaged on international voyages, passenger vessels irrespective of size built on or after 1st July 2002, and fishing vessels over 15 metres (m) LOA.

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

7.3 Commercial Vessels Dataset

56. The vessel traffic data for the baseline navigation review of the Hornsea Four array area includes a combined dataset across two survey periods:

- 25th July to 7th August 2020 (14 days summer); and
- 24th February to 10th March 2021 (14 days winter).

57. The site-specific winter survey was undertaken from the *Karima* survey vessel located at the Hornsea Four array area and incorporates visual observations and Radar data in addition to AIS data. It is noted that the winter vessel traffic survey commenced and concluded at 20:00 Greenwich Meridian Time (GMT) resulting in the first and last days being partial days; however overall the survey covers 14 full days (24 hours). The summer survey consists of AIS data only, noting the caveat described above and in Section 5.3.1 in relation to the later use of a summer 2021 dataset incorporating AIS, visual observations and Radar data.

58. The vessel traffic data for the baseline navigation review of the Hornsea Four HVAC booster station search area includes a combined dataset of 28 full days of AIS, visual observations and Radar across two survey periods:

- 17th to 30th June 2020 (14 days summer); and
- 10th to 24th March 2021 (14 days winter).

59. The site-specific winter survey was undertaken from the *Karima* survey vessel located at the Hornsea Four HVAC booster station search area within the Hornsea Four offshore ECC and incorporates visual observations and Radar data in addition to AIS data. It is noted that the winter vessel traffic survey commenced and concluded at 23:00 GMT resulting in the first and last days being partial days; however overall the survey covers 14 full days (24 hours). The summer survey consists of AIS data only, noting that a validation exercise has been undertaken using a summer 2021 dataset incorporating AIS, visual observations and Radar data.

60. For the Hornsea Four offshore ECC, AIS data from both onshore and offshore sources covering 28 full days within the same periods as the Hornsea Four array area has been used given the large extent covered by the Hornsea Four offshore ECC shipping and navigation study area. Since a period encapsulated within the period of data collection for the Hornsea Four array area has been used, the AIS data from the baseline navigation review of the Hornsea Four array area has been incorporated as one of the offshore sources to assist in ensuring maximal coverage of the Hornsea Four offshore ECC.

61. This approach to establishing the vessel traffic baseline for the Hornsea Four offshore ECC follows the approach undertaken within the NRA for the previous Hornsea developments, and the MCA have confirmed that they are satisfied with the data being used (see Table 7.4 of **Volume A2, Chapter 7: Shipping and Navigation**).

7.4 Recreational Activity

62. The RYA and CA represent the interests of recreational users including yachting and motor cruising. In 2005 the RYA, supported by Trinity House and the CA, compiled and presented a comprehensive set of charts which defined the cruising routes, general sailing and race areas used by recreational craft around the UK coast. This information has been subsequently updated and is published as the *UK Coastal Atlas of Recreational Boating 2.0* (RYA, 2019). Geographical Information System (GIS) shapefiles from this publication, including a recreational AIS density grid in proximity to the east Yorkshire coast, have been used in this assessment.

63. The RYA has also developed a detailed position statement (RYA, 2019) based upon analysed data for common recreational craft which has been used to inform the NRA.

64. In addition, recreational vessel data was extracted from the vessel tracks recorded during the vessel traffic surveys.

7.5 Commercial Fishing Activity

65. Commercial fishing vessel data was extracted from the vessel tracks recorded during the vessel traffic surveys. It is noted that the term ‘fishing vessel’ as used

throughout this NRA refers to commercial fishing vessels and non-commercial fishing activity (such as rod and line angling) is categorised under recreational vessel activity.

66. In addition, data compiled in **Volume A2, Chapter 6: Commercial Fisheries** has been validated against the outputs of the vessel traffic surveys.

8 Other Offshore Users

8.1 Oil and Gas Installations

67. Offshore oil and gas installation data was assessed using charted information and research. For the purposes of the NRA, fixed platforms and wellheads which may impact a surface vessel's transit are considered.

8.2 Marine Aggregate Dredging

68. Licenced and active marine aggregate dredging areas data was supplied by TCE and transit routes of marine aggregate dredgers was supplied by BMAPA. A desktop study was undertaken using these data to identify commercial aggregate dredging activity in proximity to Hornsea Four.

8.3 Other Navigational Features

69. Other navigational features including IMO routeing measures, Ministry of Defence (MOD) Practice and Exercise Areas (PEXA), submarine cables and pipelines, aids to navigation, anchorage areas, foul grounds, wrecks and port limits have been considered based upon charted information and consultation.

9 Maximum Design Scenario

70. The NRA reflects the design envelope, which is outlined in full in **Volume A1, Chapter 4: Project Description**. The following subsections outline the maximum extent of Hornsea Four for which any shipping and navigation impacts are assessed.

9.1 Hornsea Four Development Boundaries

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

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

73. The proposed Hornsea Four array area is located approximately 37 nm (69 km) east of the UK coast, at Flamborough Head, East Riding of Yorkshire. The total area of the Hornsea Four array area is approximately 136 square nautical miles (nm^2) (468 km^2) with water depths within the Hornsea Four array area ranging from between approximately 32 m below Chart Datum (CD) to more than 60 m below CD.

74. The co-ordinates defining the boundary of the Hornsea Four array area are illustrated in Figure 9.1 and provided in Table 9.1. It is noted that the Hornsea Four array area has been refined following Scoping and PEIR, with the area presented at Scoping reduced by approximately 42%.

Table 9.1 Co-ordinates for the Hornsea Four array area

Point	Latitude (World Geodetic System 1984 (WGS84))	Longitude (WGS84)
A	54° 12’ 42.27’’ N	000° 54’ 44.36’’ E
B	54° 12’ 17.41’’ N	001° 12’ 18.26’’ E
C	54° 04’ 13.01’’ N	001° 30’ 05.27’’ E
D	53° 59’ 15.60’’ N	001° 17’ 20.65’’ E
E	54° 00’ 23.32’’ N	001° 12’ 48.81’’ E
F	54° 07’ 24.99’’ N	000° 59’ 54.70’’ E
G	54° 09’ 13.50’’ N	001° 00’ 43.85’’ E
H	54° 10’ 49.48’’ N	000° 58’ 21.78’’ E

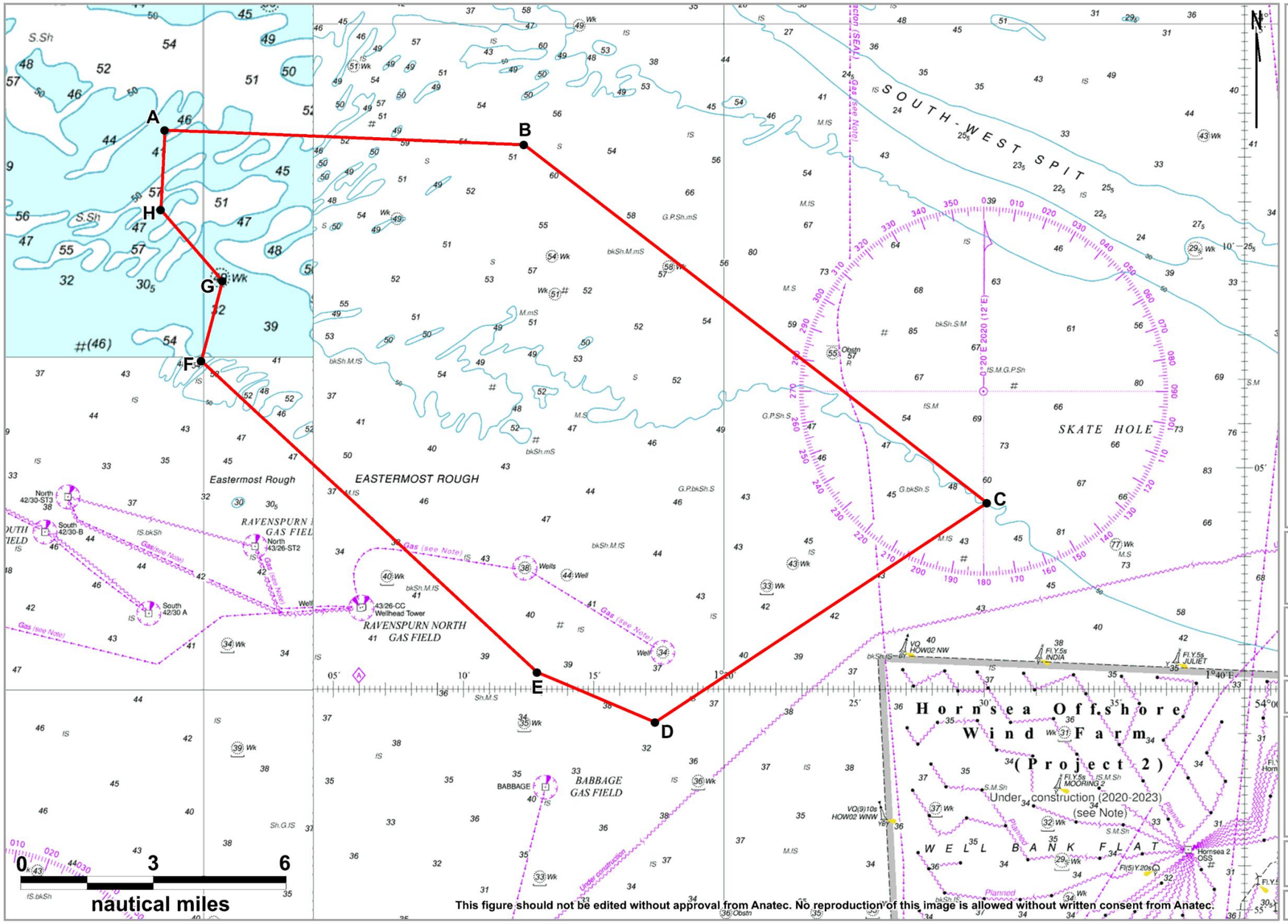


Figure 9.1 Co-ordinates for the Hornsea Four array area

75. The indicative layout of array infrastructure used to inform the assessment is shown in Figure 9.2 and includes a minimum spacing of 810 m between all structures (including along the array area boundary), a single line of orientation and a helicopter refuge area (HRA) of 1 nm width positioned perpendicular to the single line of orientation. The layout comprises the maximum number of structures within the array area (190 total) and thus represents the MDS for shipping and navigation. It is noted that this layout is aligned with the Layout Principles which will be used to inform the final layout post consent (see **Volume A4, Annex 4.7: Layout Principles).**

76. The indicative layout also includes a minimum 2.2 nm (4.1 km) distance between infrastructure associated with Hornsea Four and Hornsea Project Two, respectively (measured between the centre points of infrastructure). The open sea area between the two developments is referred to as the 'gap between Hornsea Four and Hornsea Project Two' throughout this NRA.

9.2 Array Area Infrastructure

77. The indicative layout incorporates up to 190 structures within the array as follows:

- 180 WTGs;
- Six offshore transformer substations;
- Three offshore High Voltage Direct Current (HVDC) converter substations; and
- One accommodation platform.

78. It is noted that locations for substations and the accommodation platform have not been defined in the design envelope – for the collision and allision risk modelling an MDS for the location of these structures for shipping and navigation has been determined, as illustrated in Figure 9.2. It is noted that no non-WTG structures will be located along the array perimeter which borders the gap between Hornsea Four and Hornsea Project Two.

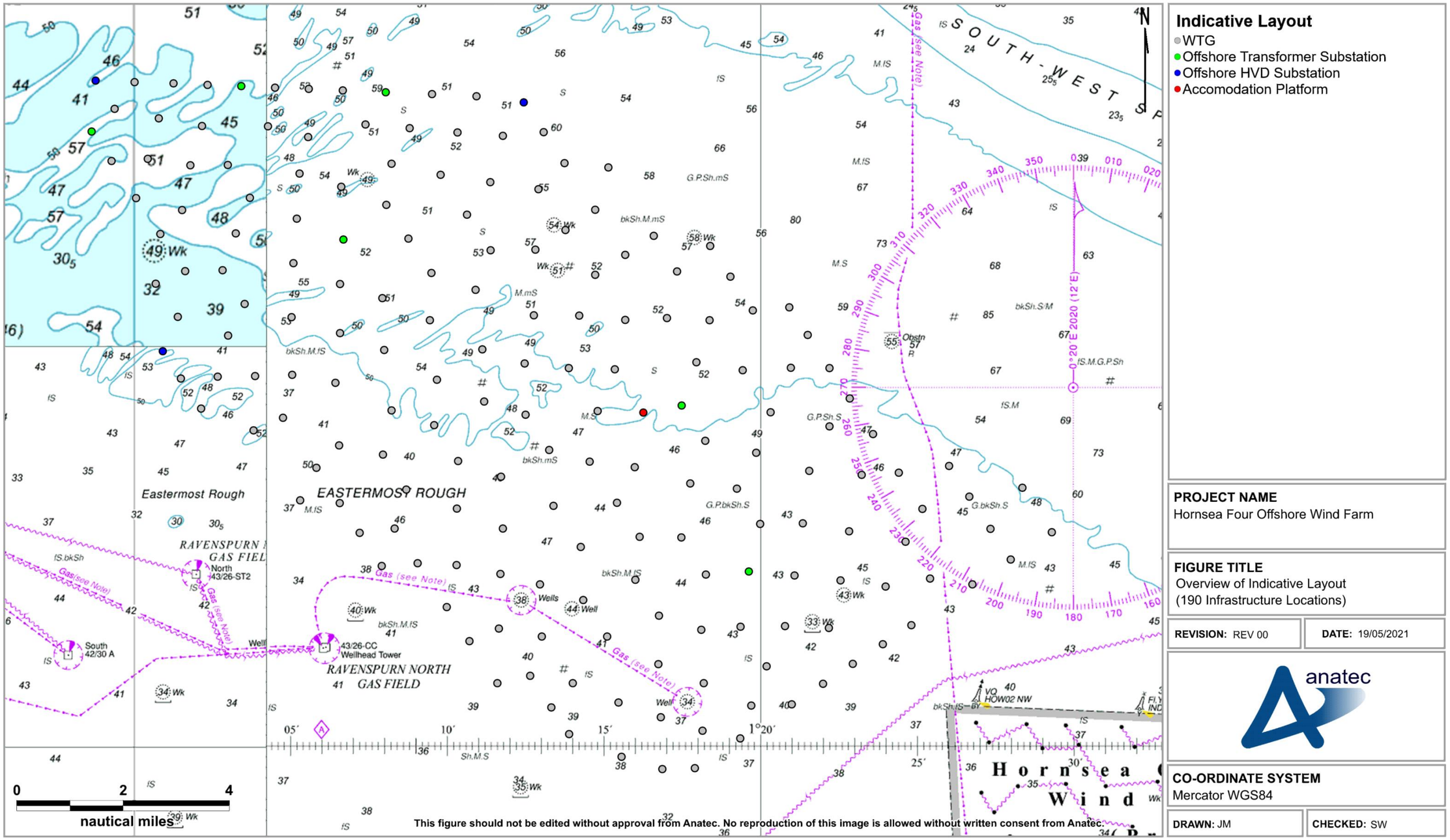


Figure 9.2 Overview of indicative layout (190 infrastructure locations).

9.2.1 Wind Turbine Generators

79. The WTGs within the indicative layout each have a maximum rotor blade diameter of 305 m and maximum blade tip height (above Lowest Astronomical Tide (LAT)) of 370 m.

80. Piled jacket and suction bucket jacket foundations have been considered as the MDS for shipping and navigation as these foundation types provide the maximum structure dimension at the sea surface. The MDS WTG measurements assuming use of piled jacket or suction bucket jacket foundation design for the layout are provided in Table 9.2.

Table 9.2 MDS for WTGs

Parameter	Specification for Layout
Foundation type	Piled jacket (WTG-type) / suction caisson jacket (WTG-type)
Dimensions at sea surface (dependent upon water depth, geology and WTG type)	37.6 m sided equilateral triangle
Hub height	217.5 m
Maximum blade tip height (above LAT)	370 m
Minimum blade tip height (above LAT)	42.43 m (40 m above Mean Sea Level (MSL))
Maximum rotor blade diameter	305 m

81. Other foundation types under consideration include monopiles, monopod suction caissons and gravity base structures (WTG-type). Descriptions of each of these foundation types are provided in **Volume A1, Chapter 4: Project Description**.

9.2.2 Other Array Area Infrastructure

82. The number of other (non-WTG) array area structures and their maximum dimensions in relation to the indicative layout are provided in Table 9.3.

Table 9.3 MDS for other array area infrastructure

Structure	Number	Maximum Sea Surface Dimensions (m)
Offshore transformer substation	6	80×80
Offshore HDVC converter substation	3	150×150
Accommodation platform	1	60×60

9.3 Offshore Export Cable Corridor Infrastructure

9.3.1 HVAC Booster Stations

83. If the HVAC transmission option is selected, up to three HVAC booster stations, each with maximum sea surface dimensions 80×80 m, will be required. These will be located within the Hornsea Four HVAC booster station search area which itself is located within the Hornsea Four offshore ECC. It is noted that the Hornsea Four HVAC booster station search area has been reduced in size by approximately 74% since the Scoping phase, with the main factor for this being to avoid the high density of vessel traffic at the western extent of the original search area. If the HVDC transmission option is selected, then no HVAC booster stations will be required. Therefore, the HVAC transmission option represents an MDS in terms of the number of structures within the offshore ECC which may impact upon shipping and navigation.

84. Since the final location of the HVAC booster stations is not known, indicative locations within the search area have been determined for the purposes of quantitative risk assessment to ensure a realistic case is considered, as shown in Figure 9.3. The spacing between the HVAC booster stations is 100 m, matching the maximum length of bridge links (if used).

85. For the purposes of the MDS assessment, the indicative HVAC booster station locations are assumed to be in a cluster to maximise the magnitude of any deviation of main routes. Their alignment in a north east to south west direction is perpendicular to the highest density vessel routes in the area. This alignment maximises allision risk.

9.3.2 Cables

86. Hornsea Four will require various types of submarine cables which can be separated into three main categories:

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

9.3.2.1 Array Cables

87. The array cables will connect individual WTGs to offshore transformer substations. Up to 324 nm (600 km) of array cables will be required with the total length determined by considerations such as the final array layout and voltage capacity.

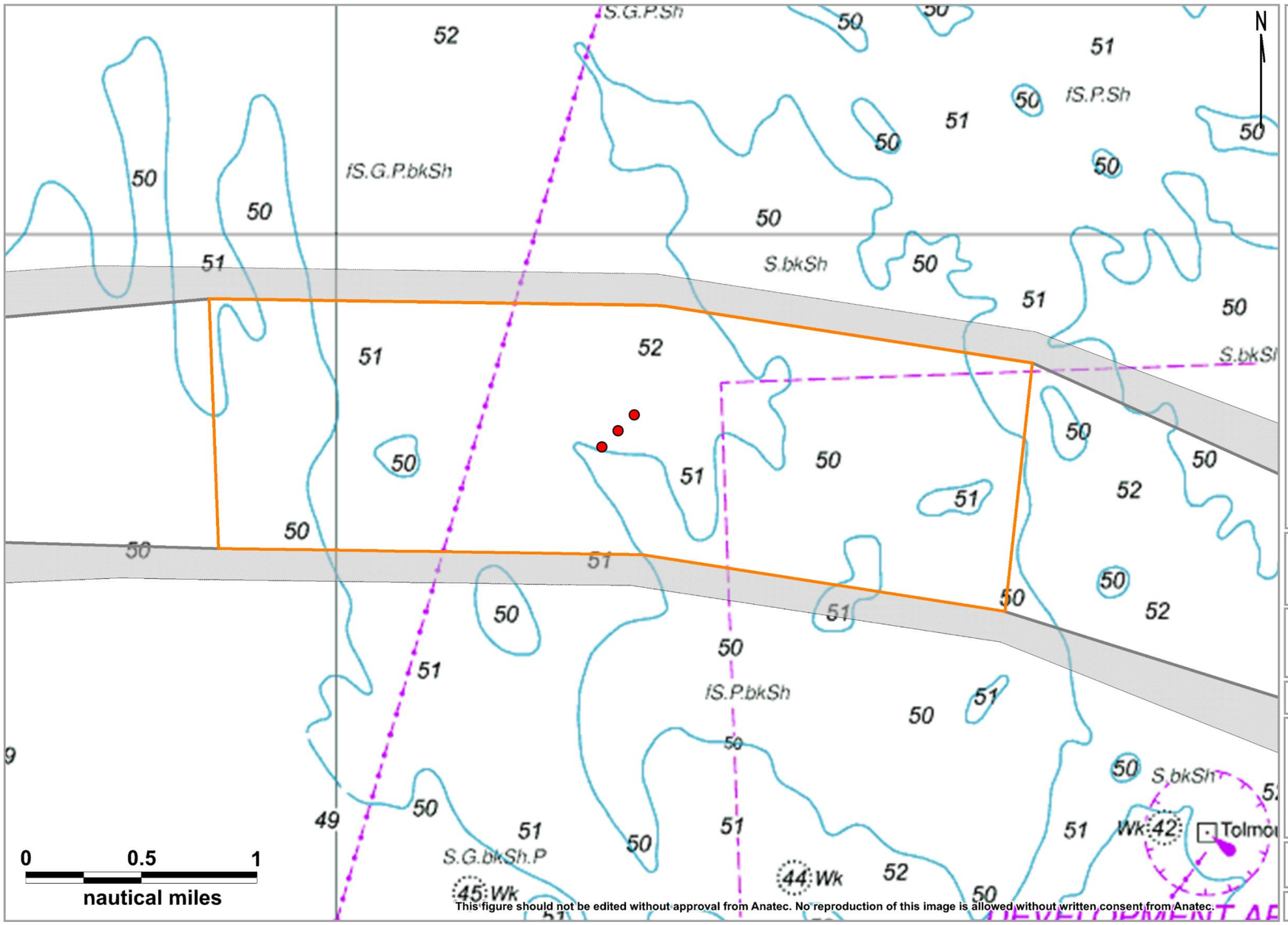


Figure 9.3 Overview of indicative HVAC booster station locations

9.3.2.2 Interconnector Cables

88. The interconnector cables will provide interlink connections between the offshore platforms within the array area. Up to six interconnector cables will be required, with a total length of up to 49 nm (90 km), depending upon the final array layout and number of substations

9.3.2.3 Export Cables

89. The Hornsea Four offshore ECC runs for 53 nm (99 km) from the western boundary of the Hornsea Four array area to the landfall area on the east Yorkshire coast south of Bridlington. Up to six export cables will be installed, depending upon the transmission option selected, with a total length of up to 353 nm (654 km) (including export cable within the array area).

90. The process of selection and routeing of the Hornsea Four offshore ECC has avoided, where possible, significant environmental constraints, such as marine conservation zones, deep water and marine aggregate dredging areas (see **Volume A4, Annex 3.2: Selection and Refinement of Offshore Infrastructure**).

9.3.2.4 Cable Burial

91. Where available, the primary means of cable protection will be by seabed burial, as detailed in Co83 and **Volume A4, Annex 5.2: Commitments Register**. The extent and method by which the subsea cables will be buried will depend upon the results of a detailed seabed survey of the final cables routes and associated Cable Burial Risk Assessment (CBRA), with an indicative maximum depth of 3 m (when using vertical injection) anticipated. Alternative cable protection methods may be used where burial is not possible; this again will be assessed within the CBRA. In addition, cable protection will be used where cables cross existing seabed assets, such as existing cables and pipelines.

9.4 Construction Phase

92. The offshore construction phase will last up to approximately three years and be undertaken in a single phase. Figure 9.4 provides an indicative construction programme for Hornsea Four which indicates the maximum duration of construction for each element of Hornsea Four.

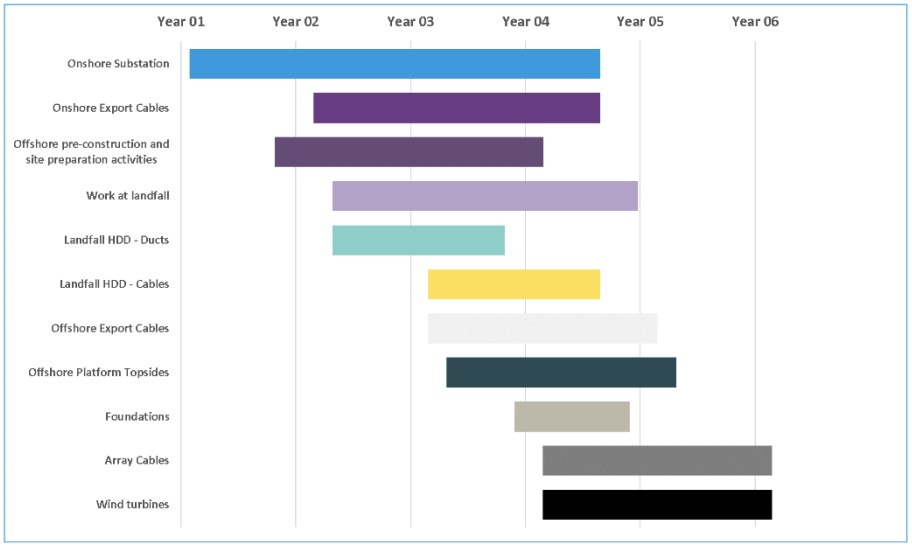


Figure 9.4 Indicative construction programme

9.5 Indicative Vessel and Helicopter Numbers

9.5.1 Construction Vessels

93. Up to 6,126 return trips per year by construction vessels may be made throughout the construction phase, breaking down as summarised in Table 9.4 (noting that numbers are indicative and assumed to be an MDS for shipping and navigation).

Table 9.4 Indicative vessel numbers per construction activity

Construction Activity	Number of Vessels	Number of Return Trips
WTG foundations	77	2,880
WTGs	38	900
Substation foundations (including accommodation platform)	18	180
Substation installation (including offshore accommodation platform	18	270
Inter array and interconnector cables	18	1,488
Export cables	24	408

9.5.2 Helicopters during Construction

94. Up to 1,616 return trips by helicopters may be made throughout the construction phase, breaking down as summarised in Table 9.5 (noting again that numbers are indicative and assumed to be an MDS for shipping and navigation).

Table 9.5 Indicative helicopter numbers per construction activity

Construction Activity	Number of Return Trips
WTG foundations	180
WTGs	135
Substation foundations (including accommodation platform)	42
Substation installation (including offshore accommodation platform	63
Inter array and interconnector cables	396
Export cables	800

9.5.3 Operation and Maintenance Vessels

95. An indicative 1,433 return trips per year by operation and maintenance vessels is assumed to be a worst case for shipping and navigation over an anticipated 35-year operational life for Hornsea Four.

96. During both the construction and 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. The project will be operational 24/7.

9.6 Maximum Design Scenario

97. The MDS for each shipping and navigation impact is outlined in **Volume A2, Chapter 7: Shipping and Navigation** and is based upon the parameters described in the preceding subsections.

10 Existing Environment

98. A plot of navigational features in proximity to the Hornsea Four array area and offshore ECC is presented in Figure 10.1. Each of the features shown is discussed in the following subsections and has been identified using the most detailed UHKO Admiralty Chart available. Features within the Humber Port Limits have been excluded from all figures in this section due to the lack of proximity to Hornsea Four.

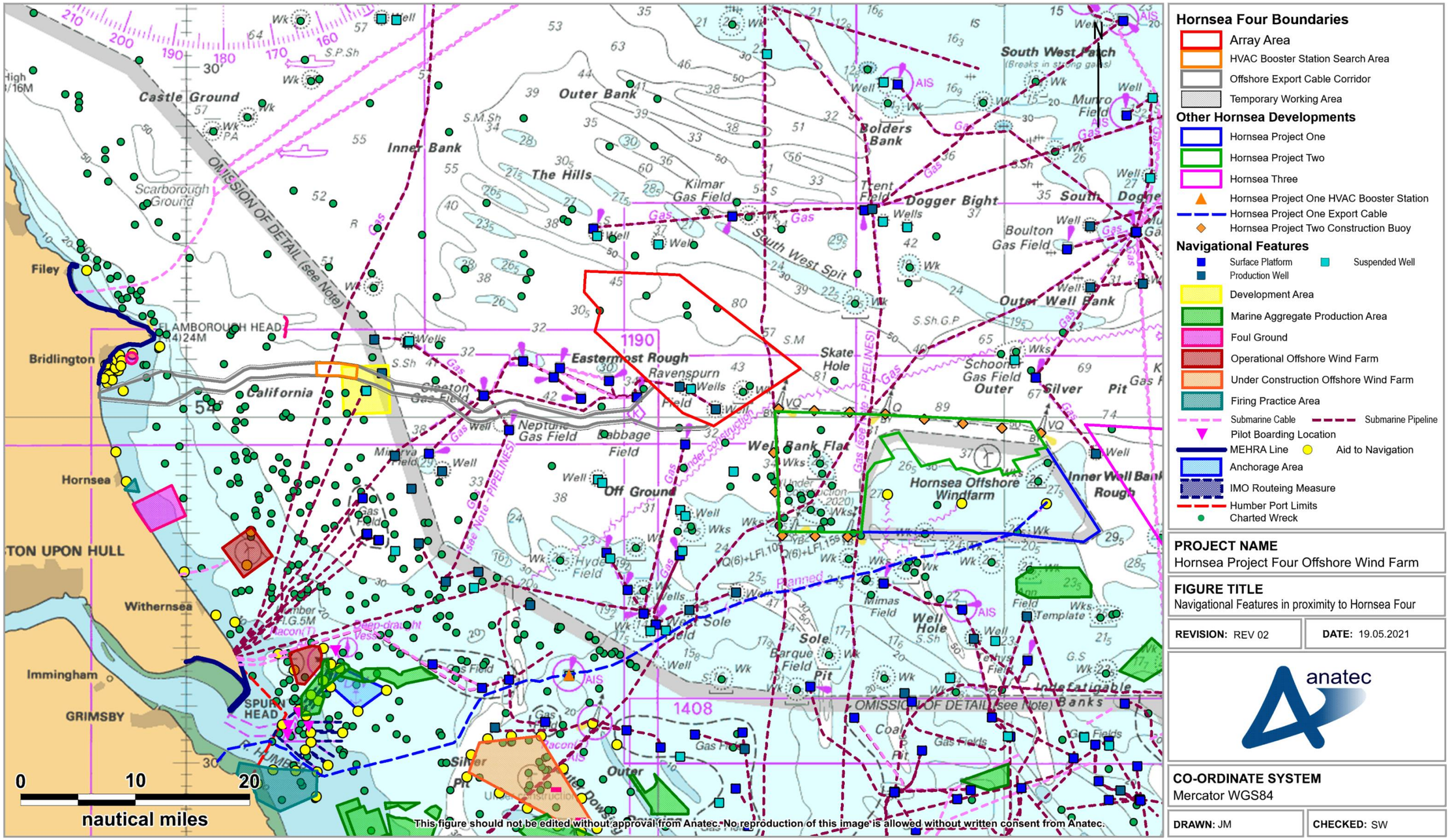


Figure 10.1 Navigational features in proximity to Hornsea Four

10.1 Other Offshore Wind Farm Developments

99. A plot of nearby UK offshore wind farm developments (operational or otherwise) in addition to Hornsea Four is presented in Figure 10.2.

100. The closest offshore wind farm development to the Hornsea Four array area is Hornsea Project Two, located approximately 1.9 nm to the south east. It is noted that this distance is measured from the consented boundary of Hornsea Project Two to the Hornsea Four Order Limits. The as built distance will be a minimum of 2.2 nm centre point to centre point when assuming Hornsea Project Two's agreed layout and any future Hornsea Four layout. The Hornsea Project One Offshore Wind Farm (hereafter 'Hornsea Project One') and Hornsea Project Three Offshore Wind Farm (hereafter 'Hornsea Three') are located approximately 9.1 nm and 25 nm from the Hornsea Four array area, respectively. Hornsea Project One is fully commissioned (and borders Hornsea Project Two). Hornsea Project Two is currently under construction, whilst Hornsea Three was awarded consent in December 2020.

101. Beyond the former Hornsea Zone, there are other Round 3 sites located within the southern North Sea. Namely, the former Dogger Bank Zone and the former East Anglia Zone which are located approximately 36 nm north east and 73 nm south east of the Hornsea Four array area, respectively. Of these sites only East Anglia ONE is operational, although Dogger Bank A, Dogger Bank B, Dogger Bank C, Sofia and East Anglia THREE have been awarded consent[2].

102. Furthermore, there are three Round 4 sites located within the southern North Sea (two leased by RWE Renewables and one by Green Investment Group – Total), although these are not shown in Figure 10.2 due to the early stage of development and subsequent low data confidence.

103. Since Hornsea Project One is fully operational, it is considered as part of the baseline assessment, as is Hornsea Project Two which is under construction. All other offshore wind farm developments (including non-UK developments not shown in Figure 10.2) within the wider southern North Sea which are not yet under construction or operational are considered only in the cumulative assessment – further information is given in Section 19.1.1.

10.2 Oil and Gas Features

104. A plot of current surface platforms, production wells and suspended wells relating to the oil and gas sector is presented in Figure 10.3. Submarine pipelines relating to oil and gas features are outlined in Section 10.4.

[2] Additionally, Norfolk Vanguard (located within the former East Anglia Zone) was awarded consent in July 2020 although this was overturned in February 2021 and the development is currently undertaking a re-determination process.

105. There are two production wells within the Johnston gas field connected to the Ravenspurn North CCW platform (part of the Ravenspurn North Central Complex) which are located within the Hornsea Four array area alongside a suspended well. Details of the surface platforms located within 5 nm of the Hornsea Four array area are provided in Table 10.1. All fields in proximity to Hornsea Four are currently producing with the exception of the Cleeton field whose infrastructure is now used as a gathering hub for the Easington Catchment Area (ECA).

Table 10.1 Oil and gas surface platforms within 5 nm of Hornsea Four array area

Surface Platform	Field (Oil/Gas)	Operator	Closest Distance to Hornsea Four Array Area (nm)
Ravenspurn North Central Complex & CCW	Ravenspurn North (gas)	Perenco	1.6
Ravenspurn North ST2	Ravenspurn North (gas)	Perenco	2.2
Babbage	Babbage (gas)	NEO Energy	2.3
Garrow	Garrow (gas)	Alpha Petroleum	3.8
Ravenspurn North ST3	Ravenspurn North (gas)	Perenco	4.3
Ravenspurn South Alpha	Ravenspurn South (gas)	Perenco	4.9

106. Ravenspurn North CCW and Ravenspurn North CC are the closest surface platforms to the Hornsea Four offshore ECC, with closest distances approximately 390 m and 420 m, respectively.

107. The Tolmount gas field includes a surface platform located approximately 1.3 nm south east of the Hornsea Four HVAC booster station search area. Other potential developments within the field may follow but will depend upon the results of further drilling operations and could be either surface or subsea; this is reflected by the presence of an Offshore Development Area (ODA) for the Tolmount gas field which intersects the Hornsea Four HVAC booster station search area.

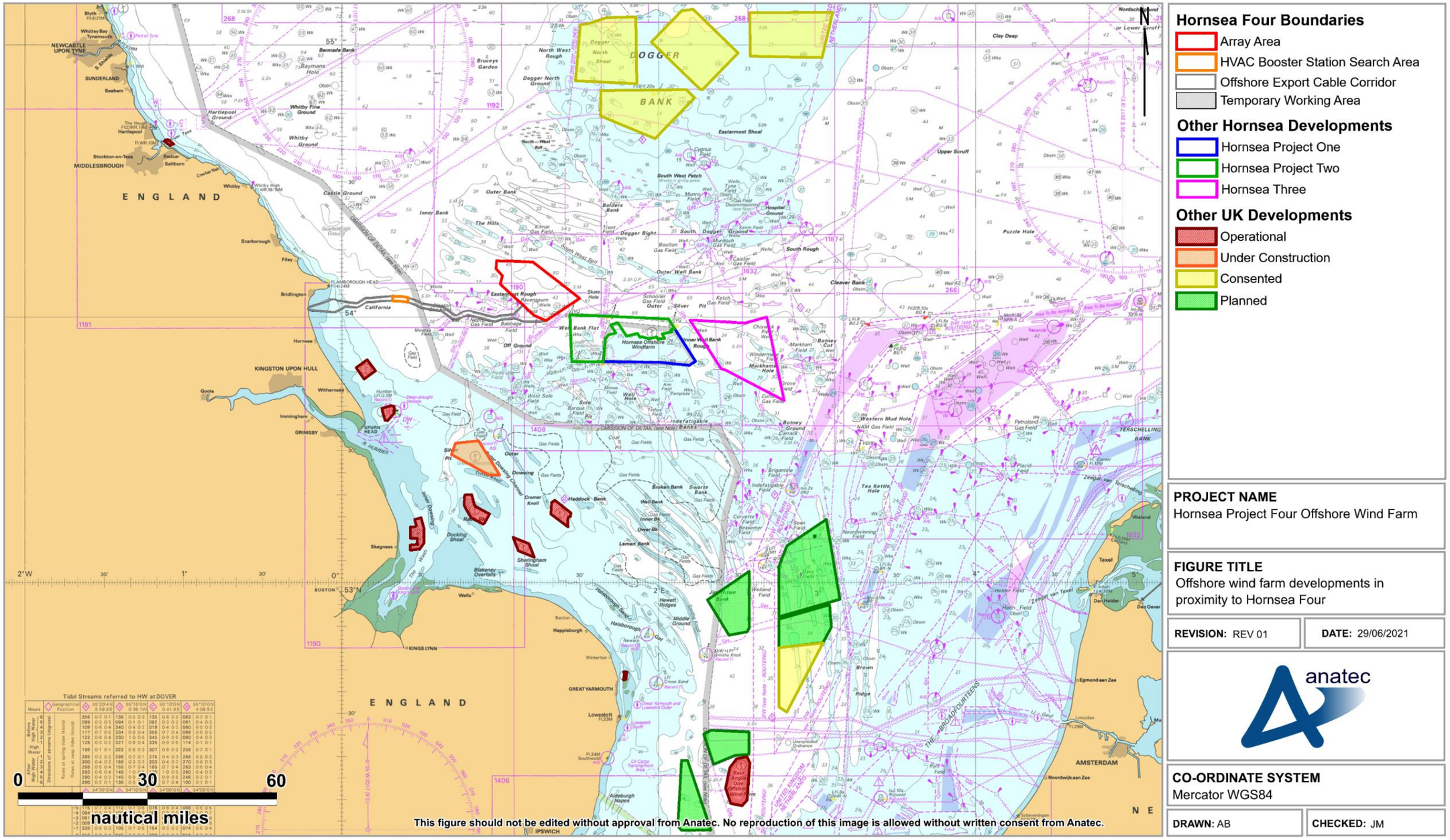


Figure 10.2 Offshore wind farm developments in proximity to Hornsea Four

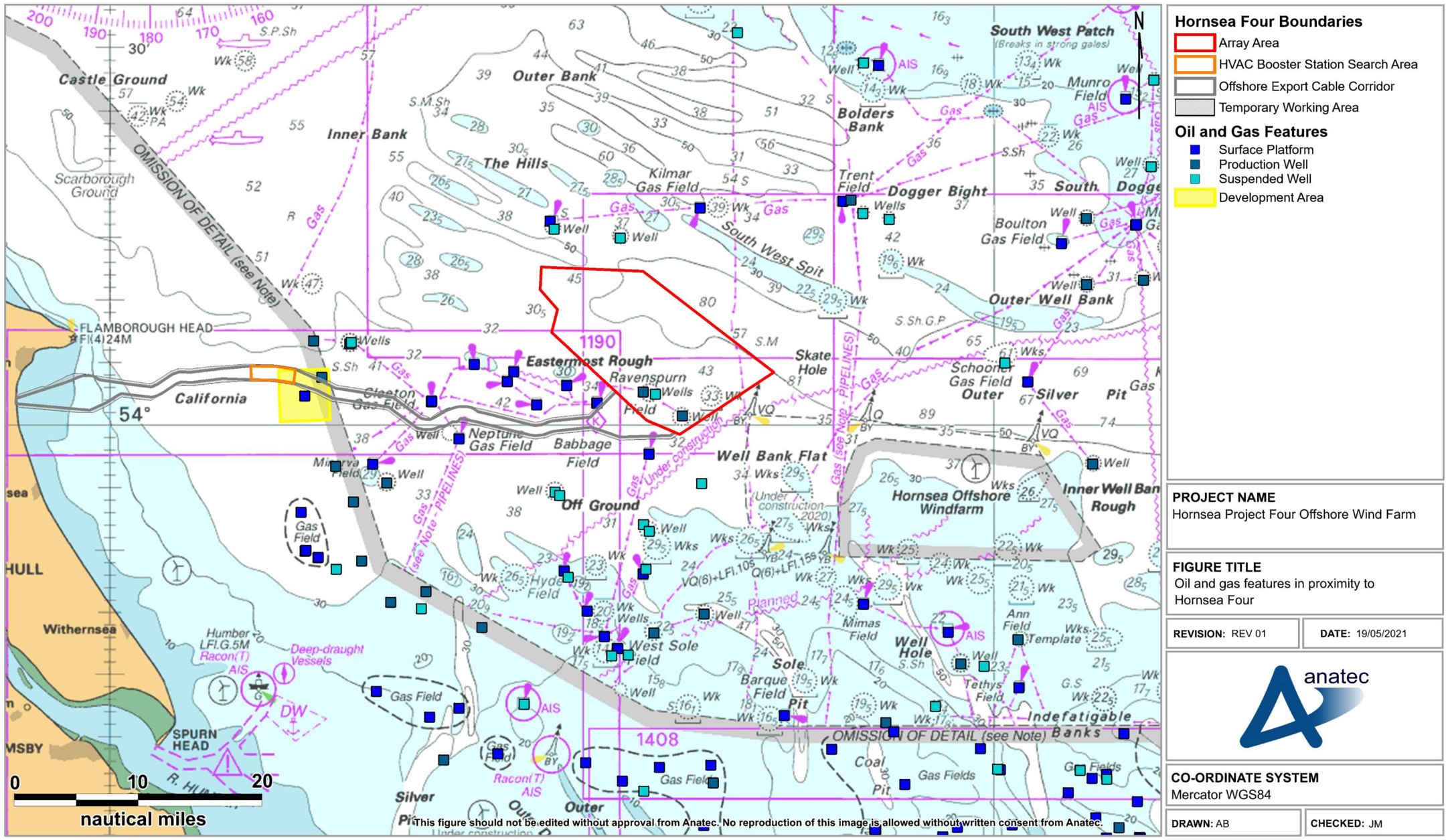


Figure 10.3 Oil and gas features in proximity to Hornsea Four

10.3 Aids to Navigation

108. A plot of nearby aids to navigation is presented in Figure 10.4. The information provided in Figure 10.4 and the following text is current as of May 2021.

109. There are no aids to navigation located within the Hornsea Four array area. The closest aid to navigation is a north cardinal mark located approximately 1.8 nm south east of the Hornsea Four array area. This mark forms part of the construction buoyage for Hornsea Project Two and is expected to be removed following the commissioning of the development.

110. There is one aid to navigation located within the Hornsea Four offshore ECC. This is the south west Smithic light buoy, a west cardinal mark designed to assist with entering Bridlington harbour.

10.4 Submarine Cables and Pipelines

111. A plot of submarine cables and pipelines is presented in Figure 10.5.

112. The submarine pipelines are associated with gas fields in the southern North Sea. There are two such pipelines located within the Hornsea Four array area; one passing north-south between the Bacton Gas Terminal on the Kent coast and the Elgin gas field within the central North Sea, and the other connecting production wells for the Ravenspurn North and Johnston gas fields (see Section 10.2).

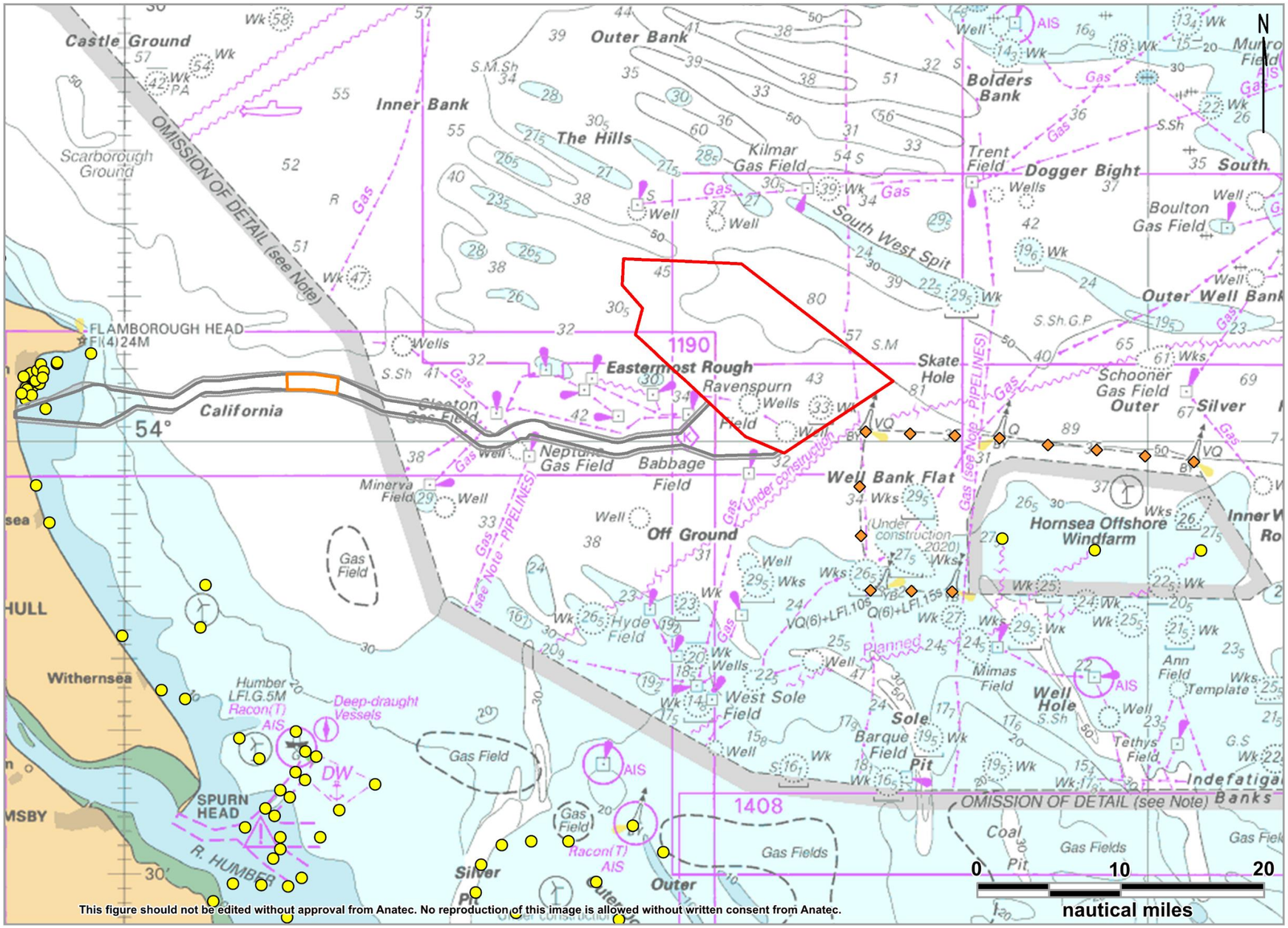
113. It is noted that the Viking Link Interconnector is shown on UKHO Admiralty charts and labelled as '*under construction*'. Since the vessel traffic surveys (see Section 7) predate the installation of the Viking Link Interconnector, this project is considered only as a CEA development (and is screened in to the CEA) (see Section 19).

114. There are four submarine pipelines crossing the Hornsea Four offshore ECC with one passing through the Hornsea Four HVAC booster station search area, between the Easington Gas Terminal on the east Yorkshire coast and the Sleipner gas field within the central North Sea.

10.5 Charted Wrecks

115. A plot of charted wrecks is presented in Figure 10.6. Charted wrecks are those detailed on UKHO Admiralty charts and posing a risk to surface navigation or subsea operations. Further details relating to wrecks are provided in **Volume A2, Chapter 9: Marine Archaeology**.

116. There are seven charted wrecks located within the Hornsea Four array area, with the shallowest at 33 m below CD. There are three charted wrecks located within the Hornsea Four offshore ECC, comprising two wrecks within 10 nm of the landfall site and one approximately 1.2 nm south of the Hornsea Four array area. There are no charted wrecks within the Hornsea Four HVAC booster station search area



Hornsea Four Boundaries
- Array Area
- Offshore Export Cable Corridor
- HVAC Booster Station Search Area
- Temporary Working Area

Navigational Features
- Aid to Navigation
- Hornsea Project Two Construction Buoy

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Aids to navigation in proximity to Hornsea Four

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CO-ORDINATE SYSTEM
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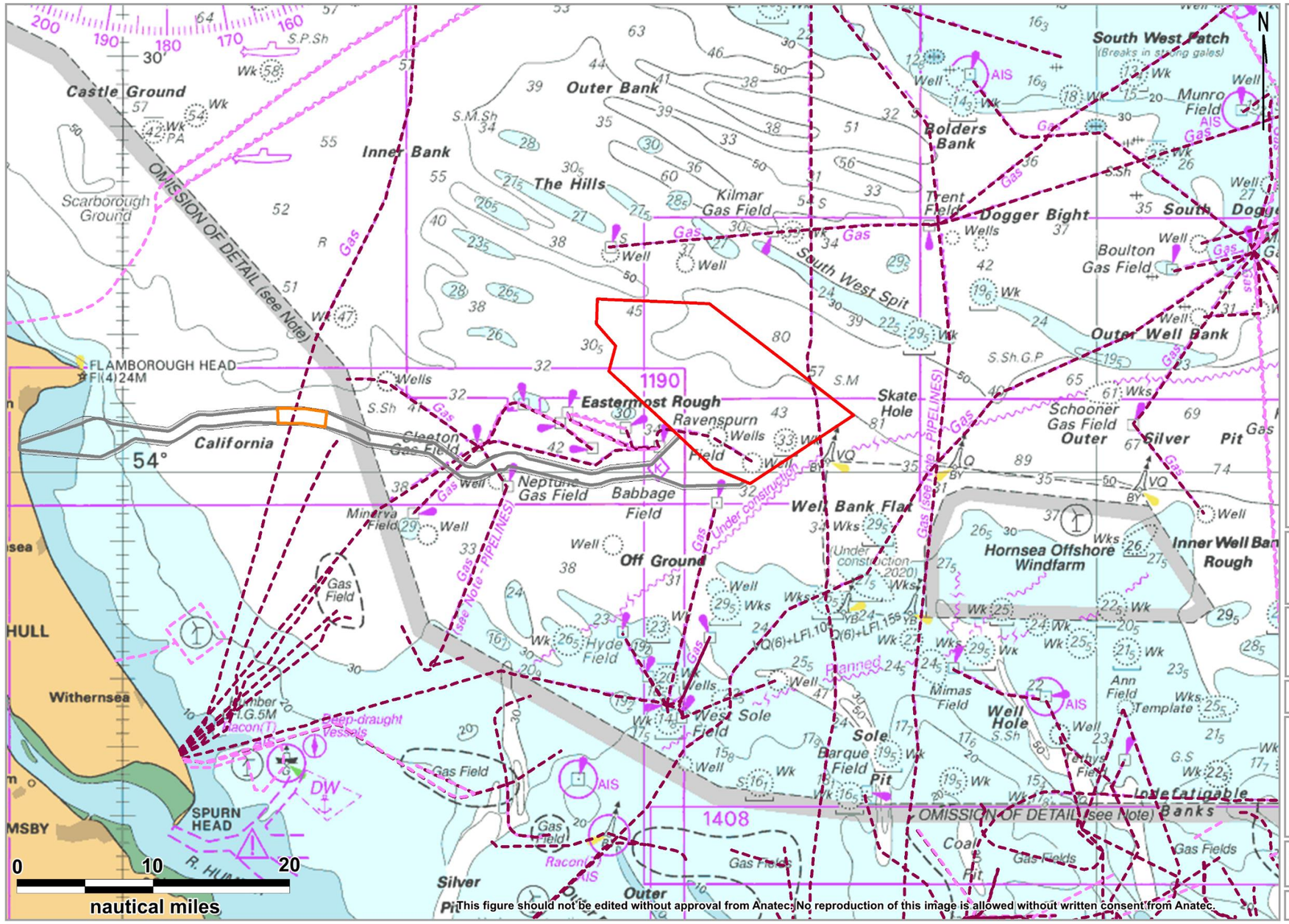
Figure 10.4 Aids to navigation in proximity to Hornsea Four



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Offshore Export Cable Corridor
- Temporary Working Area

Submarine Cables & Pipelines
- Submarine Cable
- Submarine Pipeline

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Submarine cables and pipelines in proximity to Hornsea Four

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CO-ORDINATE SYSTEM
Mercator WGS84

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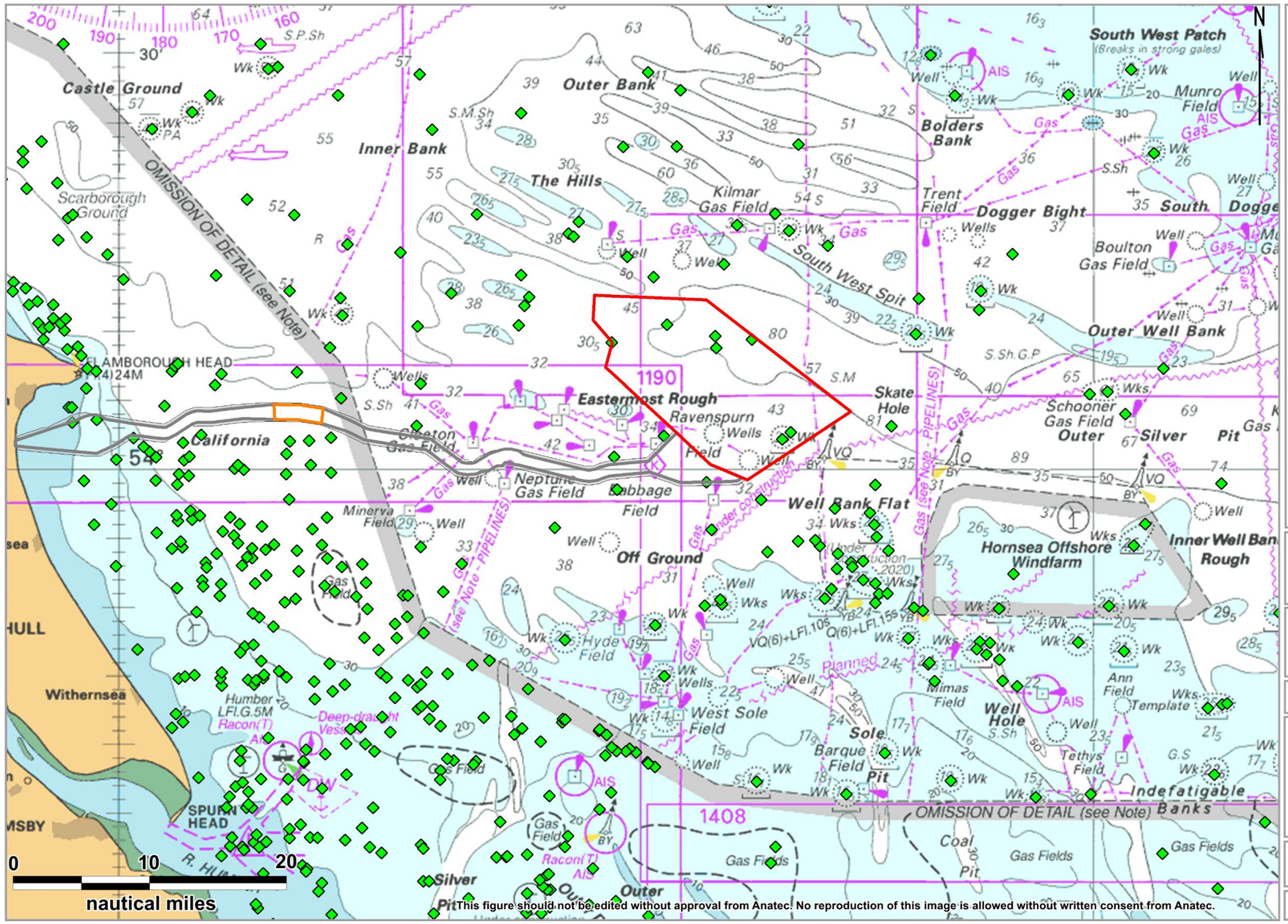
Figure 10.5 Submarine cables and pipelines in proximity to Hornsea Four



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Offshore Export Cable Corridor
- Temporary Working Area

Navigational Features
- Charted Wreck

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Charted wrecks in proximity to Hornsea Four

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CO-ORDINATE SYSTEM
Mercator WGS84

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Figure 10.6 Charted wrecks in proximity to Hornsea Four

10.6 International Maritime Organization Routeing Measures

117. There are no IMO routeing measures in proximity to the Hornsea Four array area and offshore ECC. However, the Inner Approaches Traffic Separation Scheme (TSS) lanes to the Humber, located approximately 36 nm south west of the Hornsea Four array area, are used by a large number of vessels which transit in proximity to Hornsea Four. Similarly, some vessels passing in proximity to Hornsea Four may use the Off Botney Ground TSS located approximately 57 nm east of the Hornsea Four array area.

10.7 Ports

118. A plot of nearby ports is presented in Figure 10.7. It is noted that there are other ports within the Humber not labelled in Figure 10.7. Ports within the Humber are considered collectively throughout the NRA.

119. The closest port to the Hornsea Four array area is Bridlington, located approximately 41 nm to the west on the east Yorkshire coast.

120. The number of vessel arrivals at the most visited ports in the area (DfT, 2020) is presented in Figure 10.8. These statistics exclude some vessel movements which occur within port or harbour limits, but nevertheless give a clear indication of the relative traffic levels and trends. Ports within the Humber Estuary (including Hull, Grimsby and Immingham) have been grouped together since vessels using these ports will have comparable routeing when in proximity to the Hornsea Four array area, offshore ECC and HVAC booster station search area.

121. The port limits for the Humber are presented in Figure 10.1. No element of Hornsea Four lies within the jurisdiction of a port.

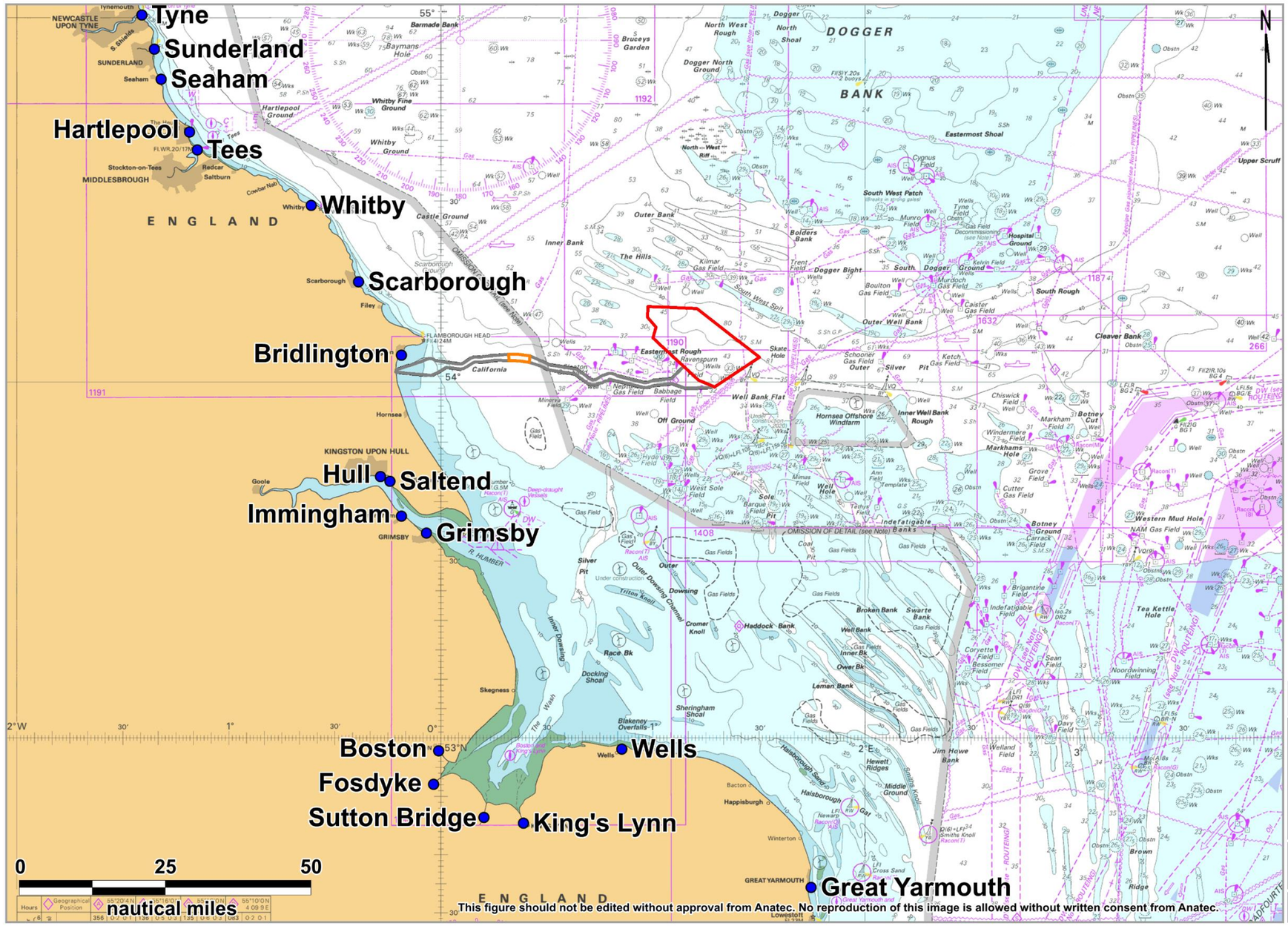


Figure 10.7 Ports in proximity to Hornsea Four

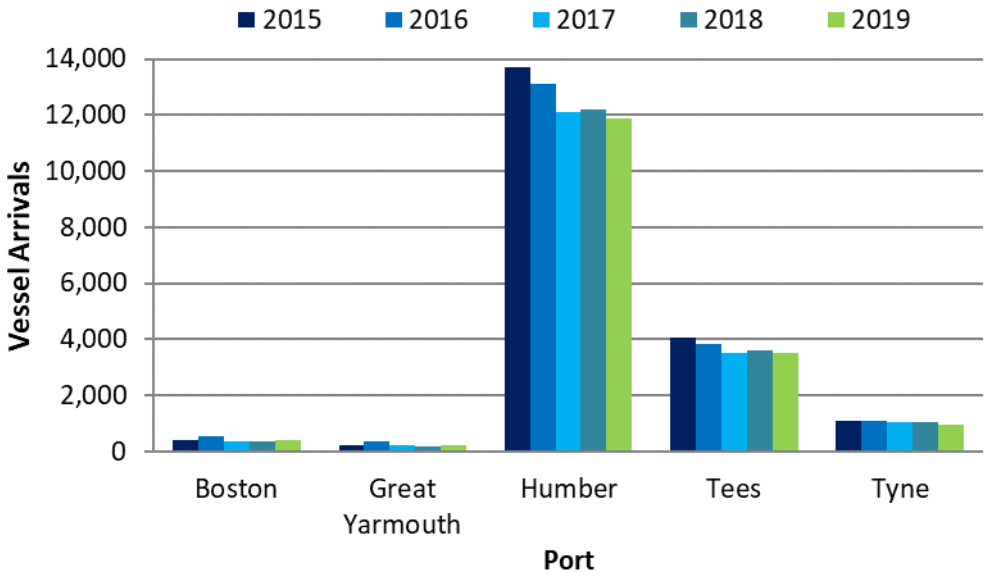
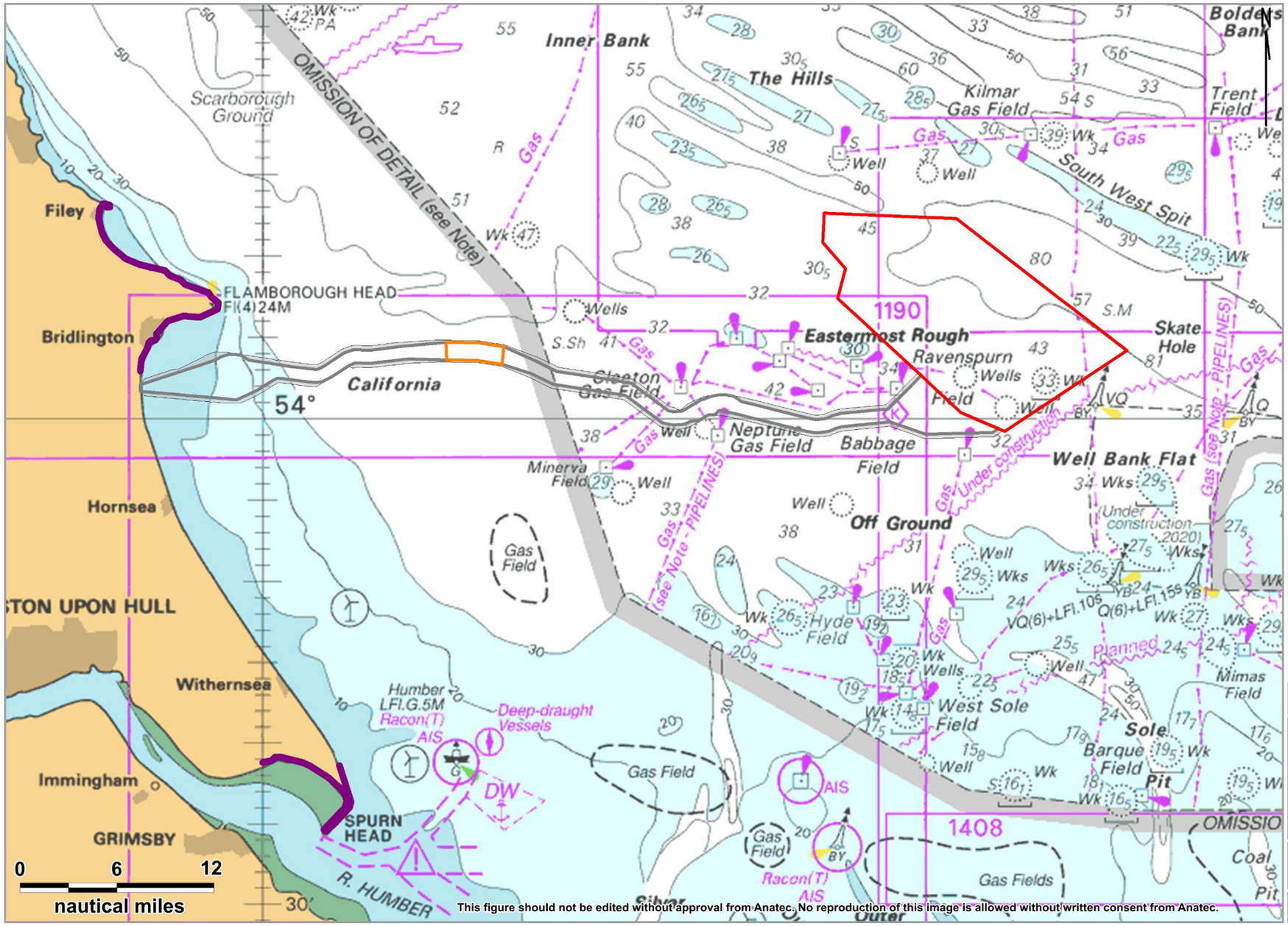


Figure 10.8 Vessel arrivals to ports in proximity to Hornsea Four (DfT, 2020)

10.8 Marine Environment High Risk Areas

122. Marine Environmental High Risk Areas (MEHRA) are areas along the UK coast designed to "*inform [ships'] Masters of areas where there is a real prospect of a problem arising. This prime purpose stands alone and regardless of any consequential defensive measures*" (Lord Donaldson, 1994). A plot of MEHRAs is presented in Figure 10.9.

123. There are two MEHRAs located in proximity to the Hornsea Four offshore ECC. The Flamborough Head MEHRA is in close proximity (less than 1 nm) to the landfall location while the Spurn Bight MEHRA is located at the Humber Estuary.



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Offshore Export Cable Corridor
- Temporary Working Area

Navigational Features
- MEHRA Line

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
MEHRAs in proximity to Hornsea Four

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Figure 10.9 MEHRAs in proximity to Hornsea Four

10.9 Other Navigational Features

10.9.1 Anchorage Areas

124. The only designated anchorage area located in the region is the Humber Deep Water Anchorage located approximately 24 nm south of the Hornsea Four offshore ECC, as shown in Figure 10.1.

10.9.2 Marine Aggregate Dredging Areas

125. There are no marine aggregate dredging areas in proximity to Hornsea Four. The closest areas are located near the Humber and are production areas owned by CEMEX UK Marine Ltd.

126. The BMAPA transit routes within the southern North Sea have been considered. There are only a small number of transit routes in proximity to the Hornsea Four array area and HVAC booster station search area. There is a high density of transit routes crossing the Hornsea Four offshore ECC nearshore, with these routes typically between the Tees or Tyne (UK) and the production areas located near the Humber.

10.9.3 Military Practice and Exercise Areas

127. There is a small arms firing practice area located off the coast of Rolston, approximately 6.8 nm south of the Hornsea Four offshore ECC, as shown in Figure 10.1.

128. There are some submarine exercise areas located to the north of the Hornsea Four array area and offshore ECC. No restrictions are placed on the right to transit a military PEXA at any time although mariners are advised to exercise caution. Exercises and firing only occur when the area is considered to be clear of all shipping.

129. There are not anticipated to be any impacts on shipping and navigation receptors associated with PEXAs, although military vessel traffic is considered as part of the baseline assessment in Section 15.

10.9.4 Foul and Spoil Grounds

130. There are two areas of foul ground in the region, located approximately 2.2 nm north and 7.1 nm south of the Hornsea Four offshore ECC, respectively, as shown in Figure 10.1.

131. There is one area of spoil ground in the region, located approximately 1.1 nm north of the Hornsea Four offshore ECC, as shown in Figure 10.1. It is noted that there is also a disused spoil ground which intersects the Hornsea Four offshore ECC close to the landfall location (not shown in Figure 10.1).

11 Meteorological Ocean Data

132. This section presents meteorological and oceanographic statistics local to Hornsea Four. The data presented in this section has been used as input to the collision and allision risk modelling (see Section 21).

11.1 Wind

133. Wind data covering a period of 38 years between 1979 and 2017 and calibrated against measurements from the meteorological mast located at the nearby Hornsea Project One, in terms of the average wind direction, is presented in Figure 11.1 in the form of a wind rose.

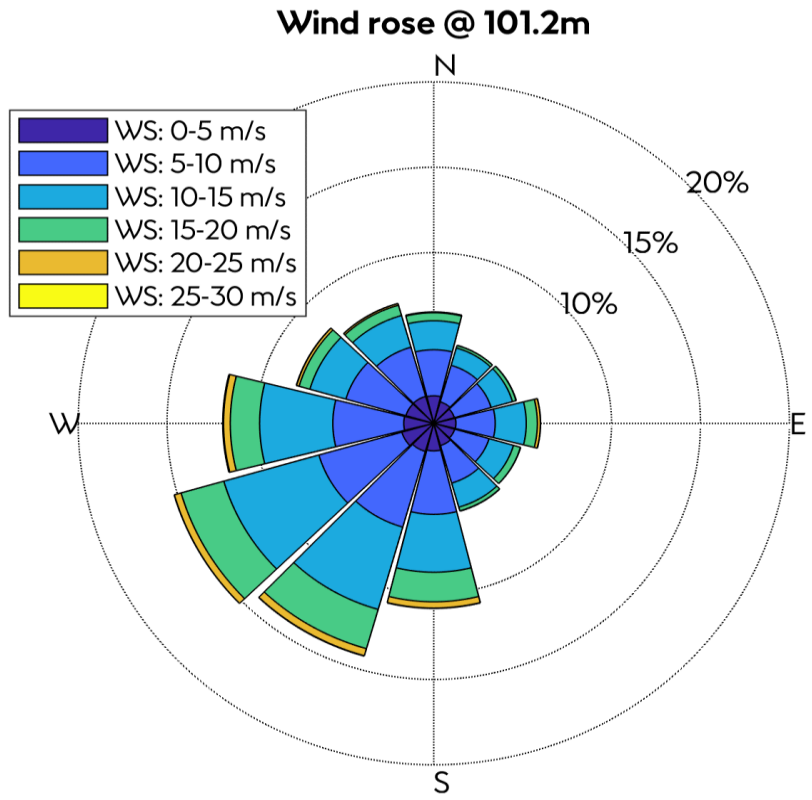


Figure 11.1 Wind direction distribution for Hornsea Four

134. It can be seen that winds are predominantly from the south west. This data is considered for both the Hornsea Four array area and HVAC booster station search area.

11.2 Wave

11.2.1 Hornsea Four Array Area

135. Sea state data for the Hornsea Four array area, covering a period of 38 years between 1979 and 2017 and calibrated against measurements from the Hornsea

Project One meteorological mast, based upon the average percentage exceedance of the significant wave height, is presented in Table 11.1.

Table 11.1 Sea state distribution for Hornsea Four array area

Sea State	Proportion (%)
Calm (<1 m)	31
Moderate (1 m to 5 m)	68
Severe (>5 m)	1

11.2.2 Hornsea Four HVAC Booster Station Search Area

136. Sea state data for the Hornsea Four HVAC booster station search area, based upon the average percentage exceedance of the significant wave height, is presented in Table 11.2.

Table 11.2 Sea state distribution for Hornsea Four HVAC booster station search area

Sea State	Proportion (%)
Calm (<1 m)	34
Moderate (1 m to 5 m)	65.5
Severe (>5 m)	0.5

11.3 Visibility

137. The annual average incidence of poor visibility (defined as less than 1 km) for the North Sea is approximately 0.03 (i.e. an average of 3% of the year) (UKHO, 2016). This value has been applied at both the Hornsea Four array area and HVAC booster station search area.

11.4 Tide

11.4.1 Hornsea Four Array Area

138. From UKHO Admiralty Chart 1187 (tidal diamond “A” located approximately 2.8 nm from the Hornsea Four array area), currents in proximity to the Hornsea Four array area are set in a generally north west to south east direction on the flood tide and south east to north west direction on the ebb tide, with a peak flood tidal rate of 1.4 knots (kt) and peak ebb tidal rate of 1.4 kt. Table 11.3 presents details for tidal diamond “A” from UKHO Admiralty Chart 1187.

Table 11.3 Details for tidal diamond "A" on UKHO Admiralty Chart 1187

Hours		Direction of Stream (°)	Rate at Spring Tide (kt)	Rate at Neap Tide (kt)
Before high water	6	134	1.4	0.8
	5	131	1.2	0.7
	4	125	0.9	0.5
	3	093	0.4	0.2
	2	345	0.4	0.2
	1	324	1.0	0.5
High water		317	1.4	0.8
After high water	1	311	1.4	0.8
	2	303	1.0	0.6
	3	271	0.4	0.2
	4	169	0.5	0.3
	5	145	1.0	0.6
	6	137	1.4	0.8

139. A number of other tidal diamonds are also used in the collision and allision risk modelling, with the tidal diamond most local to any particular location being considered. Tidal diamonds on UKHO Admiralty Charts 266 and 1190 have been used in addition to further tidal diamonds on UKHO Admiralty Chart 1187.

140. Based upon the available data and the distance offshore of the Hornsea Four array area, no impacts are expected at high water that would not also be expected at low water, and vice versa. The structures within the Hornsea Four array area are expected to have no impact on the existing tidal streams in relation to their effect on existing shipping and navigation receptors.

11.4.2 Hornsea Four HVAC Booster Station Search Area

141. From UKHO Admiralty Chart 121 (tidal diamond "A" located approximately 3.3 nm from the Hornsea Four HVAC booster station search area), currents in proximity to the Hornsea Four HVAC booster station search area are set in a generally north east to south west direction on the flood tide and south east to north west direction on the ebb tide, with a peak flood tidal rate of 1.8 kt and peak ebb tidal rate of 1.7 kt. Table 11.4 presents details for tidal diamond "A" from UKHO Admiralty Chart 121.

Table 11.4 Details for tidal diamond "A" on UKHO Admiralty Chart 121

Hours		Direction of Streams(°)	Rate at Spring Tide (kt)	Rate at Neap Tide (kt)
Before high water	6	326	1.0	0.6
	5	302	0.3	0.2
	4	170	0.7	0.4
	3	154	1.5	0.8
	2	153	1.7	1.0
	1	151	1.8	1.0
High water		150	1.2	0.7
After high water	1	139	0.4	0.2
	2	005	0.5	0.3
	3	348	1.1	0.6
	4	333	1.6	0.9
	5	333	1.7	1.0
	6	329	1.3	0.7

142. A number of other tidal diamonds are also used in the collision and allision risk modelling, with the tidal diamond most local to any particular location being considered. Tidal diamonds on UKHO Admiralty Charts 129 and 1191 have also been used.

143. As with the Hornsea Four array area, based upon the available data and the distance offshore of the Hornsea Four HVAC booster station search area, no impacts are expected at high water that would not also be expected at low water, and vice versa. The HVAC booster stations are expected to have no impact on the existing tidal streams.

12 Emergency Response Overview

144. This section summarises the existing SAR resources in the southern North Sea and the issues being considered in relation to the design of Hornsea Four.

12.1 Search and Rescue Helicopters

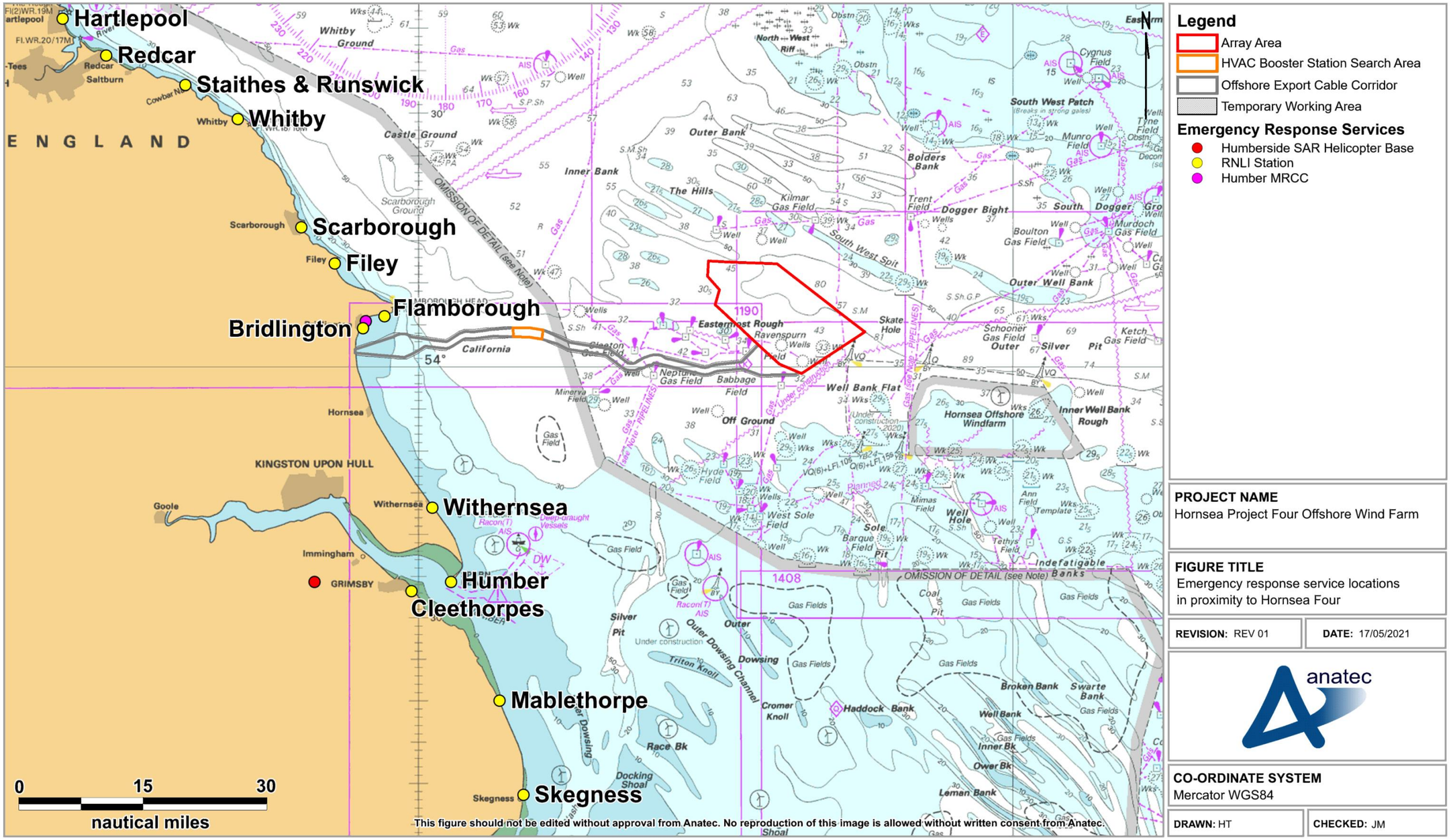
145. In March 2013, the Bristow Group were awarded the contract by the MCA (as an executive agency of the DfT) to provide helicopter SAR operations in the UK over a ten-year period. Bristow have now been operating the service since April 2015 with the next contract to be awarded sometime in 2022.

146. The SAR helicopter service is operated out of 10 base locations around the UK, with the closest to Hornsea Four located at Humberside Airport, approximately 58 nm south west of the closest point of the Hornsea Four array area (see Figure 12.1). This base was purpose-built when the Bristow Group took over SAR operations in the UK and "*provides vital life-saving support to the fishing and other marine industries and the offshore energy sector, as well as to land-based incidents including missing persons and other medical emergencies*" (Bristow Group, 2017). This base is most likely to respond to any incident requiring SAR helicopter services based upon the SAR helicopter data for the region (see Section 13.3).

147. Companies operating offshore typically have resources of vessels, helicopters and other equipment available for normal operations that can assist with emergencies offshore. Moreover, 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 Royal National Lifeboat Institution

148. The RNLI is organised into six divisions, with the relevant region for Hornsea Four being "*North and East*". Based out of more than 230 stations around the UK, there are over 400 active lifeboats across the RNLI fleet, including both all-weather lifeboats (ALB) and inshore lifeboats (ILB). Figure 12.1 presents the locations of RNLI stations in proximity to the Hornsea Four array area and Table 12.1 summarises the types of lifeboat operated by the RNLI out of these stations.



Legend

- Array Area
- HVAC Booster Station Search Area
- Offshore Export Cable Corridor
- Temporary Working Area

Emergency Response Services

- Humberside SAR Helicopter Base
- RNLI Station
- Humber MRCC

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Emergency response service locations in proximity to Hornsea Four

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CO-ORDINATE SYSTEM
Mercator WGS84

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Figure 12.1 Emergency response service locations in proximity to Hornsea Four

Table 12.1 Types of lifeboat held at RNLI stations in proximity to Hornsea Four

Station	Lifeboat(s)	ALB Class	ILB Class	Minimum Distance to Hornsea Four Array Area (nm)
Flamborough	ILB	–	B Class	39
Bridlington	ALB and ILB	Shannon	D Class	41
Withernsea	ILB	–	D Class	41
Filey	ALB and ILB	Mersey	D Class	44
Scarborough	ALB and ILB	Shannon	D Class	48
Humber	ALB	Severn	–	46
Cleethorpes	ILB	–	D Class	50
Mablethorpe	ILB (×2)	–	B and D Class	52
Whitby	ALB and ILB	Trent	D Class	58
Skegness	ALB and ILB	Shannon	D Class	60
Staithes & Runswick	ILB	–	B Class	65
Redcar	ILB (×2)	–	B and D Class	75
Hartlepool	ALB and ILB	Trent	B Class	81

149. RNLI lifeboats are available on a 24-hour basis throughout the year. It is noted that the RNLI have a 100 nm operational limit and given the distance offshore of the Hornsea Four array area it is considered unlikely that an RNLI lifeboat would respond to an incident within the Hornsea Four array area. This is reflected in the RNLI incident data for the region (see Section 13.2).

12.3 Her Majesty's Coastguard Stations

150. Her Majesty's Coastguard (HMCG), a division of the MCA, is responsible for requesting and tasking SAR resources made available to other authorities and for coordinating the subsequent SAR operations (unless they fall within military jurisdiction).

151. The HMCG coordinates SAR operations through a network of 11 Marine Rescue Coordination Centres (MRCC), including a Joint Rescue Coordination Centre (JRCC) based in Hampshire. A corps of over 3,500 volunteer Coastguard Rescue Officers (CRO) around the UK from 352 local Coastguard Rescue Teams (CRT) are involved in coastal rescue, searches and surveillance.

152. 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 encompassing Hornsea Four.

153. Each region is divided into six districts with its own MRCC, which coordinates the SAR response for maritime and coastal emergencies within its district boundaries (East of England includes an additional station, London Coastguard, for coordinating SAR on the River Thames). The closest MRCC to Hornsea Four is the Humber MRCC based in Bridlington, in east Yorkshire, located approximately 41 nm west of the closest point of the Hornsea Four array area (see Figure 12.1).

13 Maritime Incidents

154. This section reviews maritime incidents which have occurred in proximity to Hornsea Four or are related to existing offshore wind farm developments.

155. The analysis is intended to provide a general indication of whether the area of the proposed development is currently low or high risk in terms of maritime incidents and whether offshore wind farms pose a high risk to vessels. If the area was found to be a particularly high risk area for incidents then this may indicate that the development could exacerbate the existing maritime safety risks in the area.

156. Data from the following sources has been analysed:

- MAIB;
- RNLI; and
- DfT.

157. It is noted that the same incident may be recorded by multiple sources.

13.1 Marine Accident Investigation Branch Incident Data

158. All UK flagged vessels and non-UK flagged vessels in UK territorial waters (12 nm), a UK port or carrying passengers to a UK port are required to report incidents to the MAIB. Between 1,000 and 1,300 incidents have generally been reported to the MAIB annually in recent years.

159. The locations of accidents, injuries and hazardous incidents reported to the MAIB within the Hornsea Four array area, offshore ECC and HVAC booster station search area shipping and navigation study areas between 2010 and 2019 is presented in Figure 13.1, colour-coded by incident type. The same data is presented in Figure 13.2, colour-coded by casualty type.

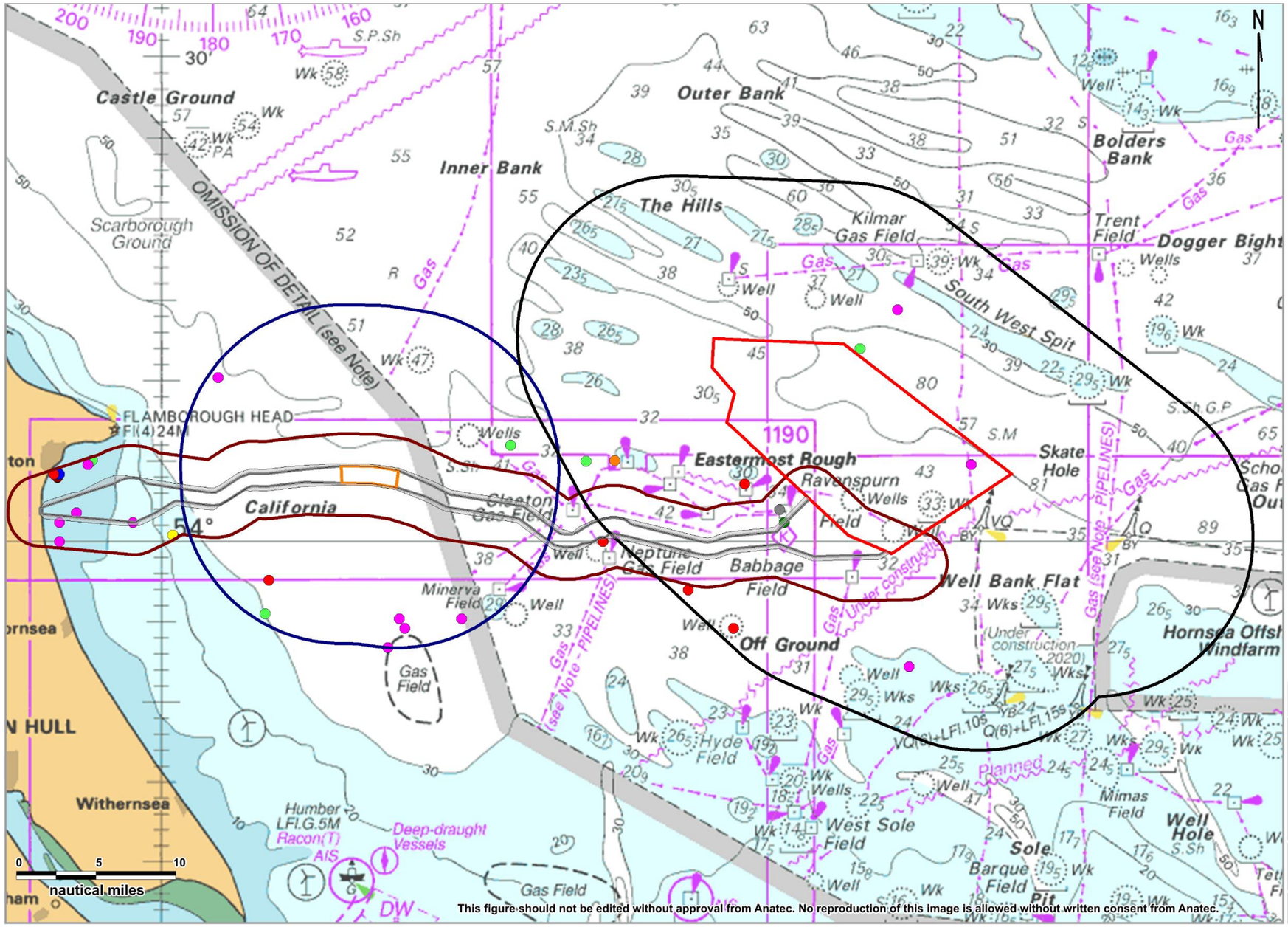
13.1.1 Hornsea Four Array Area

160. A total of 11 unique incidents, with one incident involving two vessels, were reported to the MAIB within the Hornsea Four array area shipping and navigation study area, corresponding to an average of one to two unique incidents per year.

161. One of the incidents occurred within the Hornsea Four array area itself and involved a general cargo vessel experiencing a main engine turbo charger failure in 2011. The vessel was able to reach the pilot station of her next port without assistance.

162. Of the remaining 10 incidents within the Hornsea Four array area shipping and navigation study area, eight occurred between the array area and shore, with three of these involving an oil and gas vessel and four involving an "*accident to person*". One of the oil and gas vessel incidents involved an allision between the vessel and a surface platform at the Ravenspurn North gas field when the vessel experienced

difficulties getting alongside the platform, with no injuries reported and minor damage to the vessel.



Hornsea Four Boundaries

- Array Area
- Array Area Study Area
- HVAC Booster Station Search Area
- HVAC Booster Station Search Area Study Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area

MAIB Incidents (2010 - 2019)
By Incident Type

- Unknown
- Accident To Person
- Contact
- Damage / loss of equipment
- Fire/Explosion
- Flooding/Foundering
- Grounding
- Loss of control
- Machinery Failure

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
MAIB incident location by incident type within study area (2010 to 2019)

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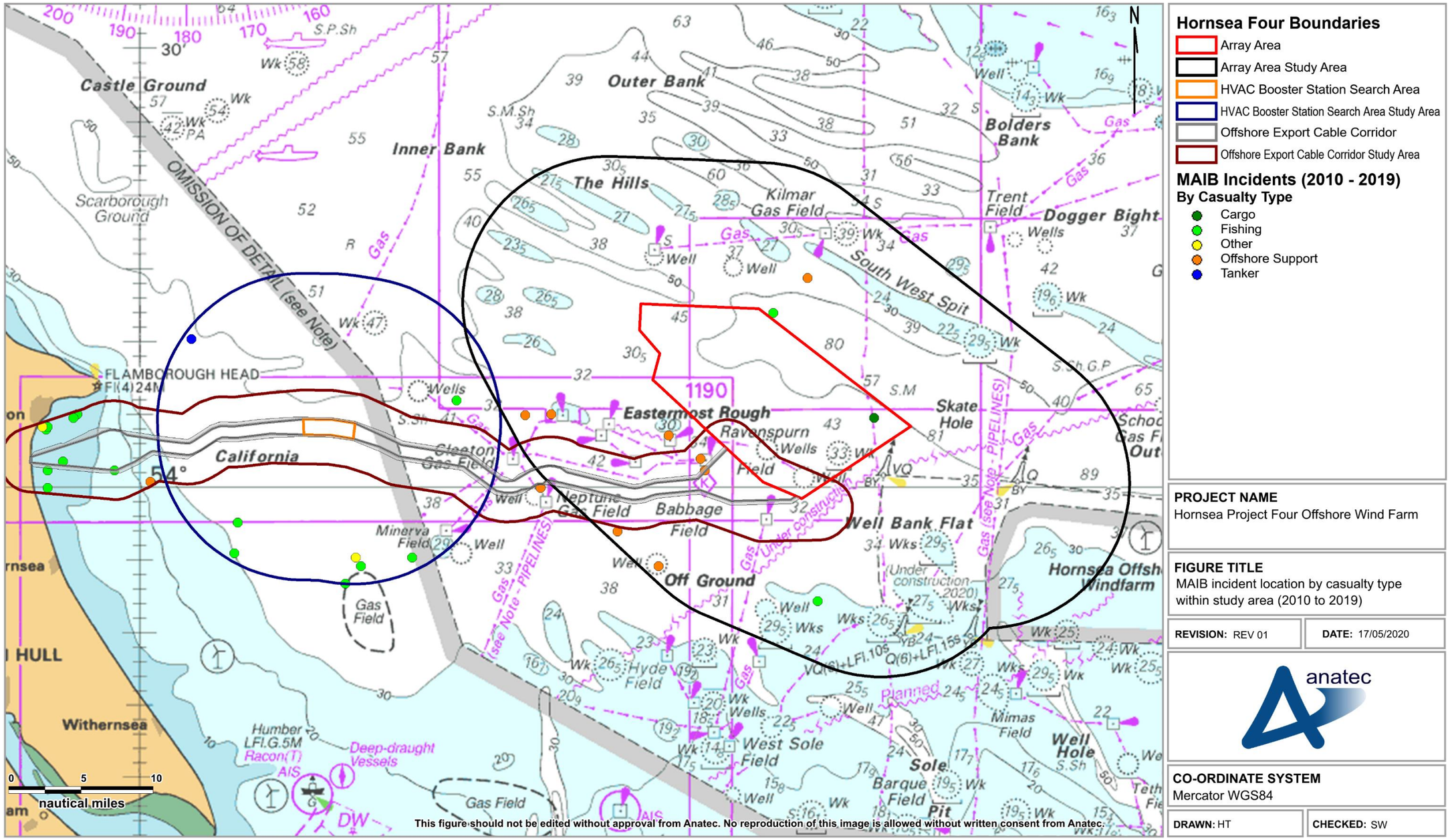
Figure 13.1 MAIB incident locations by incident type within shipping and navigation study areas (2010 to 2019)



Hornsea Four Boundaries

- Array Area
- Array Area Study Area
- HVAC Booster Station Search Area
- HVAC Booster Station Search Area Study Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area

MAIB Incidents (2010 - 2019)
By Casualty Type

- Cargo
- Fishing
- Other
- Offshore Support
- Tanker

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
MAIB incident location by casualty type within study area (2010 to 2019)

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Figure 13.2 MAIB incident locations by casualty type within shipping and navigation study areas (2010 to 2019)

13.1.2 Hornsea Four Offshore ECC

163. A total of 13 unique incidents were reported to the MAIB within the Hornsea Four offshore ECC shipping and navigation study area, corresponding to an average of one to two unique incidents per year. Incidents were concentrated towards the coast, with the majority (approximately 62%) occurring within 5 nm of the east Yorkshire coast.

13.1.3 Hornsea Four HVAC Booster Station Search Area

164. A total of eight unique incidents were reported to the MAIB within the Hornsea Four HVAC booster station search area shipping and navigation study area, corresponding to an average of one unique incident per year. No incidents were reported within the Hornsea Four HVAC booster station search area itself with the closest occurring approximately 7.1 nm north east. This incident involved a 12m fishing vessel which experienced a loss of control in 2019, resulting in the vessel requiring a tow back to shore, although no damage was incurred.

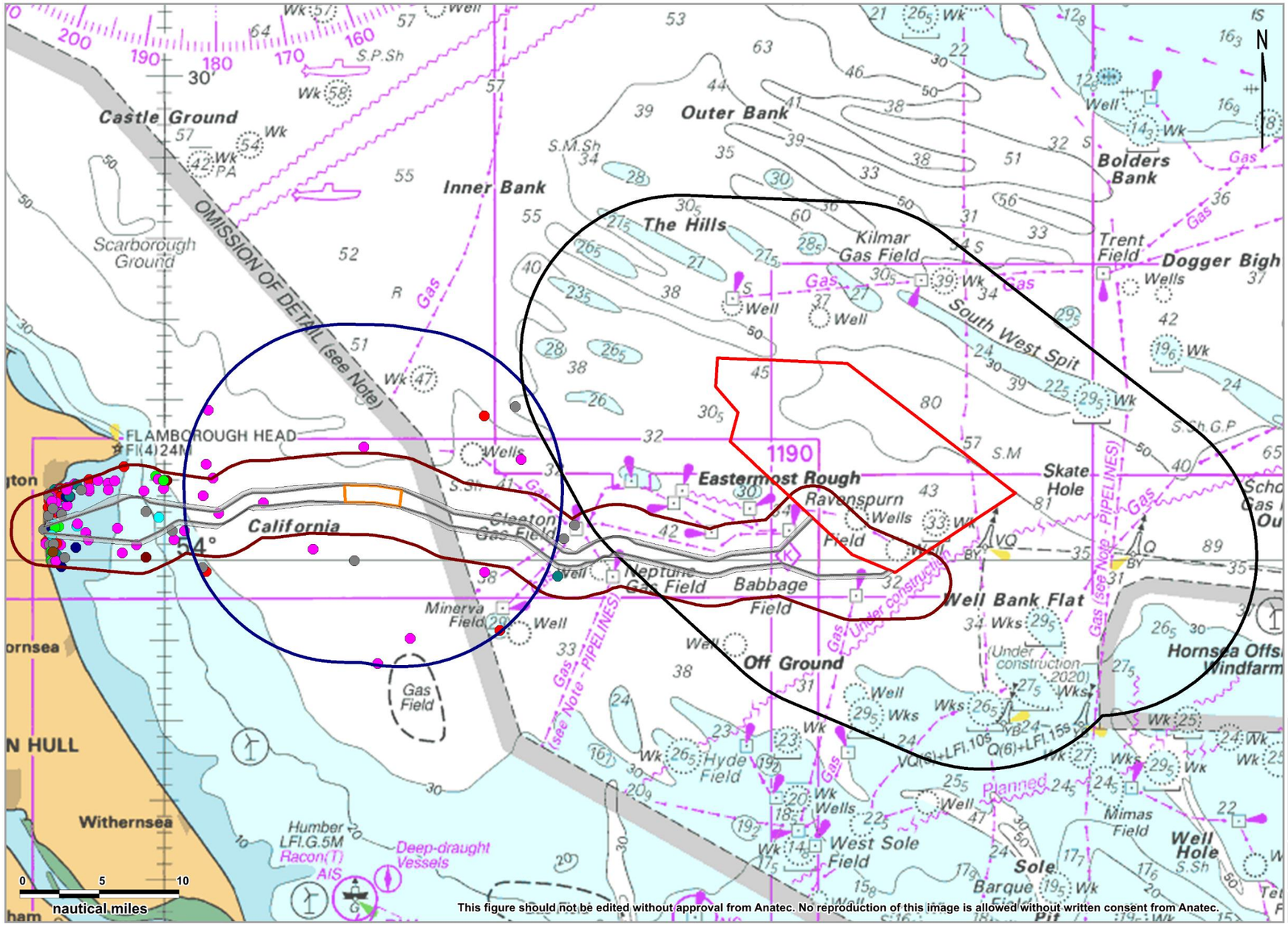
13.2 Royal National Lifeboat Institution Data

165. Data on RNLI lifeboat responses within the Hornsea Four array area, offshore ECC and HVAC booster station search area shipping and navigation study areas for the 10-year period between 2010 and 2019 were analysed (excluding hoaxes or false alarms). As noted in Section 12.2, the RNLI have a strategic performance standard of reaching casualties up to a maximum of 100 nm offshore and therefore given the distance and journey time to respond, an RNLI lifeboat may respond to a drifting vessel but are unlikely to respond to a life-saving incident in proximity to the Hornsea Four array area.

166. The locations of incidents responded to by the RNLI within the Hornsea Four array area, offshore ECC and HVAC booster station search area shipping and navigation study areas are presented in Figure 13.3, colour-coded by incident type. The same data is presented in Figure 13.4, colour-coded by casualty type.

13.2.1 Hornsea Four Array Area

167. No RNLI lifeboat launches were reported within the Hornsea Four array area shipping and navigation study area.



Hornsea Four Boundaries

- Array Area
- Array Area Study Area
- HVAC Booster Station Search Area
- HVAC Booster Station Search Area Study Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area

RNLI Incidents (2010 - 2019)

By Incident Type

- Adverse Conditions
- Capsize
- Collision
- Flooding/Foundering
- Grounding
- Machinery Failure
- Other
- Person in Danger
- Sail Failure
- Steering Failure
- Vessel May Be in Trouble

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
RNLI incident location by incident type within study area (2010 to 2019)

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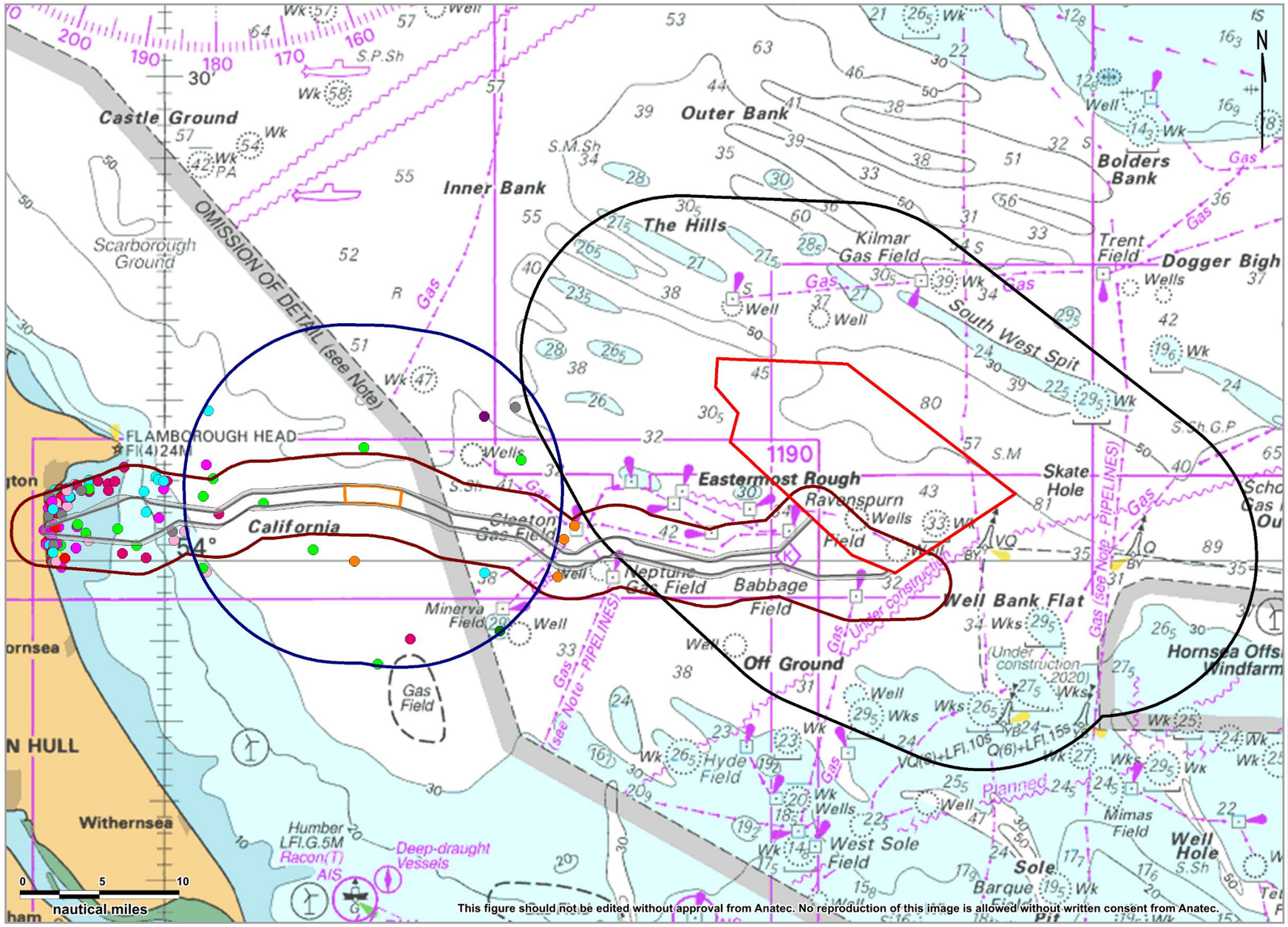
Figure 13.3 RNLI incident locations by incident type within shipping and navigation study areas (2010 to 2019)



Hornsea Four Boundaries

- Array Area
- Array Area Study Area
- HVAC Booster Station Search Area
- HVAC Booster Station Search Area Study Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area

RNLI Incidents (2010 - 2019)

By Casualty Type

- Commercial (Other)
- Fishing
- Oil and Gas
- Other (Non-Vessel Based)
- Other (Vessel Based)
- Passenger
- Person in Danger
- Personal Craft
- Recreational (Powered)
- Recreational (Other)
- Recreational (Sailing)

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
RNLI incident location by casualty type within study area (2010 to 2019)

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Figure 13.4 RNLI incident locations by casualty type within shipping and navigation study areas (2010 to 2019)

13.2.2 Hornsea Four Offshore Export Cable Corridor

168. A total of 147 RNLI lifeboat launches to 143 unique incidents were reported within the Hornsea Four offshore ECC shipping and navigation study area, corresponding to an average of 15 unique incidents per year. Incidents were concentrated towards the coast, with the majority (approximately 83%) occurring within 5 nm of the east Yorkshire coast. The incidents furthest offshore responded to by the RNLI were three incidents involving oil and gas vessels at the Cleeton gas field in 2010, two of which were responded to by the ON1216 Severn class lifeboat from the Humber station (furthest distance approximately 35 nm from the station). In all three cases the incident was resolved without the aid of the RNLI lifeboat.

169. The majority of reported RNLI lifeboat launches for incidents within the Hornsea Four offshore ECC were from the Bridlington station (84%) with Flamborough station (14%) also used frequently. The most frequent incident type within the Hornsea Four offshore ECC was "*Machinery Failure*" (36%) followed by "*Person in Danger*" (18%) and "*Adverse Conditions*" (7%). Excluding "*Person in Danger*" and non-vessel incidents, the most frequent casualty vessel type was personal craft (22%) followed by recreational sailing vessels (14%) and other recreational vessels (14%).

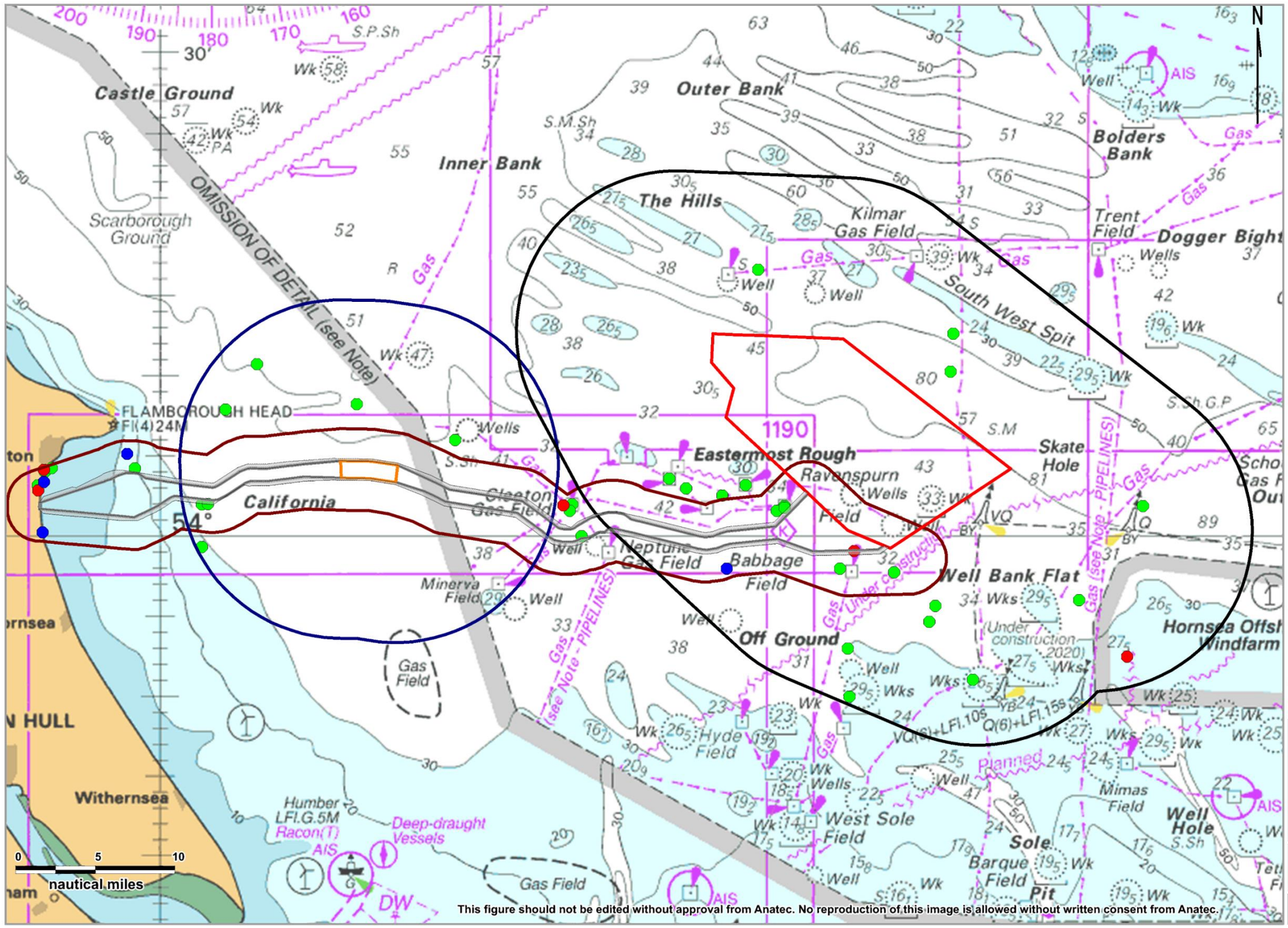
13.2.3 Hornsea Four HVAC Booster Station Search Area

170. A total of 19 RNLI lifeboat launches to 18 unique incidents were reported within the Hornsea Four HVAC booster station search area shipping and navigation study area, corresponding to an average of two incidents per year (it is noted that four of these incidents also occurred within the Hornsea Four offshore ECC shipping and navigation study area). None of these incidents occurred within the Hornsea Four HVAC booster station search area itself.

171. Fishing vessels were the most frequent casualty vessel type within the Hornsea Four HVAC booster station search area (approximately 50% of incident vessels) with the ON1169 Mersey class lifeboat from the Bridlington station the most frequent lifeboat responder (approximately 33% of incidents). This lifeboat was replaced in December 2017 by a new Shannon class lifeboat.

13.3 Department for Transport Search and Rescue Helicopter Data

172. The DfT has produced data on civilian search and rescue helicopter activity in the UK by the Bristow Group on behalf of the MCA between 2015 and 2020. The locations of SAR helicopter taskings within the Hornsea Four array area, offshore ECC and HVAC booster station search area shipping and navigation study areas are presented in Figure 13.5, colour-coded by tasking outcome.



Hornsea Four Boundaries

- Array Area
- Array Area Study Area
- HVAC Booster Station Search Area
- HVAC Booster Station Search Area Study Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area

SAR Helicopter Taskings (2015 - 2020) By Tasking Outcome

- Complete
- Stood Down
- Terminated

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
SAR tasking locations by outcome within study areas (2015 to 2020)

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Figure 13.5 SAR helicopter tasking locations by outcome within shipping and navigation study areas (2015 to 2020)

13.3.1 Hornsea Four Array Area

173. A total of 22 SAR helicopter taskings were undertaken for incidents within the Hornsea Four array area shipping and navigation study area, corresponding to an average of four to five taskings per year. Most of the taskings involved a "*Rescue/Recovery*" (91%), with the majority (86%) completed. None of the incidents occurred within the Hornsea Four array area itself.

13.3.2 Hornsea Four Offshore ECC

174. A total of 22 SAR helicopter taskings were undertaken for incidents within the Hornsea Four offshore ECC shipping and navigation study area, corresponding to an average of four to five taskings per year. The majority of taskings involved a "*Rescue/Recovery*" (64%), with the majority (86%) completed.

13.3.3 Hornsea Four HVAC Booster Station Search Area

175. A total of seven SAR helicopter taskings were undertaken for incidents within the Hornsea Four HVAC booster station search area shipping and navigation study area, corresponding to an average of one to two taskings per year (it is noted that two of these incidents also occurred within the Hornsea Four offshore ECC shipping and navigation study area). All of the taskings involved a "*Rescue/Recovery*" and all were completed. None of the incidents occurred within the Hornsea Four HVAC booster station search area itself.

13.4 Historical Offshore Wind Farm Incidents

13.4.1 Incidents Involving UK Offshore Wind Farm Developments

176. As of July 2021 there are 39 fully commissioned and operational offshore wind farms in the UK, ranging from the North Hoyle Offshore Wind Farm (fully commissioned in 2003) to Hornsea Project One (fully commissioned in 2020). These developments consist of approximately 16,200 fully operational WTG years.

177. MAIB incident data has been used to collate a list of historical collision and allision incidents involving UK offshore wind farm developments, which is summarised in Table 13.1. Other sources have also been used to produce this list including the UK Confidential Human Factors Incident Reporting Programme (CHIRP) for Aviation and Maritime, International Marine Contractors Association (IMCA) and basic web searches.

178. There have also been a number of collision and allision incidents involving non-UK offshore wind farm developments, including an allision incident involving an offshore service and supply vessel which experienced a loss of control whilst undertaking an emergency control system test shortly after casting off from a WTG in a German offshore wind farm (Federal Bureau of Maritime Casualty Investigation (BSU), 2019).

179. The worst consequences reported for vessels involved in a collision or allision incident involving a UK offshore wind farm development has been minor flooding, with no life-threatening injuries to persons reported.

180. As of July 2021, there have been no collisions as a result of the presence of an offshore wind farm in the UK. The only reported collision incident in relation to a UK offshore wind farm involved a project vessel hitting a third-party vessel whilst in harbour.

181. As of July 2021, there have been nine reported[3] cases of an allision between a vessel and a WTG (under construction, operational or disused) in the UK, with all but one involving a support vessel for the development and the errant vessel in each case under power rather than drifting. Therefore, there has been an average of 1,800 years per WTG allision incident in the UK, noting that this is a conservative calculation given that only operational WTG hours have been included (whereas allision incidents counted include non-operational WTGs).

13.4.2 Incidents Responded to by Vessels Associated with UK Offshore Wind Farms

182. From news reports, basic web searches and experience at working with existing offshore wind farm developments, a list has been collated of historical incidents responded to by vessels associated with UK offshore wind farm developments, which is summarised in Table 13.2. It is noted that the initial cause of these incidents is not related to the offshore wind farm in question.

[3] Reported to an accident investigation branch or an anonymous reporting service. Unconfirmed incidents have not been considered noting that to date only one further alleged incident has been rumoured but there is no evidence to confirm.

Table 13.1 Summary of historical collision and allision incidents involving UK offshore wind farm developments

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision – project vessel with WTG	7th August 2005	A vessel involved with the installation of WTGs underestimated the effect of the current and allided with the base of a WTG whilst manoeuvring alongside it. Minor damage was sustained to a gangway on the vessel, the WTG tower and a WTG blade.	Minor damage to gangway on the vessel	None	MAIB
Project	Allision – project vessel with WTG	29th September 2006	When approaching a WTG, an offshore services vessel was struck by the tip of a WTG blade which was rotating rather than secured in a fixed position.	None	None	MAIB
Project	Allision – project vessel with disused pile	8th February 2010	The Skipper on-board a work boat slipped their hand on the throttle controls whilst in proximity to a disused pile. There was insufficient time to correct the error and the vessel struck the pile. A passenger moving around the interior of the vessel was thrown off his feet. Although not known at the time, the passenger was later diagnosed with back injuries. No serious damage was caused to the vessel.	Minor	Injury	MAIB
Project	Collision – third party vessel with project vessel	23rd April 2011	A third-party catamaran was hit by a project guard vessel within a harbour.	Moderate	None	MAIB
Project	Allision – project vessel with WTG	18th November 2011	The Officer of the Watch (OOW) on-board a cable-laying vessel fell asleep and woke to find the vessel inside a wind farm. He attempted to manoeuvre the vessel out of the wind farm on autopilot but the settings did not allow a quick turn and the vessel struck the foundations of a partially completed WTG. The vessel suffered two hull breaches.	Major	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Collision – project vessel with service vessel	2nd June 2012	A Crew Transfer Vessel (CTV) became lodged under the boat landing equipment of a flotel. Nine persons were safely evacuated and transferred to a nearby vessel before being brought back into port.	Moderate	None	UK CHIRP
Project	Allision – project vessel with WTG	20th October 2012	The OOW misjudged the distance from a WTG monopile and made contact with the vessel's stern resulting in minor damage.	Minor	None	MAIB
Project	Allision – project vessel with buoy	21st November 2012	A wind farm passenger transfer catamaran struck a buoy at high speed whilst supporting operation for an offshore wind farm. The vessel was abandoned by the crew of 12 with the vessel having been holed, causing extensive flooding. There were however no injuries. It was found that the Master had unknowingly altered the vessel's course and had not been formally assessed to determine his suitability for the role.	Major	None	MAIB
Project	Allision – project vessel with WTG	21st November 2012	A work boat allided with the unlit transition piece of a WTG at moderate speed. The impact caused all five persons on-board to be forced out of their seats. The vessel was able to proceed to port unassisted with no water ingress incurred, although there was some structural damage. It was found that the vessel's Master had relied too heavily on visual cues and there had been insufficient training with navigation equipment. The WTG transition piece had been reported as unlit although the defect reporting system had failed to promulgate a navigation warning.	Moderate	None	MAIB
Project	Allision – project vessel with WTG	1st July 2013	After disembarking passengers at an offshore substation, a service vessel's jets were disengaged, but the vessel jet drive suffered a failure which resulted in an allision with a WTG foundation. The vessel suffered some damage whereas the WTG foundation was not damaged.	Minor	None	IMCA Safety Flash

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision – project vessel with WTG	14th August 2014	A standby safety vessel allided with a WTG pile and consequently leaked marine gas oil and a surface sheen trailed from the vessel. Under its own power the vessel moved away from environmentally sensitive areas until the leak was stopped.	Minor with pollution	None	UK CHIRP
Third party	Allision – fishing vessel with WTG	26th May 2016	A crew member on-board a fishing vessel left the autopilot on, resulting in an allision with a WTG. A lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)
Project	Allision – project vessel with WTG	16th January 2020	A project vessel servicing a number of WTGs allided with a WTG whilst transiting back to port resulting in a member of the crew coming into contact with the railings. The vessel proceeded unaided back to port where the man was subsequently taken to hospital to obtain doctors' advice.	None	Injury	Web search (Vessel Tracker, 2020)

(*) As per incident reports.

Table 13.2 Summary of historical incidents responded to by vessels associated with UK offshore wind farm developments

Incident Type	Date	Related Development	Description of Incident	Source
Capsize	21st June 2018	Walney Offshore Wind Farm	Following the capsize of a trimaran HMCG Holyhead issued a mayday relay broadcast requesting any vessels in the area assist. A support vessel for Walney arrived just in time to recover two persons from the water. Due to adverse conditions, the two persons were winched onboard a Coastguard helicopter and taken to shore.	Web search (4C Offshore, 2018)

Incident Type	Date	Related Development	Description of Incident	Source
Capsize	5th November 2018	Race Bank Offshore Wind Farm	A fishing vessel capsized after losing electrical power resulting in two fishermen in the water. A Belgian military helicopter spotted the casualties and dropped a life raft to assist before guiding the RNLI to the location. A vessel operating at the nearby Race Bank was also reported to have helped with the rescue.	Web search (British Broadcasting Corporation (BBC), 2018)
Vessel in trouble	15th May 2019	London Array Offshore Wind Farm	A yacht encountering difficulties in the Thames Estuary sought shelter by tying up to an offshore wind turbine. The alarm was raised by a wind farm support vessel which came across the secured yacht. The support vessel contacted the Coastguard who tasked Margate's RNLI ALB to assist but while on passage to the casualty position the yacht suffered further damage including the loss of its single mast. At one stage the person aboard the yacht entered the water, but was recovered by the wind farm support vessel. With concern of the effects of cold water immersion the Coastguard instructed the support vessel to return to Ramsgate and seek medical assistance for the yacht's occupant.	Web search (The Isle of Thanet News, 2019)
Drifting	7th July 2019	Gwynt y Môr Offshore Wind Farm	A wind farm support vessel responded to an 'all-ships' broadcast from the Coastguard to help four people stranded on a broken down speedboat following a day of fishing south east off North Wales. The vessel went to the speedboat's aid to prevent it drifting into the Gwynt y Môr array, according to the Rhyl RNLI, and later towed the boat back towards Rhyl where it met the ALB about 10 km north of the harbour. The lifeboat took over the tow and brought the casualties aboard.	Web search (Renews, 2019)
Machinery failure	28th September 2019	Race Bank Offshore Wind Farm	A nearby fishing vessel lost all engine and electrical power and launched flares. The guard vessel and Service Operation Vessel (SOV) for Race Bank both immediately offered assistance until the MCA's arrival on-scene.	Internal daily progress report received by Anatec
Vessel in trouble	13th December 2019	Race Bank Offshore Wind Farm	A vessel passing Race Bank got into difficulty and the guard vessel for Race Bank was requested to assist. Once control of the situation was established, the Humber Coastguard requested that the guard vessel tow the casualty vessel into Grimsby.	Internal daily progress report received by Anatec

Incident Type	Date	Related Development	Description of Incident	Source
Search	21st May 2020	Walney Offshore Wind Farm	The guard vessel for Walney was contacted by HMCG Holyhead in the early hours of the morning reporting a red flare sighted at the wind farm. The vessel proceeded to undertake a search but did not find anything to report.	Internal daily progress report received by Anatec
Aircraft crash	15th June 2020	Hornsea Project One	A United States (US) jet operating out of Royal Air Force (RAF) Lakenheath in Suffolk crashed into the North Sea during a routine training flight, approximately 74 km off the coast. Following a mayday call, the RNLI launched lifeboats from Bridlington and Scarborough and the Coastguard launched a helicopter from Humberside. A CTV and SOV for the construction of Hornsea Project One headed to the area to assist in the search for the missing pilot. The pilot was later found but was deceased.	Web search (4C Offshore, 2020)
Fire/ explosion	15th December 2020	Dudgeon Offshore Wind Farm	The crew of the SOV for Dudgeon, in cooperation with the developer's medic and technicians, rescued seven fishermen in distress near the wind farm. The fishing vessel experienced explosions on board, and all seven fishermen were "*seriously injured*". The SOV deployed its Fast Rescue Boat (FRB) and started evacuating the fishing vessel. Meanwhile, the SOV's remaining crew prepared to receive the injured.	Web search (Offshore WIND, 2020)

14 Key Consultation Overview

183. This section outlines key consultation undertaken as part of the NRA process.

14.1 Stakeholder Consultation

184. Consultation with stakeholders has taken place throughout the NRA process, including those stakeholders noted in Section 4.2. Table 7.4 of **Volume A2, Chapter 7: Shipping and Navigation** summarises the issues raised relevant to shipping and navigation during consultation and indicates either how these issues have been addressed within the ES and NRA or how Hornsea Four has had regard to them.

14.2 Regular Operator Consultation

185. There were 18 Regular Operators identified from the vessel traffic surveys which may be required to deviate their routes due to the Hornsea Four array area or HVAC booster stations. These Regular Operators were provided with an overview of the Project and offered the opportunity to provide comment and attend the Hazard Workshops (see Appendix D). The full list of Regular Operators identified is provided below. Only DFDS Seaways, Sea-Cargo and Boston Putford Offshore Safety provided feedback; details of consultation held with these operators is included in Table 7.4 of **Volume A2, Chapter 7: Shipping and Navigation**.

- A2B-online
- Amasus Shipping
- Bore Lines
- Boston Putford Offshore Safety
- DFDS Seaways
- Euro Marine Carrier
- Finnlines
- Hoegh Autoliners
- Island Offshore
- James Fisher Everard
- JT Essberger
- Nordic Tankers
- P&O Ferries
- Reederei H.P. Wegener
- Sea-Cargo
- Sloman Neptun
- Unifeeder
- Wilson Eurocarriers

15 Vessel Traffic Surveys

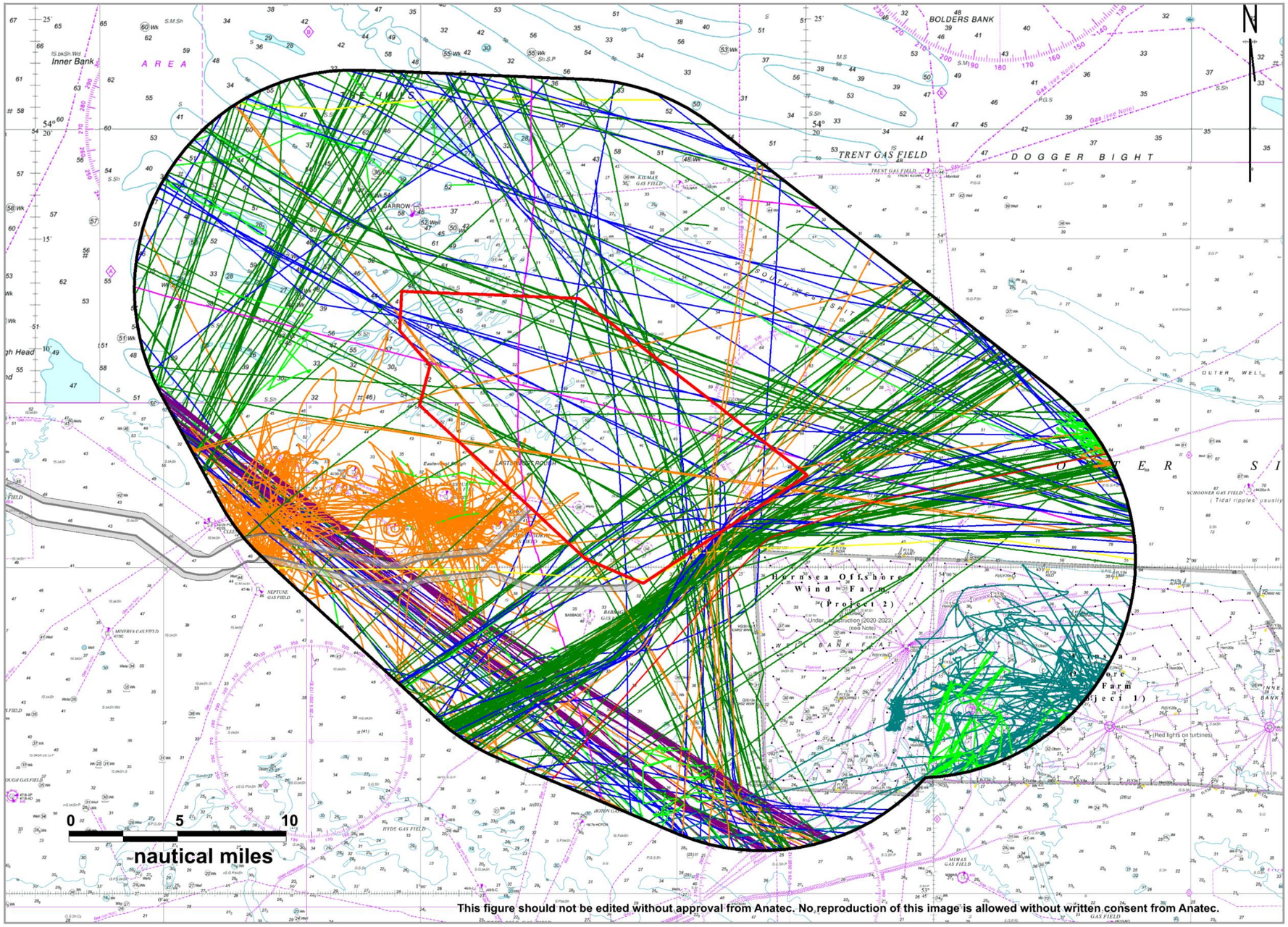
186. This section presents shipping data in relation to three areas – the Hornsea Four array area, offshore ECC and HVAC booster station search area shipping and navigation study areas. Details on the survey methodology used when recording the vessel traffic data is provided in Section 7 and details of the study areas applied is provided in Section 5.2.

15.1 Hornsea Four Array Area

187. A number of tracks recorded during the Hornsea Four array area survey periods were classified as temporary (non-routine), such as the tracks of the survey vessel and tracks of vessels associated with the construction of Hornsea Project Two. These have therefore been excluded from the analysis. Oil and gas vessels operating at permanent installations were retained in the analysis, as were wind farm vessels operating at operational offshore wind farms.

188. A plot of the vessel tracks recorded during a 14-day survey period in July and August 2020 (summer AIS), colour-coded by vessel type and excluding temporary traffic, is presented in Figure 15.1. A plot of the vessel tracks recorded during a further 14-day survey period in February and March 2021 (winter – dedicated vessel survey), colour-coded by vessel type and excluding temporary traffic, is presented in Figure 15.2.

189. Plots of the vessel tracks for the summer and winter survey periods converted to a density heat map are presented in Figure 15.3 and Figure 15.4, respectively.



Hornsea Four Boundaries
- Array Area
- Array Area Study Area
- Offshore Export Cable Corridor
- Temporary Working Area

Vessel Type
- Fishing
- Dredger/Subsea
- Tug
- Passenger
- Cargo
- Tanker
- Other
- Recreational
- Oil and Gas
- Wind Farm

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Vessel traffic survey data within array area study area by type (14 days summer)

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Figure 15.1 Vessel traffic survey data within Hornsea Four array area shipping and navigation study area colour-coded by vessel type (14 days summer 2020)

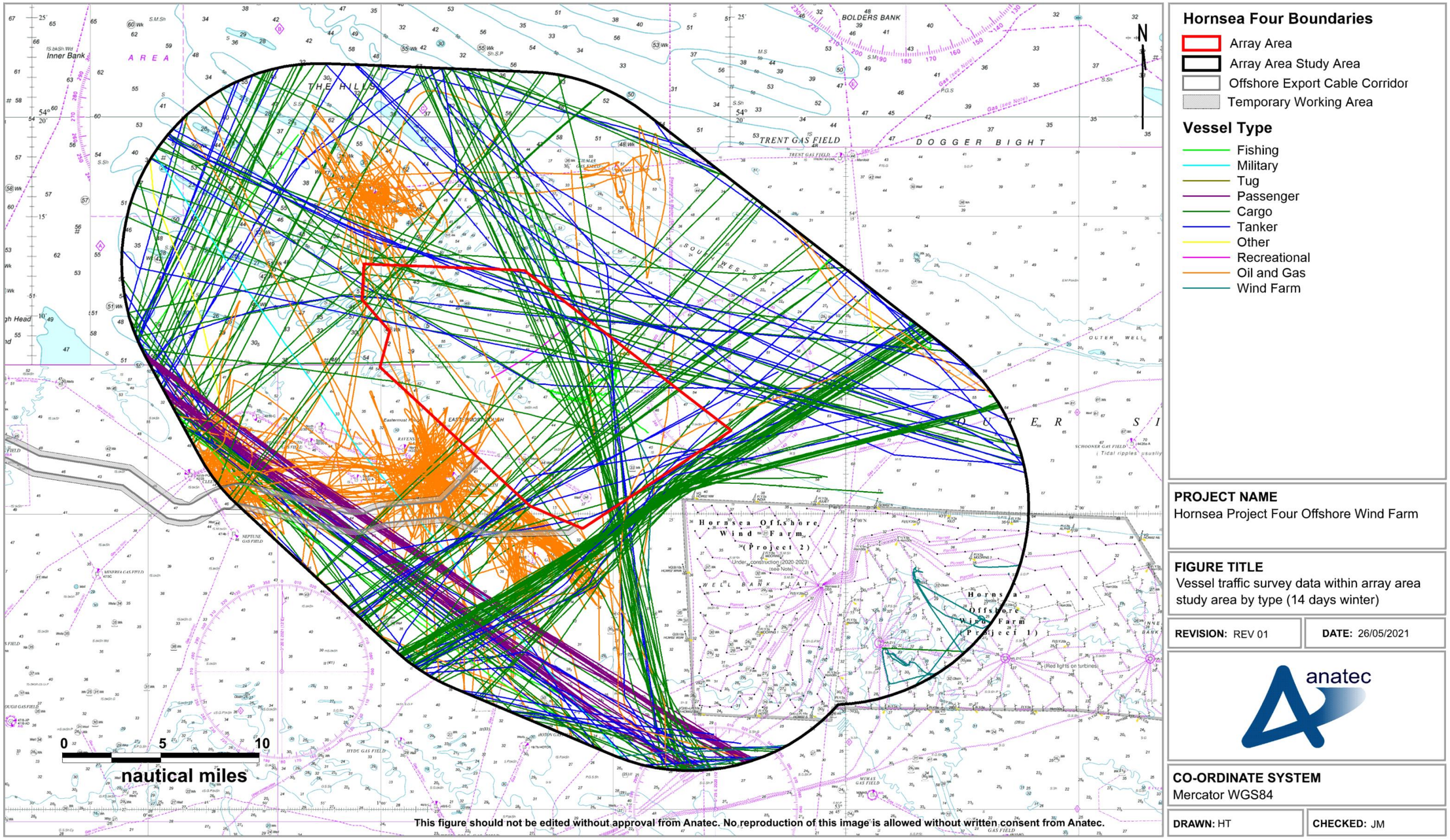

Figure 15.2 Vessel traffic survey data within Hornsea Four array area shipping and navigation study area colour-coded by vessel type (14 days winter 2021)

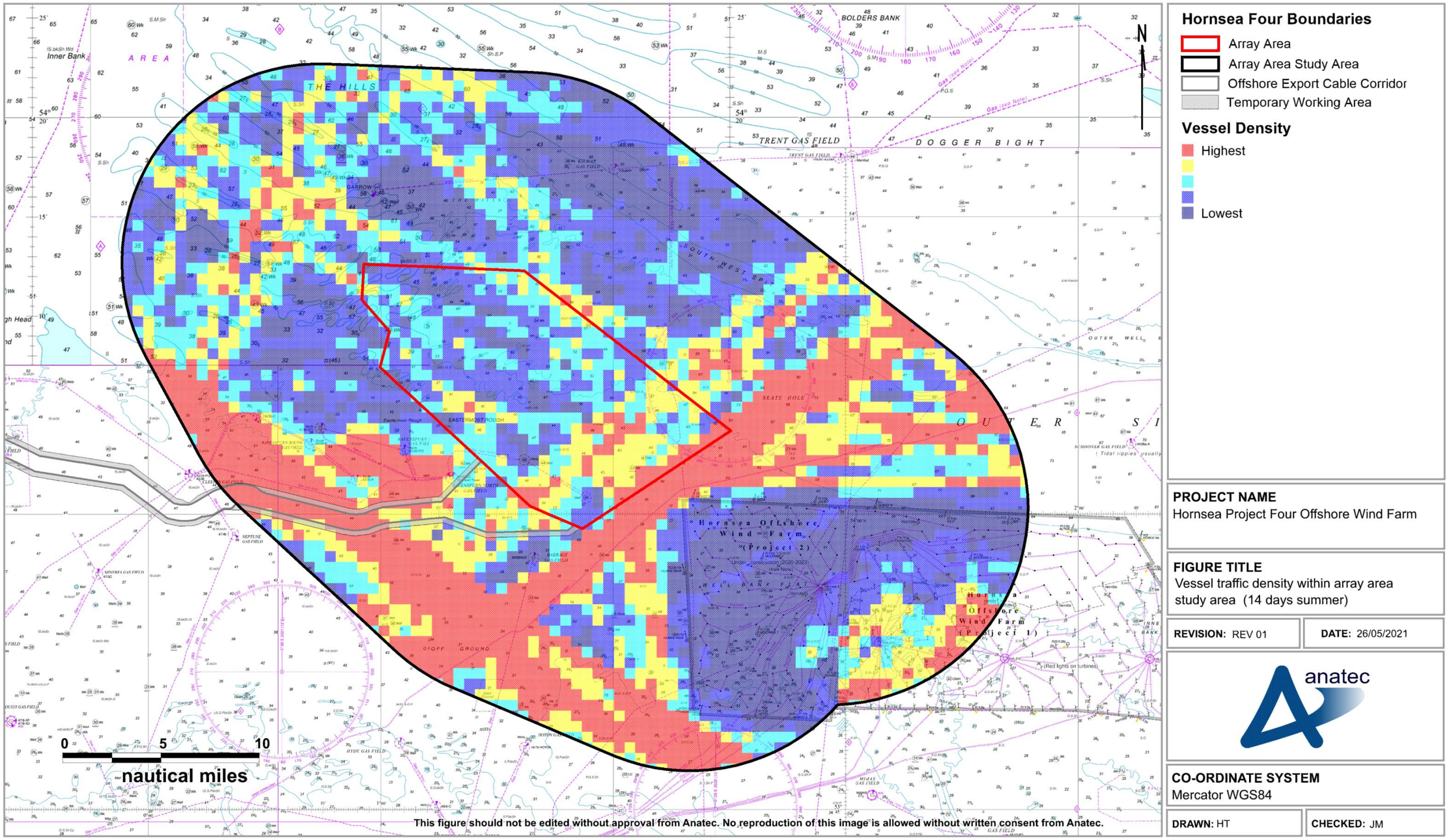

Figure 15.3 Vessel traffic density heat map within Hornsea Four array area shipping and navigation study area excluding temporary traffic (14 days summer 2020)

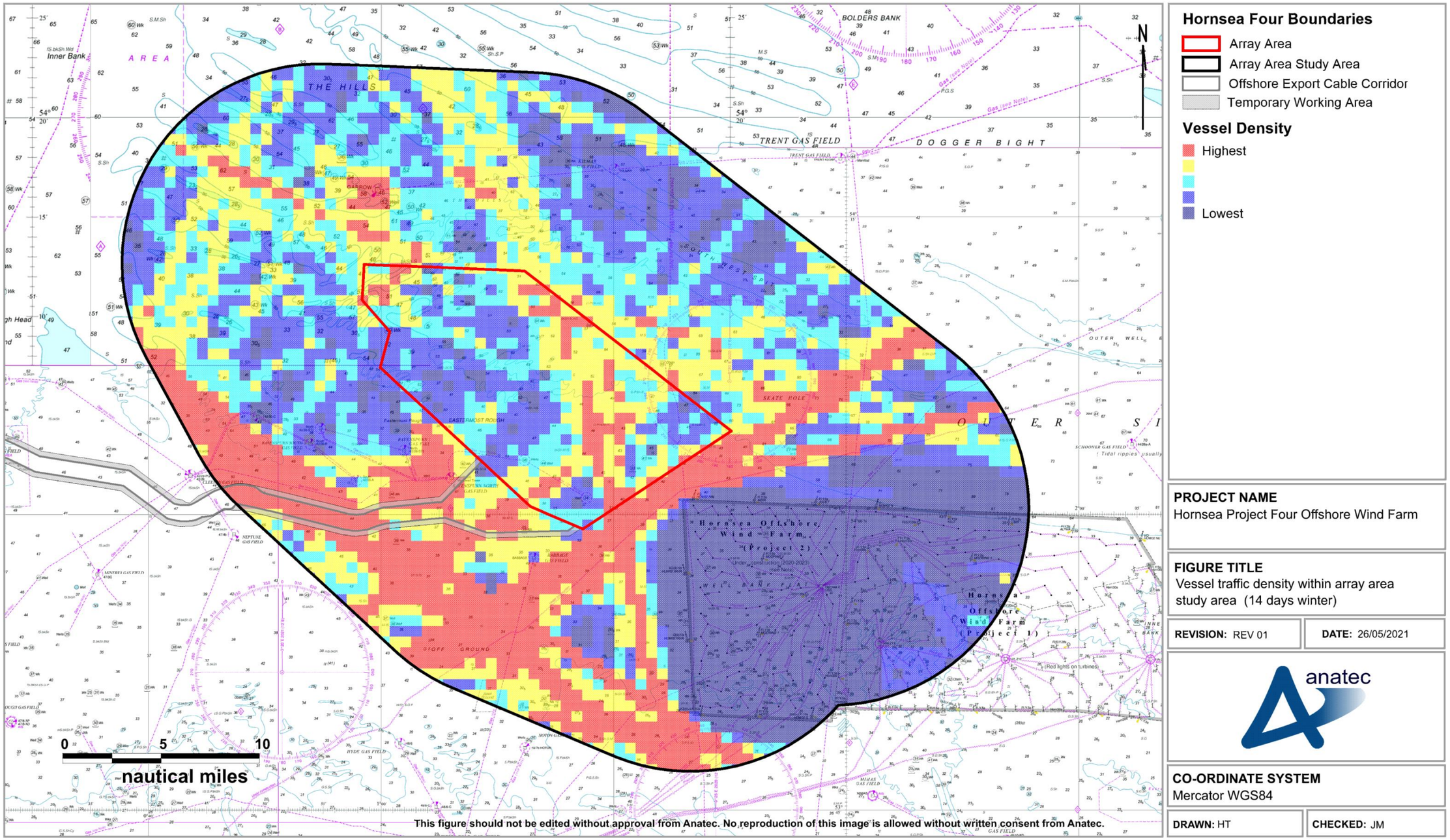

Figure 15.4 Vessel traffic density heat map within Hornsea Four array area shipping and navigation study area excluding temporary traffic (14 days winter 2021)

15.1.1 Vessel Counts

190. For the 14 days analysed in the summer survey period, there were an average of 27 unique vessels per day recorded within the Hornsea Four array area shipping and navigation study area. In terms of vessels intersecting the Hornsea Four array area itself, there was an average of seven unique vessels per day.

191. Figure 15.5 illustrates the daily number of unique vessels recorded within the Hornsea Four array area shipping and navigation study area and the Hornsea Four array area itself during the summer survey period. Throughout the summer survey period approximately 27% of unique vessel tracks recorded within the Hornsea Four array area shipping and navigation study area intersected the Hornsea Four array area itself.

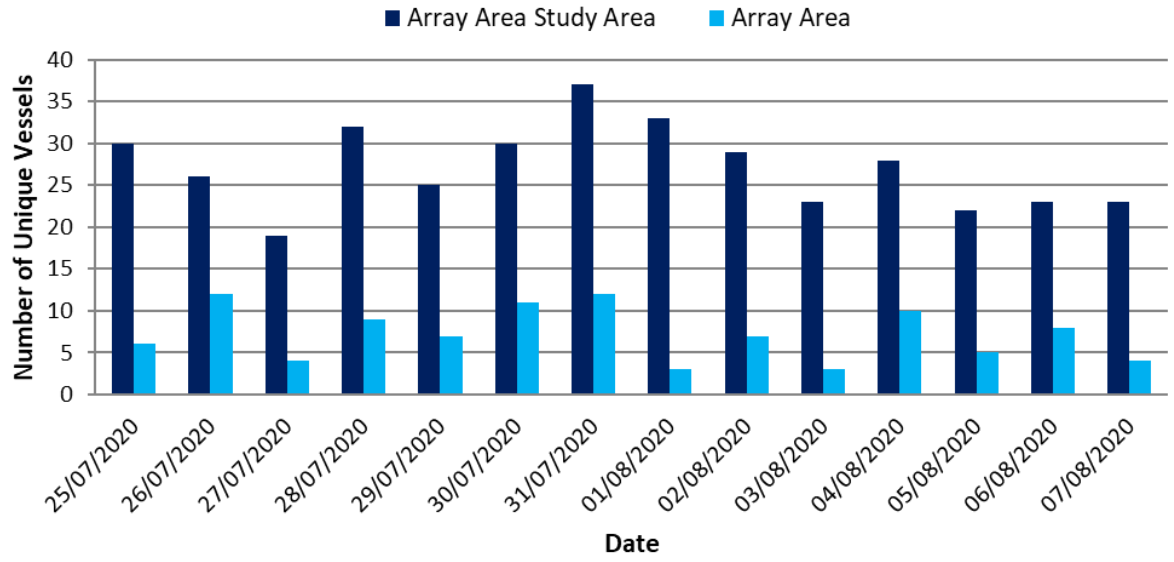

Figure 15.5 Unique vessels per day within Hornsea Four array area and shipping and navigation study area (14 days summer 2020)

192. The busiest day recorded within the Hornsea Four array area shipping and navigation study area throughout the summer survey period was 31st July 2020 when 37 unique vessels were recorded. The busiest days recorded within the Hornsea Four array area itself throughout the summer survey period were 26th and 31st July 2020 when 12 unique vessels were recorded.

193. The quietest day recorded throughout the summer survey period was 27th July 2020 when 19 unique vessels were recorded within the Hornsea Four array area shipping and navigation study area. The quietest full days recorded within the Hornsea Four array area itself throughout the summer survey period were 1st and 3rd August 2020 when three unique vessels were recorded.

194. For the 14 days analysed in the winter survey period, there were an average of 25 unique vessels per day recorded within the Hornsea Four array area shipping

and navigation study area. In terms of vessels intersecting the Hornsea Four array area itself, there was an average of seven unique vessels per day.

195. Figure 15.6 illustrates the daily number of unique vessels recorded within the Hornsea Four array area shipping and navigation study area and the Hornsea Four array area itself during the winter survey period. Throughout the winter survey period approximately 28% of unique vessel tracks recorded within the Hornsea Four array area shipping and navigation study area intersected the Hornsea Four array area.

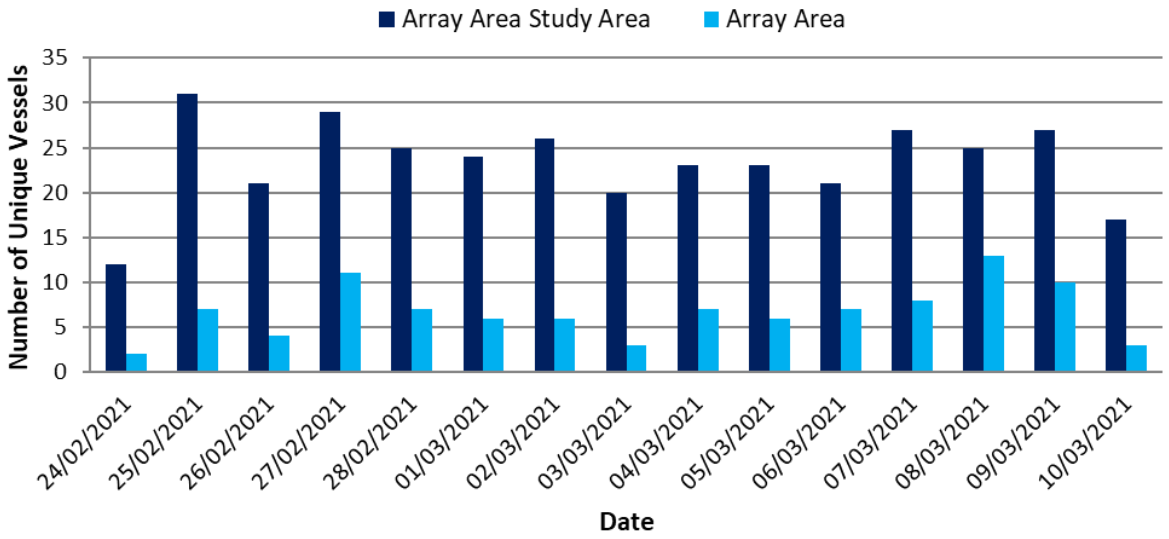

Figure 15.6 Unique vessels per day within Hornsea Four array area and shipping and navigation study area (14 days winter 2019)

196. The busiest day recorded within the Hornsea Four array area shipping and navigation study area throughout the winter survey period was 25th February 2021 when 31 unique vessels were recorded. The busiest day recorded within the Hornsea Four array area itself throughout the winter survey period was 8th March 2021 when 13 unique vessels were recorded.

197. The quietest full day recorded throughout the winter survey period was 3rd March 2021 when 20 unique vessels were recorded within the Hornsea Four array area shipping and navigation study area. The quietest full day recorded for the array area itself was also 3rd March 2021 when three vessels were recorded.

15.1.2 Vessel Types

198. The percentage distribution of the main vessel types recorded passing within the Hornsea Four array area shipping and navigation study area is presented in Figure 15.7.

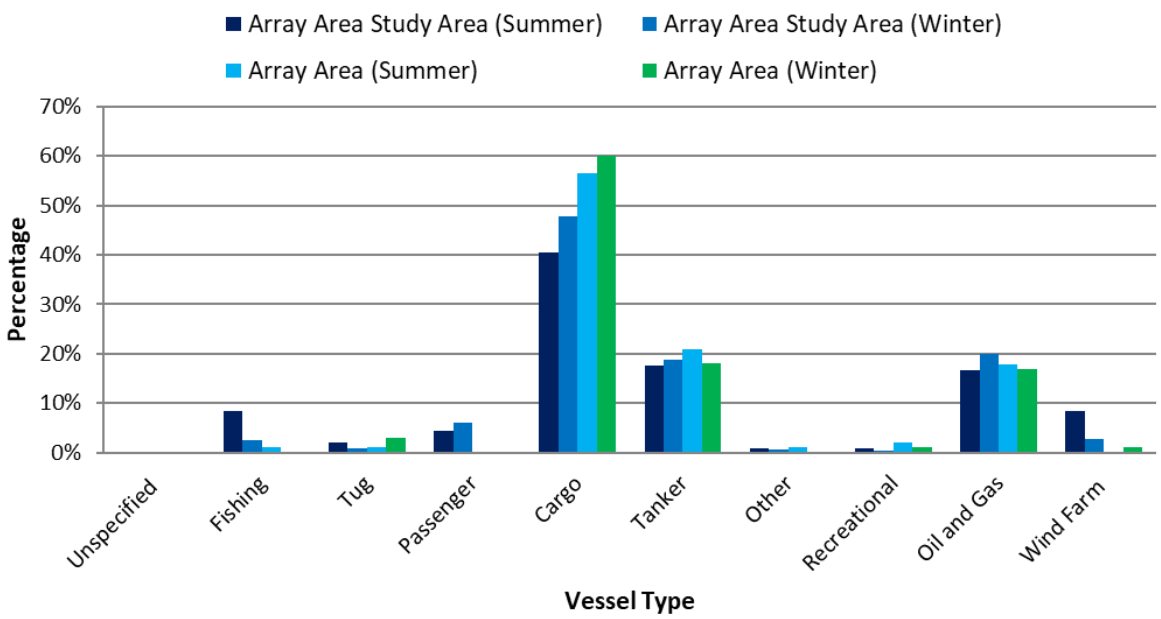

Figure 15.7 Vessel type distribution within Hornsea Four array area and shipping and navigation study area (28 days summer and winter 2020/21)

199. Throughout the summer period, the main vessel types were cargo vessels (56% within the Hornsea Four array area), tankers (21%) and oil and gas vessels (18%). Throughout the winter period, the main vessel types were also cargo vessels (60% within the Hornsea Four array area), tankers (18%) and oil and gas vessels (17%). It should be noted that the cargo vessel category includes commercial ferries which generally broadcast their vessel types on AIS as cargo. Details specific to commercial ferries are presented in Section 15.1.6.

15.1.2.1 Cargo Vessels

200. Figure 15.8 presents a plot of cargo vessels, including commercial ferries, recorded within the Hornsea Four array area shipping and navigation study area throughout both survey periods.

201. Throughout the survey periods an average of 13 unique cargo vessels per day passed within the Hornsea Four array area shipping and navigation study area. Regular cargo vessels operating in proximity to the Hornsea Four array area include Roll On Roll Off (Ro Ro) vessels primarily operated by DFDS Seaways running routes between Immingham (UK) and Esbjerg (Denmark), Immingham and Gothenburg (Sweden) and North Shields (UK) and Ijmuiden (Netherlands).

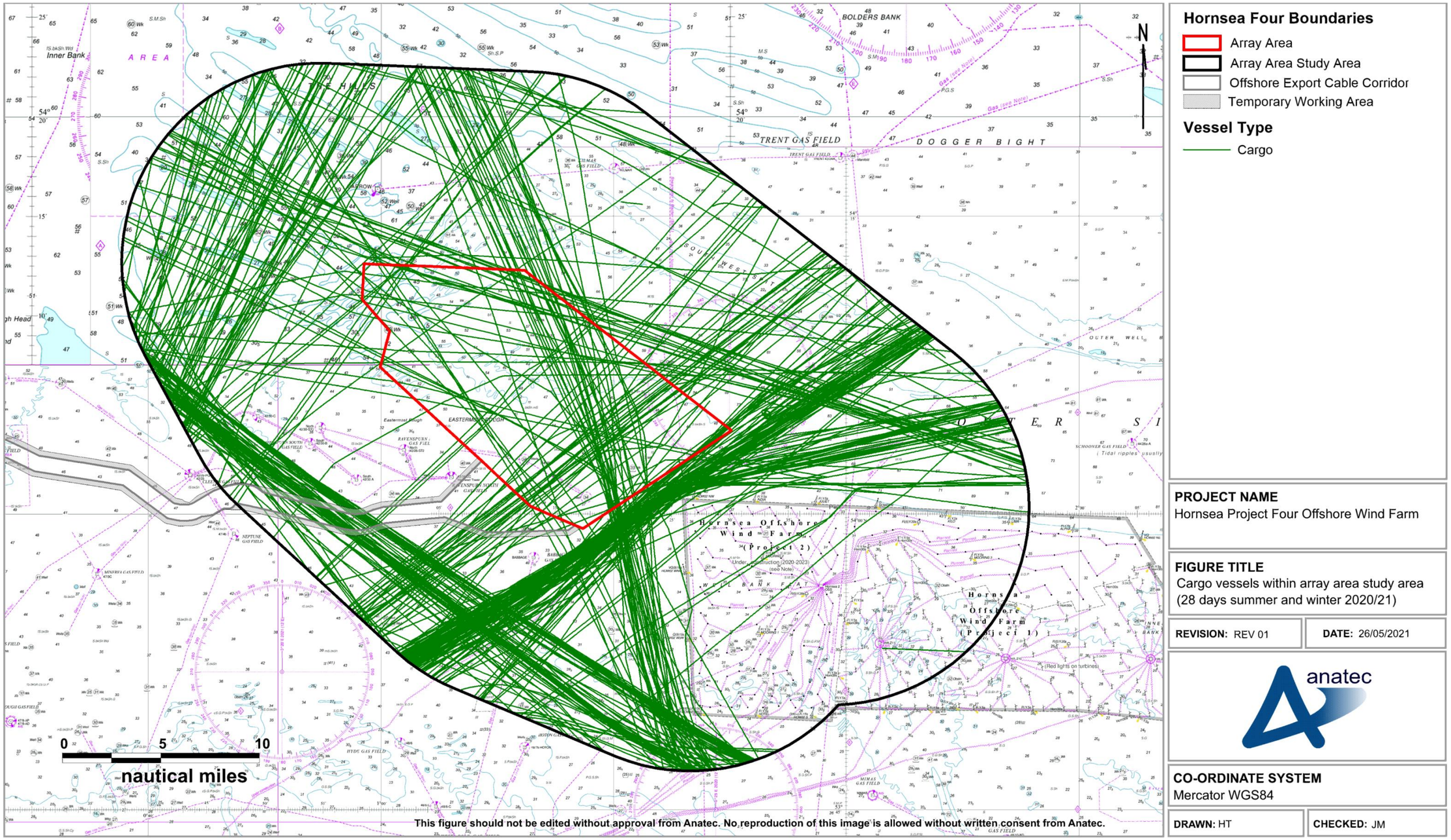

Figure 15.8 Cargo vessels within Hornsea Four array area shipping and navigation study area (28 days summer and winter 2020/21)

15.1.2.2 Tankers

202. Figure 15.9 presents a plot of tankers recorded within the Hornsea Four array area shipping and navigation study area throughout both survey periods.

203. Throughout the survey periods, an average of five unique tankers per day passed within the Hornsea Four array area shipping and navigation study area. All of the tankers recorded throughout the survey period were on passage to oil and gas terminals throughout the UK and mainland Europe including Rotterdam (Netherlands) and Antwerp (Belgium).

15.1.2.3 Oil and Gas Vessels

204. Figure 15.10 presents a plot of oil and gas vessels recorded within the Hornsea Four array area shipping and navigation study area throughout both survey periods.

205. Throughout the survey periods, an average of five unique oil and gas vessels per day passed within the Hornsea Four array area shipping and navigation study area. The majority of these vessels were on passage to/from oil and gas installations in the region. Oil and gas vessels which were not transient included the *Island Condor* acting as a walk to work vessel for the nearby Ravenspurn gas field and the *Putford Defender* and *Putford Saviour*, both acting as Emergency Response and Rescue Vessels (ERRV) for Ravenspurn. Vessel activity was also present at the Babbage, Kilmar and Garrow gas fields.

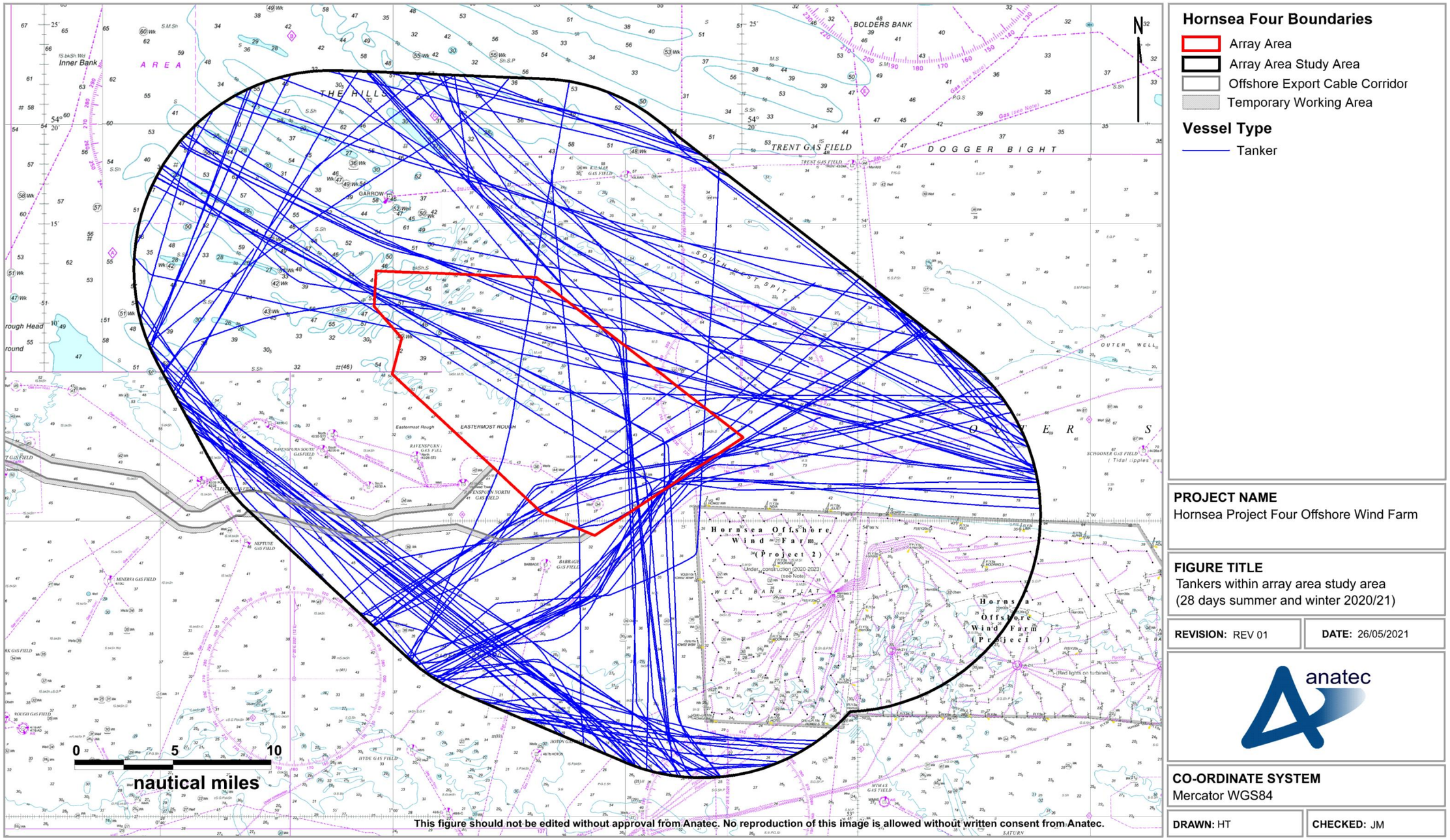

Figure 15.9 Tankers within Hornsea Four array area shipping and navigation study area (28 days summer and winter 2020/21)

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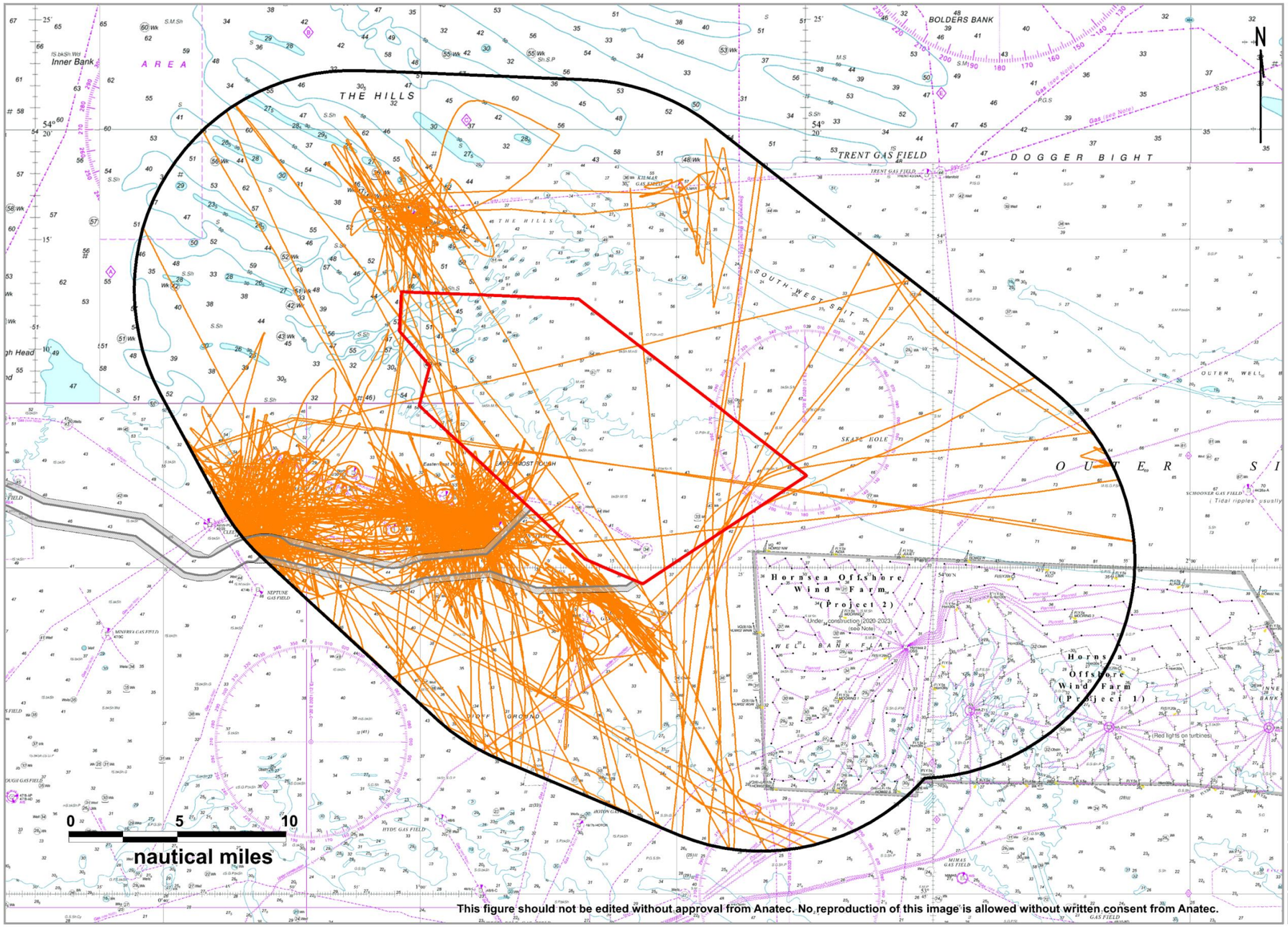

Hornsea Four Boundaries

- Array Area
- Array Area Study Area
- Offshore Export Cable Corridor
- Temporary Working Area

Vessel Type

- Oil and Gas

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Oil & Gas vessels within array area study area (28 days summer and winter 2020/21)

REVISION: REV 01 | **DATE:** 26/05/2021

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Figure 15.10 Oil and gas support vessels within Hornsea Four array area shipping and navigation study area (28 days summer and winter 2020/21)

15.1.3 Vessel Sizes

15.1.3.1 Vessel Length

206. Vessel LOA was available for approximately 99% of vessels recorded throughout the survey periods and ranged from 7 m for a SAR vessel to 336 m for a crude oil tanker. Figure 15.11 illustrates the distribution of vessel lengths recorded throughout each survey period.

207. Excluding the small proportion of vessels for which a length was not available the average length of vessels within the Hornsea Four array area shipping and navigation study area throughout the summer and winter survey periods were 115 m and 131 m, respectively. The proportion of smaller vessels (<50 m) indicated some seasonal variation for fishing vessels, with fishing vessels contributing a greater portion of the total vessel traffic in summer (15% within the Hornsea Four array area shipping and navigation study area).

208. Figure 15.12 presents a plot of all vessel tracks (excluding temporary traffic) recorded within the Hornsea Four array area shipping and navigation study area throughout the survey periods, colour-coded by vessel length.

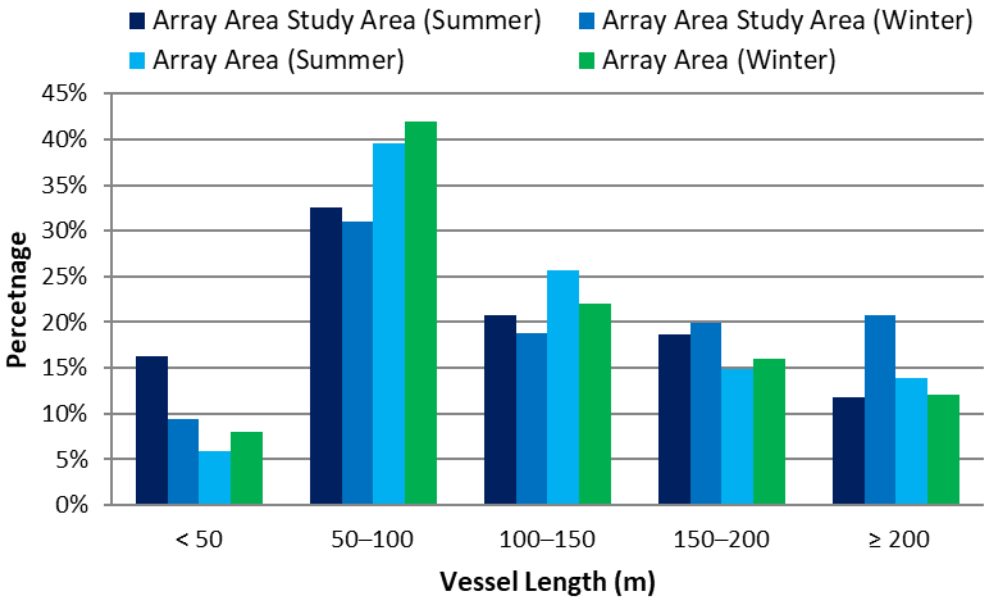


Figure 15.11 Vessel length distribution within Hornsea Four array area and shipping and navigation study area (28 days summer and winter 2020/21)

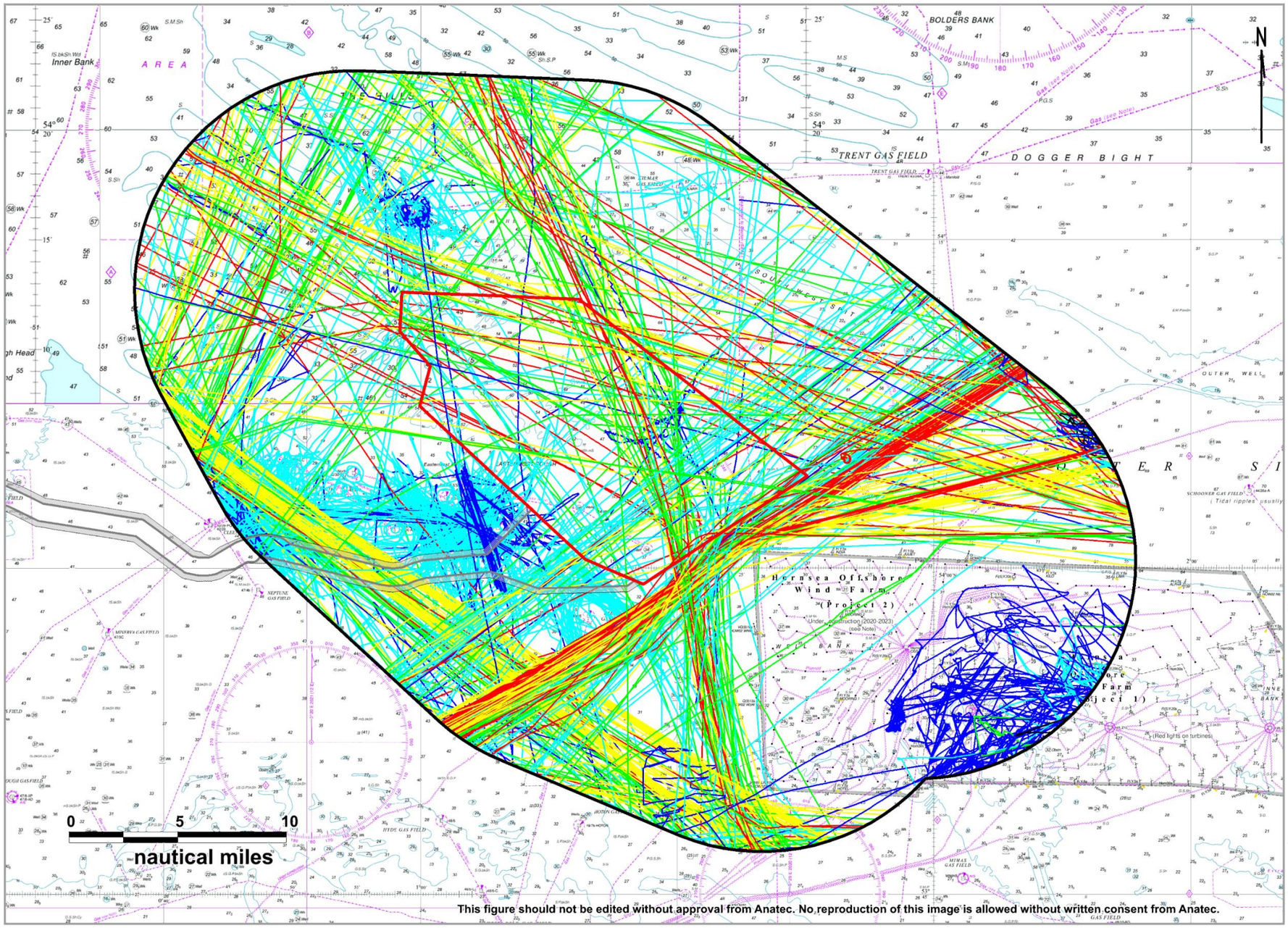


Figure 15.12 Vessel traffic survey data within Hornsea Four array area shipping and navigation study area colour-coded by vessel length (28 days summer and winter 2020/21)

15.1.3.2 Vessel Draught

209. Vessel draught was available for approximately 94% of vessel tracks recorded on AIS throughout the survey periods and ranged from 1.7 m for a wind farm vessel to 20.5 m for a crude oil tanker. Figure 15.13 illustrates the distribution of vessel draughts recorded throughout each survey period.

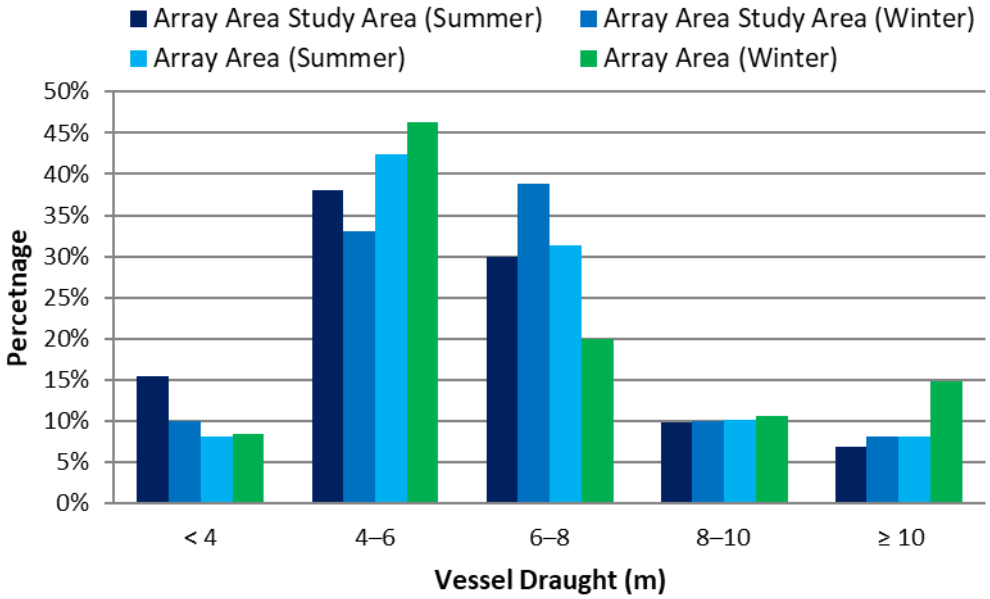


Figure 15.13 Vessel draught distribution within Hornsea Four array area shipping and navigation study area (28 days summer and winter 2020/21)

210. Excluding those vessels for which a draught was not available (mainly non-AIS vessels) the average draught of vessels within the Hornsea Four array area shipping and navigation study area throughout the summer and winter survey periods were 6.0 m and 6.4 m, respectively. There was limited seasonal variation with slightly more vessels with draughts less than 4 m observed in the summer survey period within the Hornsea Four array area shipping and navigation study area.

211. Figure 15.14 presents a plot of all vessel tracks (excluding temporary traffic) recorded within the Hornsea Four array area shipping and navigation study area throughout the survey periods, colour-coded by vessel draught.

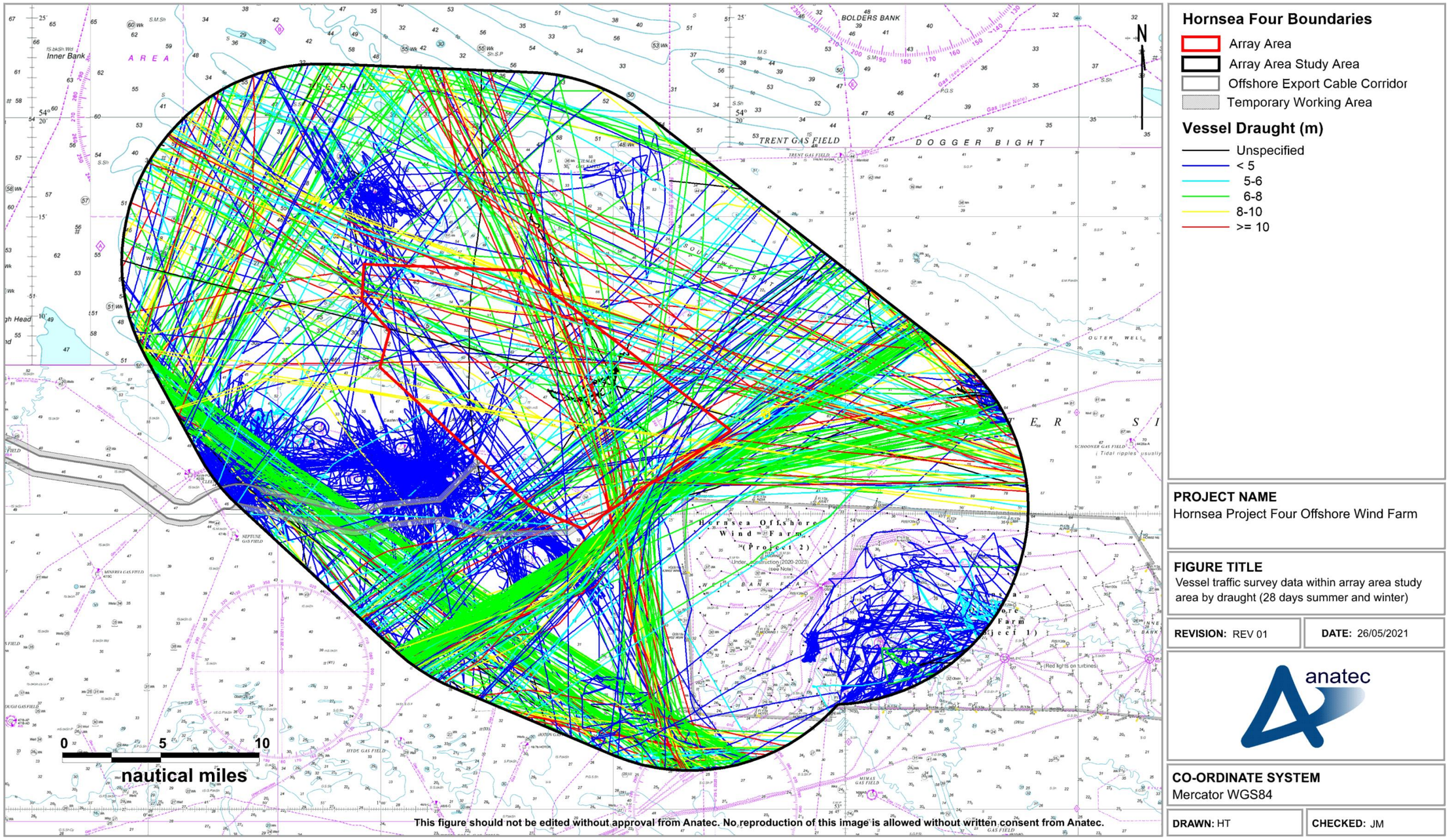


Figure 15.14 Vessel traffic survey data within Hornsea Four array area shipping and navigation study area colour-coded by vessel draught (28 days summer and winter 2020/21)

15.1.4 Anchored Vessels

212. Anchored vessels can be identified based upon the AIS navigational status which is programmed on the AIS transmitter on board a vessel. However, information is manually entered into the AIS equipment, and therefore it is common for vessels not to update their navigational status if only at anchor for a short period of time.

213. For this reason, those vessels which travelled at a speed of less than 1 kt for more than 30 minutes had their corresponding vessel tracks individually checked for patterns characteristic of anchoring activity. After applying these criteria, only one vessel was deemed to be at anchor. This was a bulk carrier located 1.7 nm east of the Hornsea Four array area and broadcasting an AIS navigational status of "*at anchor*". The vessel was anchored over a period of five days during July 2020 with its broadcast destination indicating that it was awaiting orders.

15.1.5 Vessel Routeing

15.1.5.1 Definition of a Main Route

214. Main routes have been identified using the principles set out in MGN 654 (MCA, 2021). Vessel traffic data are assessed and vessels transiting at similar headings and locations are identified as a main route. To help identify main routes, vessel traffic data can also be interrogated to show vessels (by name and/or operator) that frequently transit those routes identifying 'regular runner/operator routes'. Consultation feedback has also informed the main routes. The route width is then calculated using the 90th percentile rule from the median line of the potential shipping route as shown in Figure 15.15.

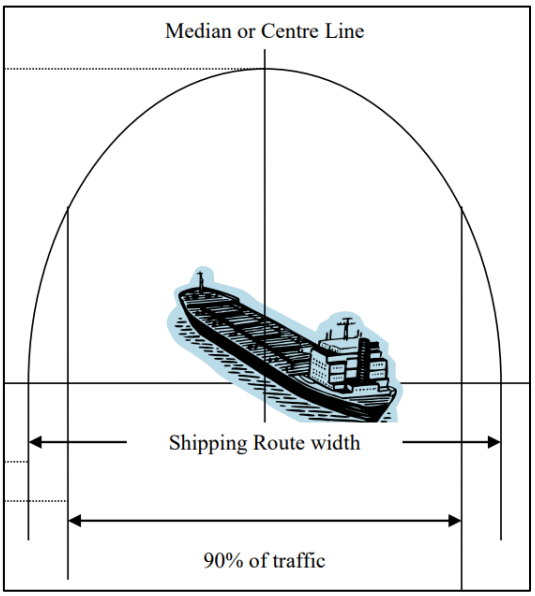


Figure 15.15 Illustration of main route calculation (MCA, 2021)

15.1.5.2 Pre Wind Farm Main Routes

215. Main route identification was undertaken for the Hornsea Four array area shipping and navigation study area. Fourteen main commercial routes were identified as transiting through the Hornsea Four array area shipping and navigation study area. Figure 15.16 presents a plot of the main routes and corresponding 90th percentiles within the Hornsea Four array area shipping and navigation study area.

216. A brief description of the traffic on each of the main routes identified is provided in Table 15.1, including the main ports, noting that routes may include alternative ports.

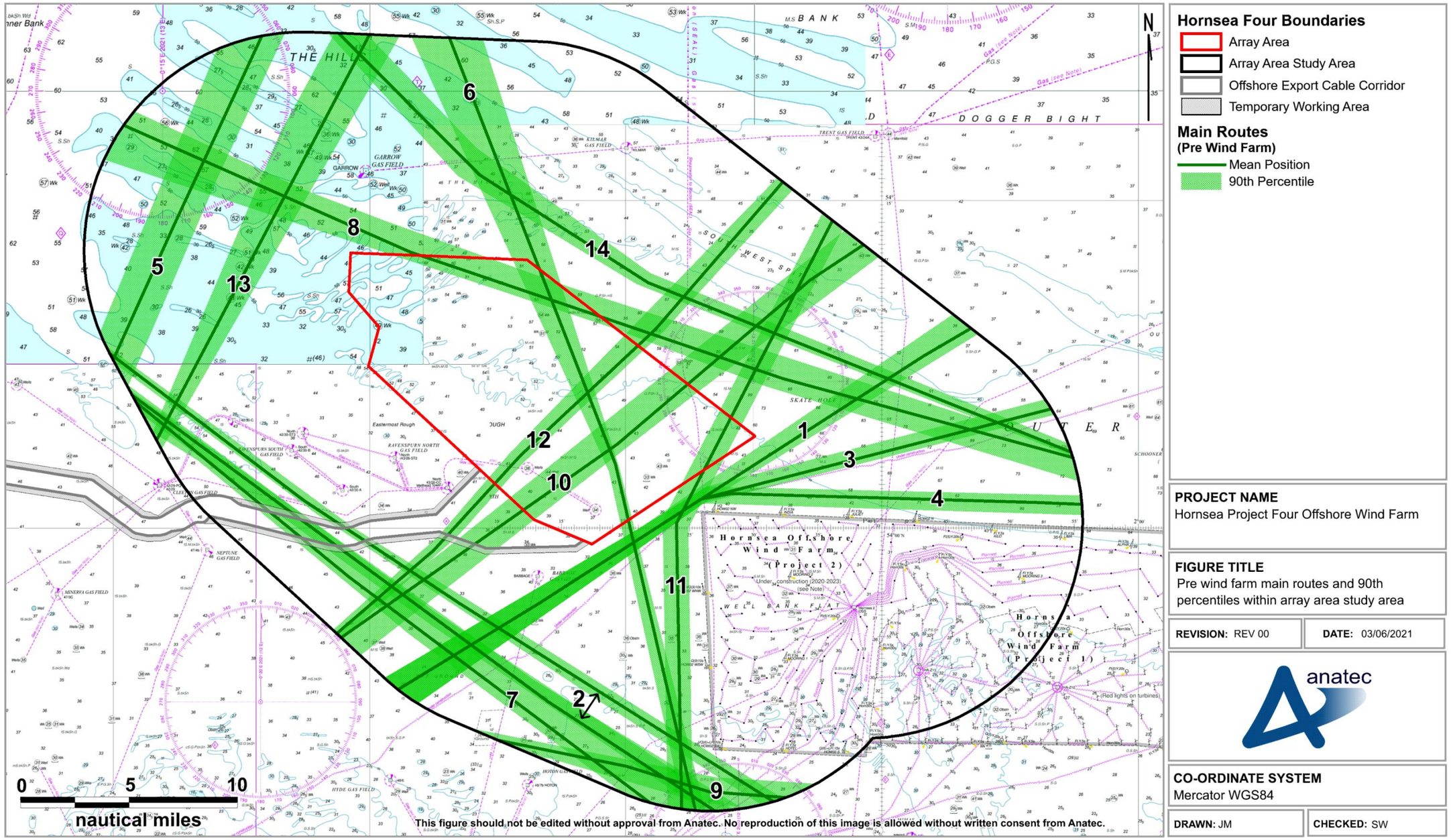


Figure 15.16 Pre wind farm main routes and 90th percentiles within Hornsea Four array area shipping and navigation study area

Table 15.1 Description of main routes identified within Hornsea Four array area shipping and navigation study area

Route Number	Average Transits per Day	Description (main ports, also may include alternative ports)
1	2	**Immingham–Gothenburg**. Route 1 is generally transited by cargo vessels (81%) and tankers (11%) and is a DFDS Seaways cargo ferry route between Immingham and Gothenburg. The main vessels operating on this route are the *Begonia Seaways*, *Ficaria Seaways* and *Freesia Seaways*.
2	2	**Newcastle–Amsterdam (Netherlands)**. Route 2 is transited by passenger vessels (100%) and is a DFDS Seaways passenger ferry route between North Shields (UK) and Ijmuiden (Netherlands). The main vessels operating on this route are the *King Seaways* and *Princess Seaways*.
3	1 to 2	**Immingham–Esbjerg**. Route 3 is generally transited by cargo vessels (83%) and tankers (12%) and is a DFDS Seaways cargo ferry route between Immingham and Esbjerg. The main vessels currently operating on this route are the *Magnolia Seaways* and *Petunia Seaways*.
4	1 to 2	**Immingham–Hamburg (Germany)**. Route 4 is generally transited by cargo vessels (50%) and tankers (35%).
5	1	**Immingham–north Norway ports**. Route 5 is transited by cargo vessels (83%) and tankers (17%) and is a Sea-Cargo cargo ferry route between Immingham and Tananger (Norway).
6	1	**Grangemouth (UK)–Rotterdam**. Route 6 is generally transited by cargo vessels (84%).
7	1	**Tees–Rotterdam**. Route 7 is generally transited by tankers (46%), cargo vessels (29%) and oil and gas vessels (11%).
8	1	**Tees–Rotterdam**. Route 8 is generally transited by cargo vessels (62%) and tankers (38%).
9	0 to 1	**Immingham–Antwerp.** Route 9 is generally transited by cargo vessels (53%) and tankers (40%).
10	0 to 1	**Immingham–Baltic ports**. Route 10 is generally transited by cargo vessels (85%) and tankers (12%).
11	0 to 1	**Great Yarmouth (UK)–Trent gas field**. Route 11 is transited by oil and gas vessels (100%).
12	0 to 1	**Immingham–Baltic ports**. Route 12 is transited by cargo vessels (100%).
13	0 to 1	**Immingham–northern Norway ports**. Route 13 is transited by cargo vessels (100%) and is a Finnlines cargo ferry route between Hull (UK) and Helsinki (Finland).
14	0 to 1	**Tees–Amsterdam**. Route 14 is generally transited by tankers (80%).

15.1.6 Commercial Ferry Activity

217. Throughout the survey periods 13 unique commercial ferries were identified, with 11 undertaking regular routes; each of these is among the main routes identified in Section 15.1.5. Figure 15.17 presents a plot of commercial ferries recorded within the Hornsea Four array area shipping and navigation study area throughout the survey periods, colour-coded by route.

218. The most frequently transited commercial ferry route was a DFDS Seaways operated route between North Shields and Ijmuiden, with the *Princess Seaways* and *King Seaways* making two transits per day between them within the Hornsea Four array area shipping and navigation study area throughout the survey periods. Two other DFDS Seaways commercial ferry routes were also relatively prominent, with these operating between Immingham and Gothenburg and Immingham and Esbjerg.

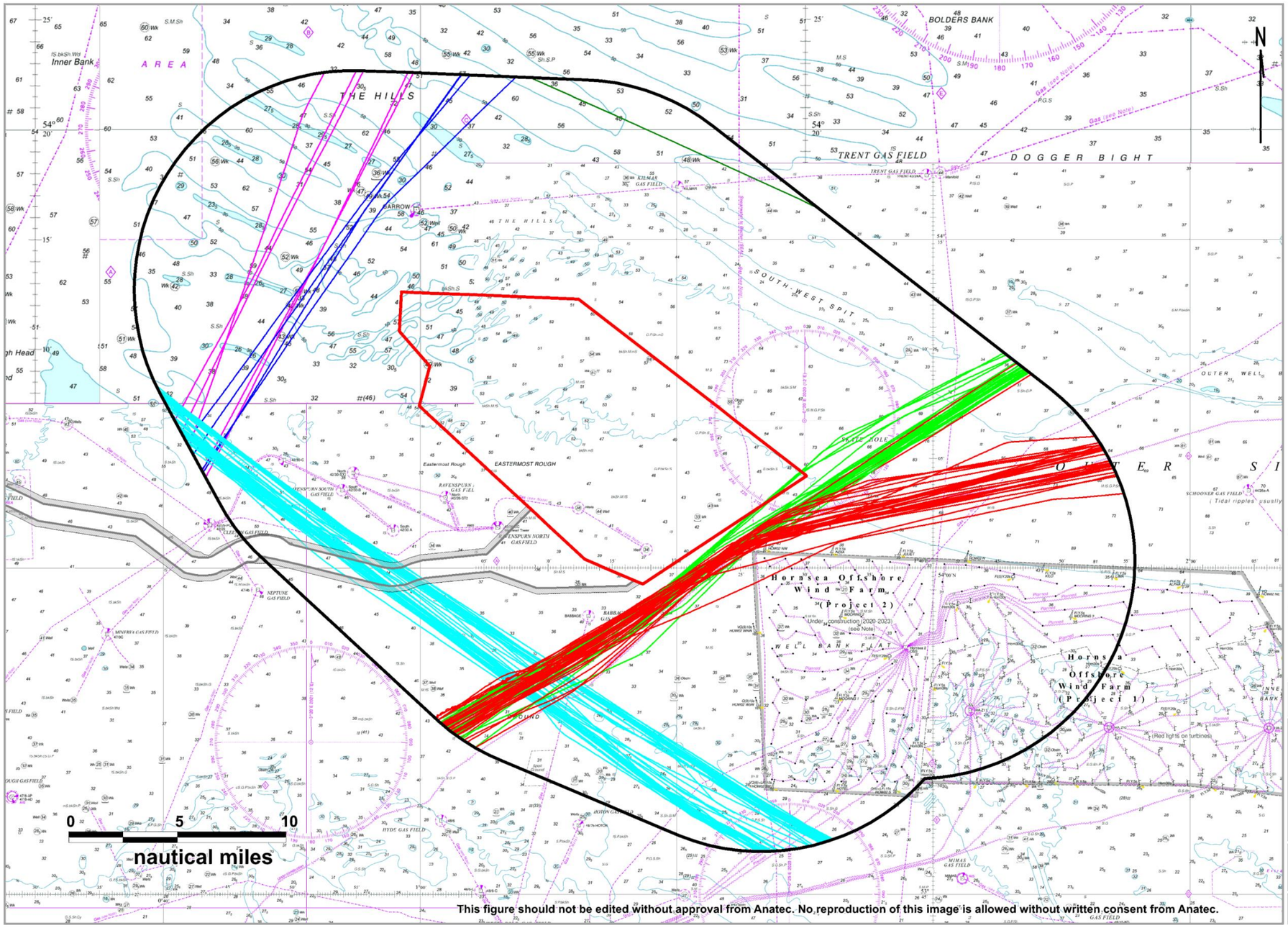
219. Alternative routeing during adverse weather conditions is considered in Section 16.

15.1.7 Recreational Vessel Activity

220. For the purposes of the NRA, recreational activity includes sailing and motor craft of between 2.4 and 24 m LOA.

221. Figure 15.18 presents a plot of recreational vessels recorded within the Hornsea Four array area shipping and navigation study area throughout both survey periods.

222. Only four recreational vessel tracks were recorded passing within the Hornsea Four array area shipping and navigation study area, corresponding to an average of one unique recreational vessel every seven days. It is noted that all recreational craft recorded throughout the 28 days (including the winter survey period when Radar data and visual observations were also being collected) were recorded on AIS, with no recreational craft recorded on Radar.



Hornsea Four Boundaries

- Array Area
- Array Area Study Area
- Offshore Export Cable Corridor
- Temporary Working Area

Commercial Ferry Route

- Immingham - Esbjerg
- Hull - Helsinki
- Immingham - Gothenburg
- Immingham - Tananger
- Tyne - Emden
- North Shields - Ijmuiden

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Commercial ferries within array area study areaby route (28 days summer & winter)

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Figure 15.17 Commercial ferries within Hornsea Four array area shipping and navigation study area by route (28 days summer and winter 2020/21)

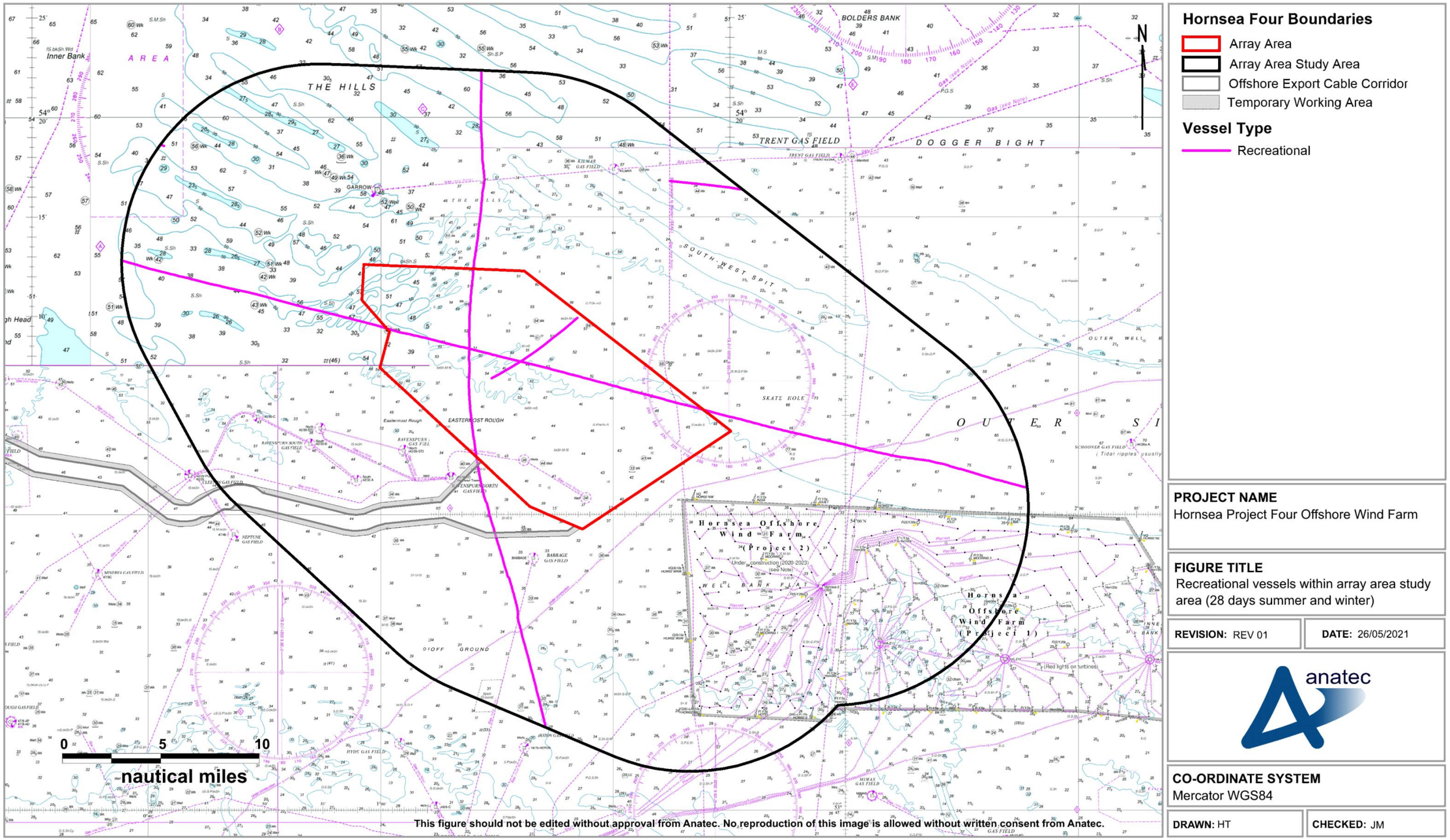


Figure 15.18 Recreational vessels within Hornsea Four array area shipping and navigation study area (28 days summer and winter 2020/21)

15.1.8 Commercial Fishing Vessels

15.1.8.1 Vessel Traffic Survey Data

223. Figure 15.19 presents a plot of fishing vessels recorded within the Hornsea Four array area shipping and navigation study area throughout both survey periods.

224. An average of one to two unique fishing vessels per day passed within the Hornsea Four array area shipping and navigation study area. Two fishing vessels were recorded on Radar during the winter survey period; both of these vessels were also recorded within the array area itself. Behavioural assessment indicated that these Radar-recorded vessels were both actively fishing and in transit. It is noted that AIS is only mandatory for fishing vessels greater than 15 m LOA and fishing vessels smaller than this are less likely to be far offshore i.e. in the proximity of the Hornsea Four array area.

225. Fishing vessel movements were mainly characteristic of fishing vessels engaged in fishing activity, though a small number were also observed on transit through the Hornsea Four array area shipping and navigation study area.

226. Flag State (nationality) information was available for all fishing vessels recorded on AIS within the Hornsea Four array area shipping and navigation study area. Of the nationalities identified, the most common recorded on AIS were UK (56%), Netherlands (23%), Belgium (15%) and Denmark (2%).

227. Primary fishing method information was researched for all fishing vessels recorded on AIS within the Hornsea Four array area shipping and navigation study area. Of the fishing vessel methods identified, the most common were potter/whelkers (54%) and twin trawlers (20%).

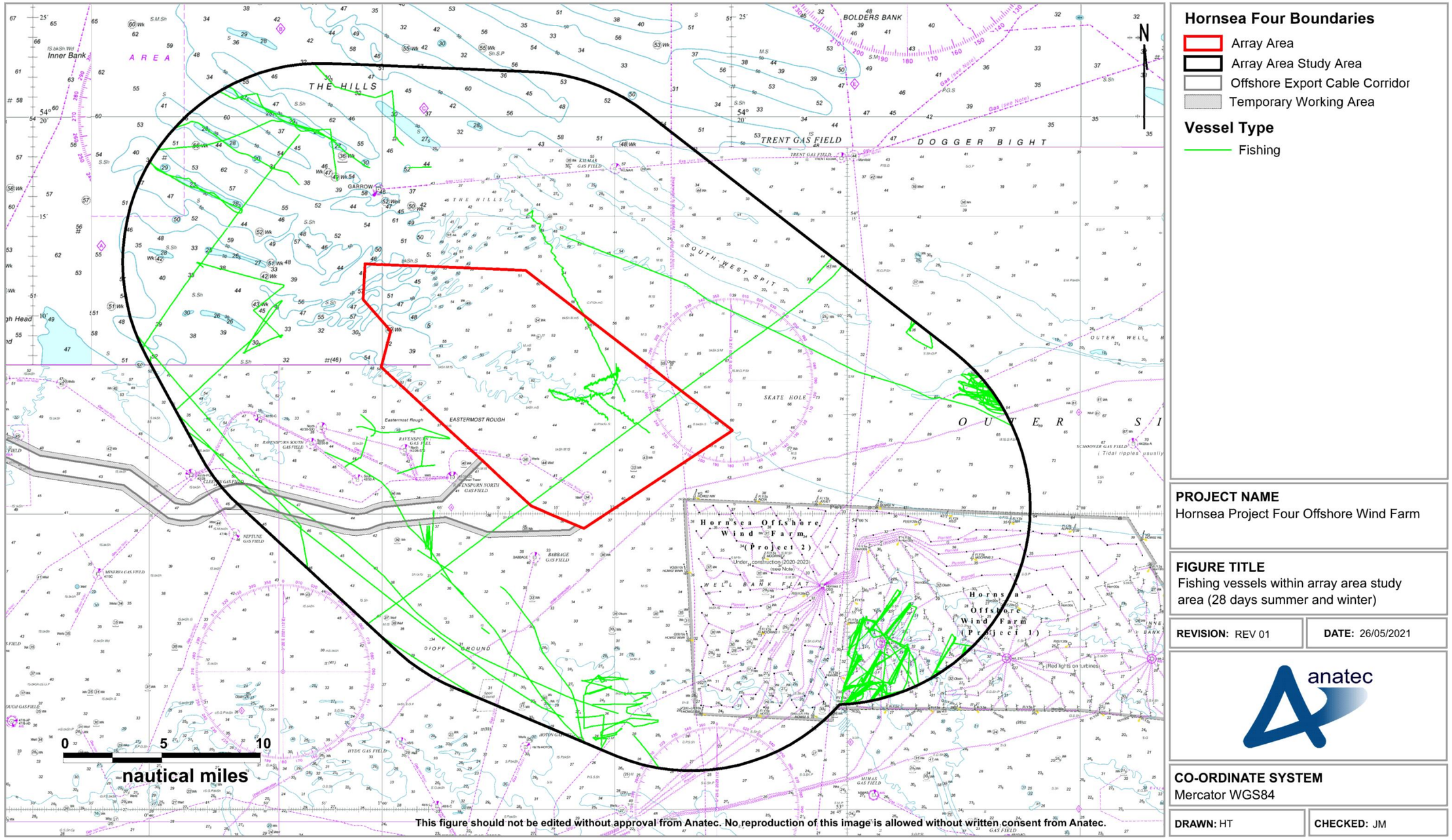


Figure 15.19 Commercial fishing vessels within Hornsea Four array area shipping and navigation study area (28 days summer and winter 2020/21)

15.1.8.2 Comparison with Volume A2, Chapter 6: Commercial Fisheries

228. Commercial fishing is assessed in detail in **Volume A2, Chapter 6: Commercial Fisheries**. The assessment of fishing vessel activity undertaken for this chapter found that a variety of nationalities were present in proximity to the Hornsea Four array area, including the UK and Netherlands, France and Belgium. UK flagged activity included potting, beam trawling and demersal otter trawling, a proportion of which featured vessels under 15 m length, and therefore may not have been broadcasting on AIS.

229. Herring, sandeel and brown crab were the leading species landed by vessels in proximity to the Hornsea Four array area, with the latter almost entirely from English flagged vessels.

230. This largely correlates with the AIS data; French flagged fishing vessels are likely underrepresented in the AIS data given that they were predominantly potters which are typically smaller fishing vessels which may not have to carry AIS mandatorily.

15.2 Hornsea Four Offshore Export Cable Corridor

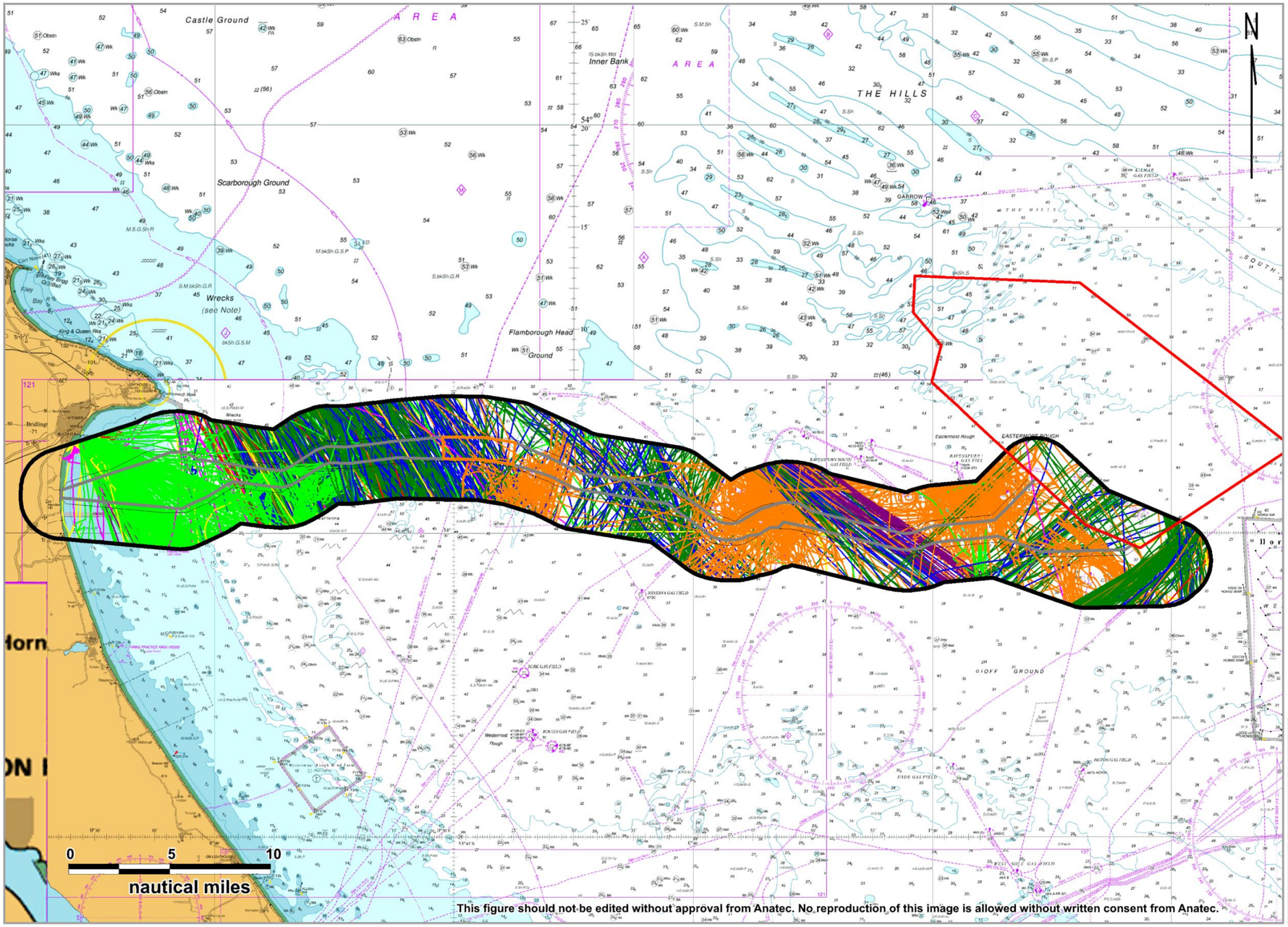
231. A number of tracks recorded during the Hornsea Four offshore ECC survey periods were classified as temporary (non-routine), such as the tracks of the survey vessel for the Hornsea Four array area and HVAC booster station search area. These have therefore been excluded from the analysis. Oil and gas vessels operating at permanent installations were retained in the analysis, although key vessels associated with temporary drilling operations in the Tolmount gas field have been excluded.

232. A plot of the vessel tracks recorded during a 28-day survey period in July and August 2020 (summer AIS) and February and March 2021 (winter dedicated traffic survey), colour-coded by vessel type and excluding temporary traffic, is presented in Figure 15.20.

15.2.1 Vessel Count

233. For the 14 days analysed in the summer survey period, there were an average of 55 unique vessels per day recorded within the Hornsea Four offshore ECC shipping and navigation study area. In terms of vessels intersecting the Hornsea Four offshore ECC itself, there was an average of 45 unique vessels per day.

234. Figure 15.21 illustrates the daily number of unique vessels recorded within the Hornsea Four offshore ECC shipping and navigation study area and the Hornsea Four offshore ECC itself during the summer survey period. Throughout the summer survey period approximately 82% of vessel tracks recorded within the Hornsea Four offshore ECC shipping and navigation study area intersected the Hornsea Four offshore ECC itself.



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area
- Temporary Working Area

Vessel Type
- Fishing
- Miltary
- Dredger/Subsea
- Tug
- Passenger
- Cargo
- Tanker
- Other
- Recreational
- Oil and Gas
- Wind Farm

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Vessel traffic survey data within cable corridor study area (28 days, summer and winter)

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Figure 15.20 Vessel traffic survey data within Hornsea Four offshore ECC shipping and navigation study area colour-coded by vessel type (28 days summer and winter 2020/21)

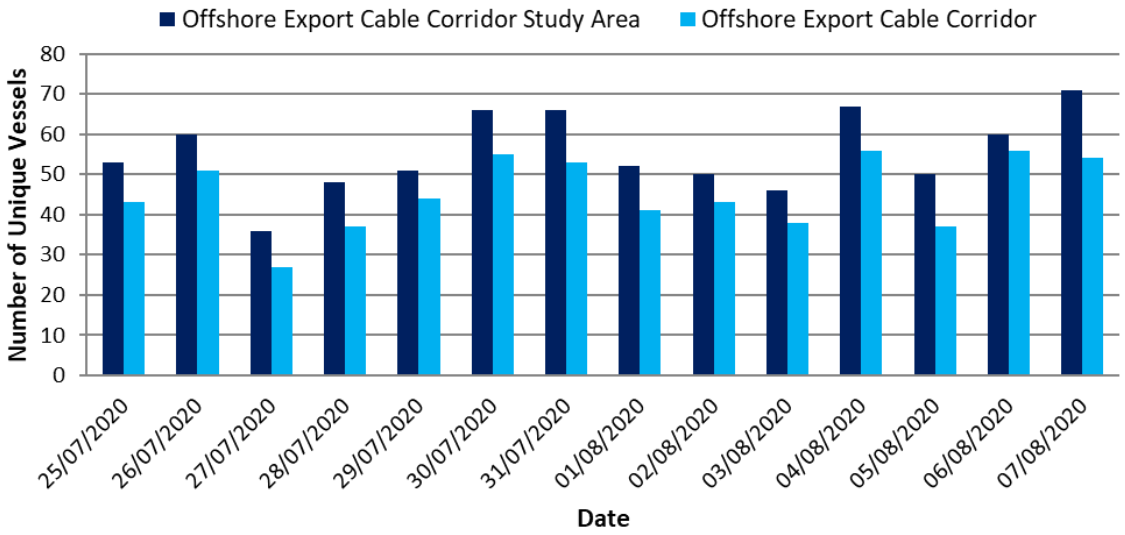


Figure 15.21 Unique vessels per day within Hornsea Four offshore ECC and shipping and navigation study area (14 days summer 2020)

235. The busiest day recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout the summer survey period was 7th August 2020 when 71 unique vessels were recorded. The busiest days recorded within the Hornsea Four offshore ECC itself throughout the summer survey period were 4th and 6th August 2020 with 56 unique vessels recorded.

236. The quietest day recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout the summer survey period was 27th July 2020 when 36 unique vessels were recorded. This was also the quietest day recorded within the Hornsea Four offshore ECC itself throughout the summer survey period with 27 unique vessels recorded.

237. For the 14 days analysed in the winter survey period, there were an average of 55 unique vessels per day recorded within the Hornsea Four offshore ECC shipping and navigation study area. In terms of vessels intersecting the Hornsea Four offshore ECC itself, there was an average of 46 unique vessels per day.

238. Figure 15.22 illustrates the daily number of unique vessels recorded within the Hornsea Four offshore ECC shipping and navigation study area and the Hornsea Four offshore ECC itself during the winter survey period. Throughout the winter survey period approximately 80% of vessel tracks recorded within the Hornsea Four offshore ECC shipping and navigation study area intersected the Hornsea Four offshore ECC.

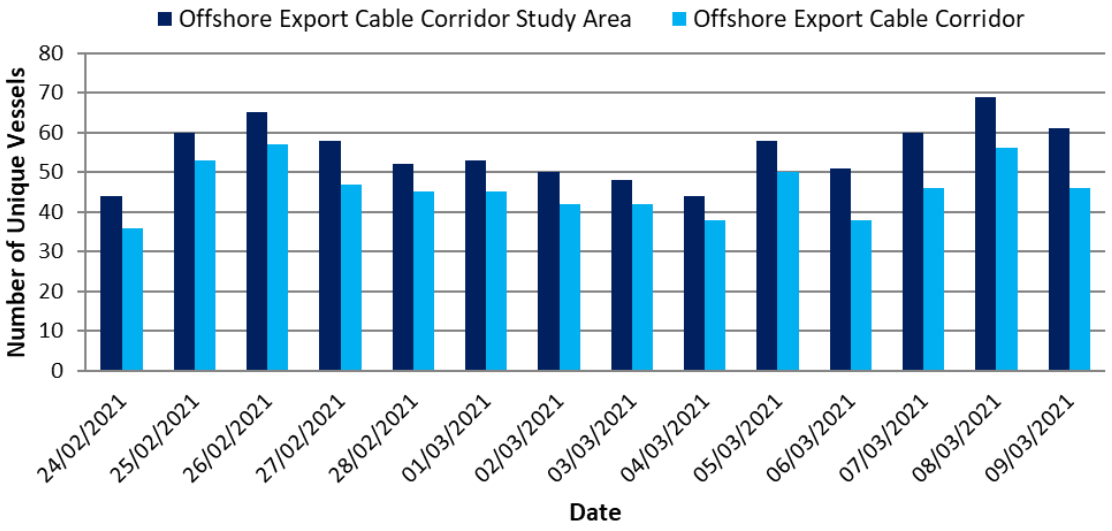


Figure 15.22 Unique vessels per day within Hornsea Four offshore ECC and shipping and navigation study area (14 days winter 2021)

239. The busiest day recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout the winter survey period was 8th March 2021 when 69 unique vessels were recorded. The busiest day recorded within the Hornsea Four offshore ECC itself throughout the winter survey period was 26th February 2021 with 57 unique vessels recorded.

240. The quietest day recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout the winter survey period were 24th February 2021 and 4th March 2021 when 44 unique vessels were recorded on both days. The quietest day recorded within the Hornsea Four offshore ECC itself throughout the winter survey period was 24th February 2021 with 35 unique vessels recorded.

15.2.2 Vessel Types

241. The distribution of the main vessel types recorded passing within the Hornsea Four offshore ECC shipping and navigation study area is presented in Figure 15.23.

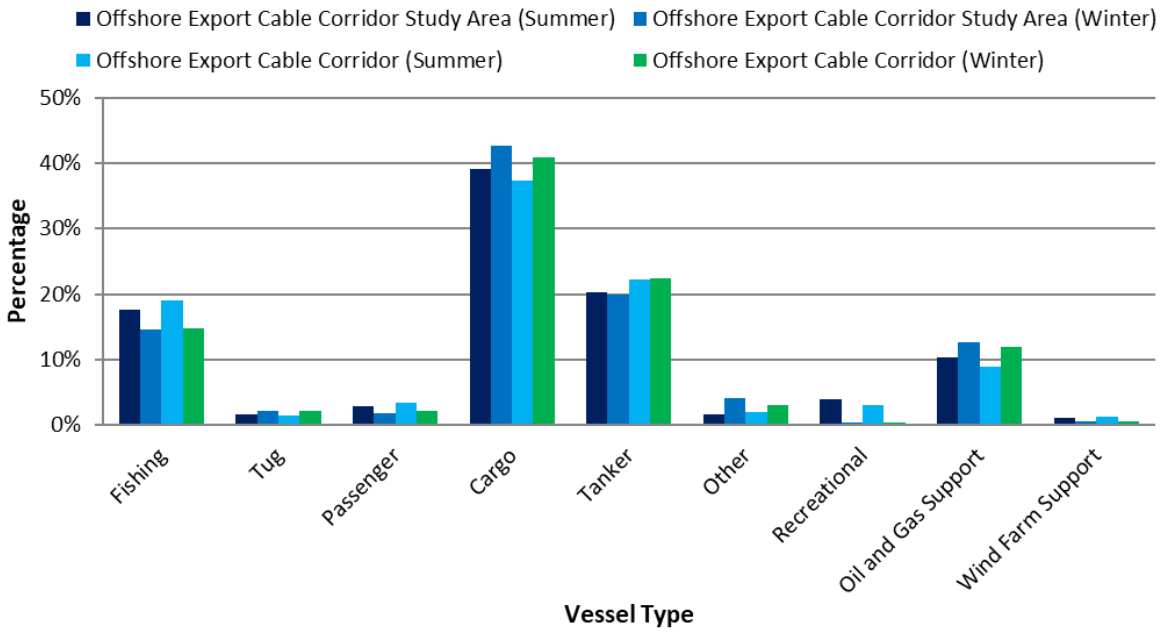


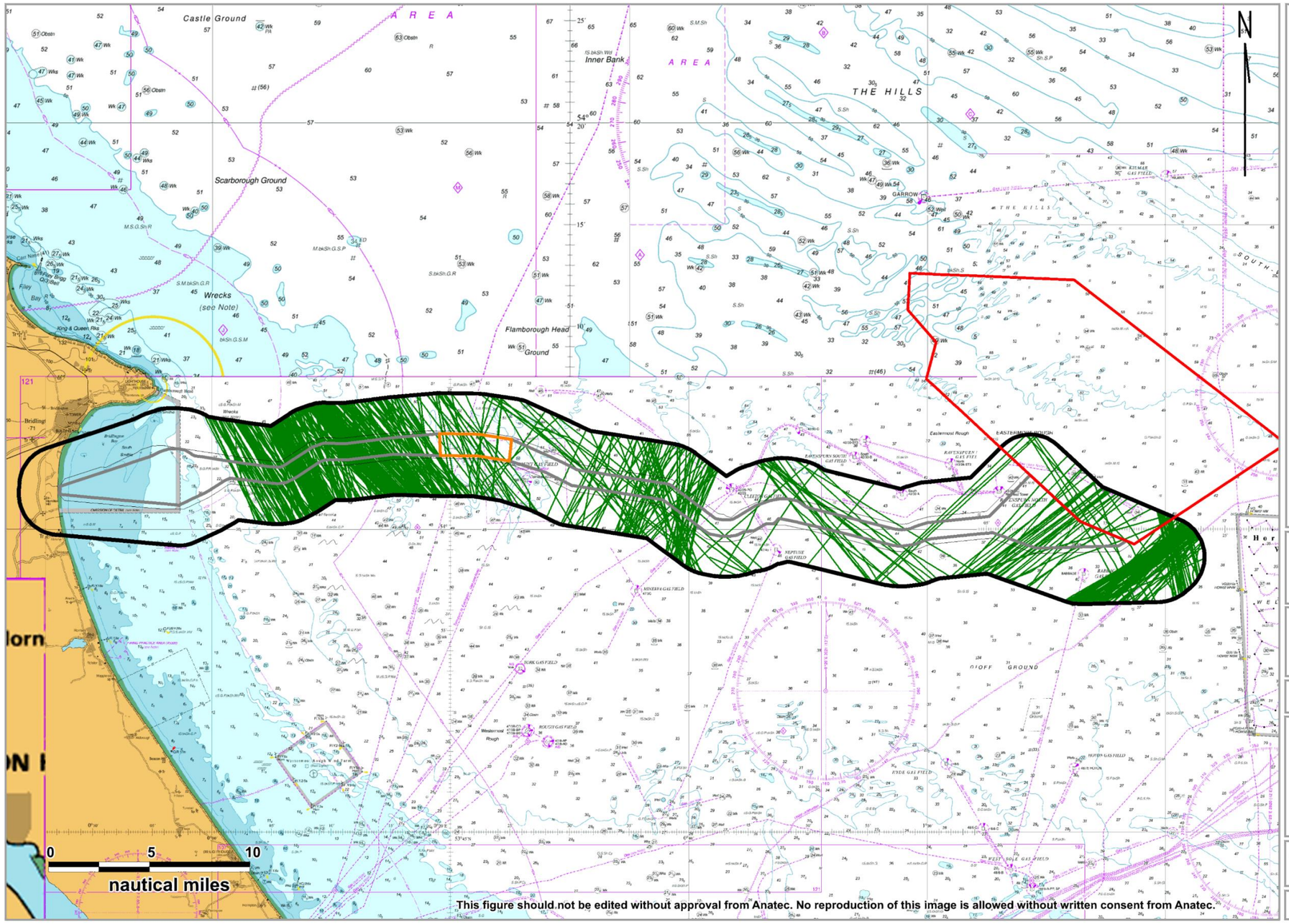
Figure 15.23 Vessel type distribution within Hornsea Four offshore ECC shipping and navigation study area (28 days summer and winter 2020/21)

242. Throughout the summer survey period, the main vessel types were cargo vessels (37% within the Hornsea Four offshore ECC), tankers (22%) and fishing vessels (19%). Throughout the winter survey period, the main vessel types were cargo vessels (41%), tankers (22%) and fishing vessels (15%). It should be noted that the cargo vessel category includes commercial ferries which generally broadcast their vessel types on AIS as cargo.

15.2.2.1 Cargo Vessels

243. Figure 15.24 presents a plot of cargo vessels, including commercial ferries, recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout both survey periods.

244. Throughout the survey periods, an average of 23 unique cargo vessels per day passed within the Hornsea Four offshore ECC shipping and navigation study area. The majority of these vessels were transiting coastal routes between northern UK ports and southern North Sea ports. Regular cargo vessels operating within the Hornsea Four offshore ECC shipping and navigation study area include Ro Ro vessels primarily operated by DFDS Seaways, P&O Ferries and Sea-Cargo running routes between Tees and Zeebrugge (Belgium), Tees and Rotterdam, Immingham and Esbjerg, Immingham and Gothenburg and Immingham and Tananger.



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Ofshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area
- Temporary Working Area

Vessel Type
- Cargo

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Vessel traffic survey data withn cable corridor study area (28 days, summer and winter)

REVISION: REV 00 | **DATE:** 30/06/2021

CO-ORDINATE SYSTEM
Mercator WGS84

DRAWN: AB | **CHECKED:** JM

Figure 15.24 Cargo vessels within Hornsea Four offshore ECC shipping and navigation study area (28 days summer and winter 2020/21)

15.2.2.2 Tankers

245. Figure 15.25 presents a plot of tankers recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout both survey periods.

246. Throughout the survey periods, an average of 11 unique tankers per day passed within the Hornsea Four offshore ECC shipping and navigation study area. The majority of these vessels were transiting coastal routes between northern UK ports (including Grangemouth, Tees and Aberdeen (UK)) and southern North Sea ports (including Immingham, Antwerp and Rotterdam).

15.2.2.3 Oil and Gas Vessels

247. Figure 15.26 presents a plot of oil and gas vessels recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout both survey periods.

248. Throughout the survey periods, an average of five unique oil and gas vessels per day passed within the Hornsea Four offshore ECC shipping and navigation study area. The majority of these vessels were undertaking operations for the platforms located at the Ravenspurn North, Ravenspurn South, Babbage and Tolmount gas fields. Activity landward of Tolmount gas field was minimal since onshore bases are mainly at Great Yarmouth, Lowestoft (UK) and Grimsby (UK).

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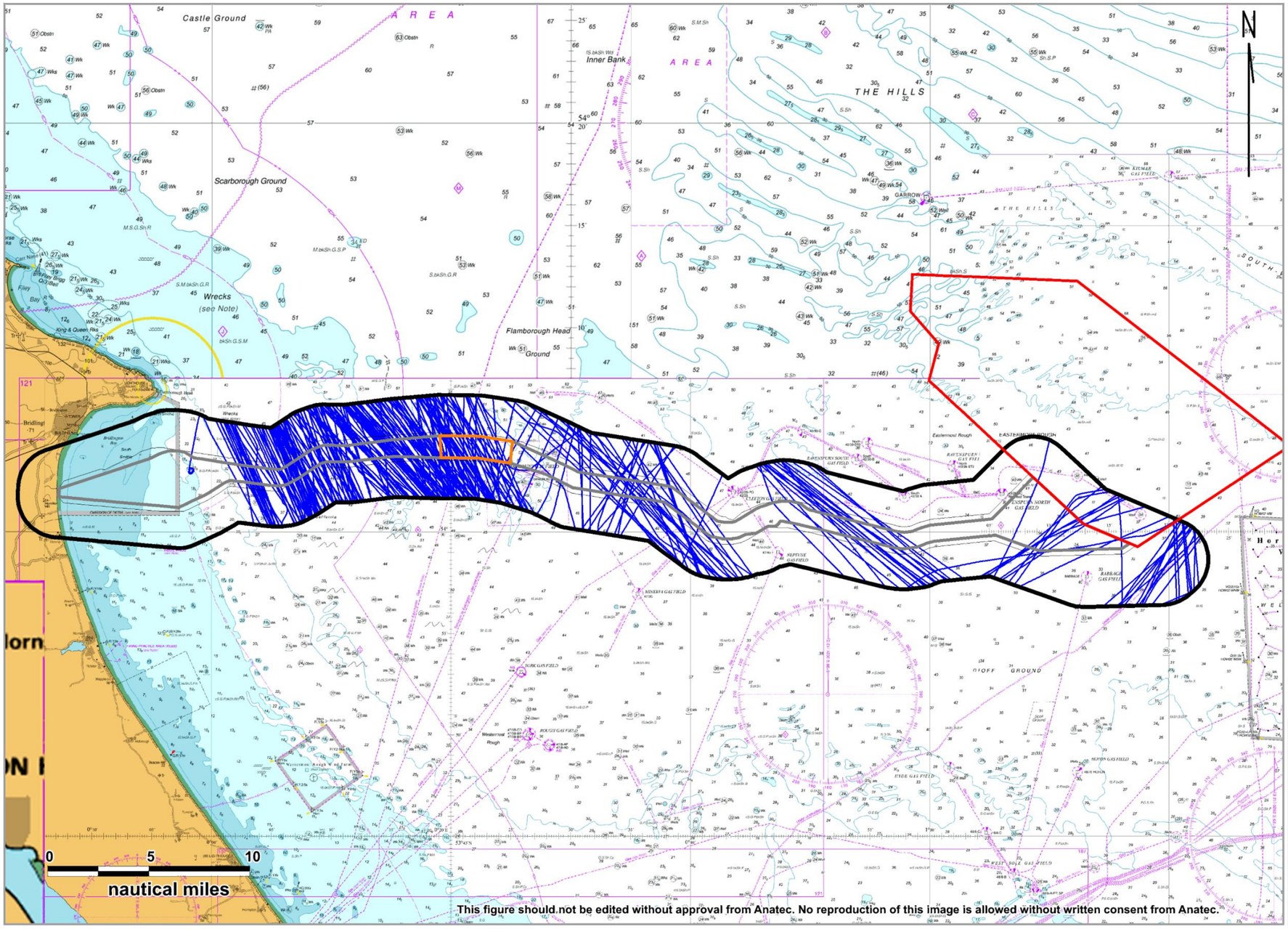


Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Ofshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area
- Temporary Working Area

Vessel Type
- Tanker

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

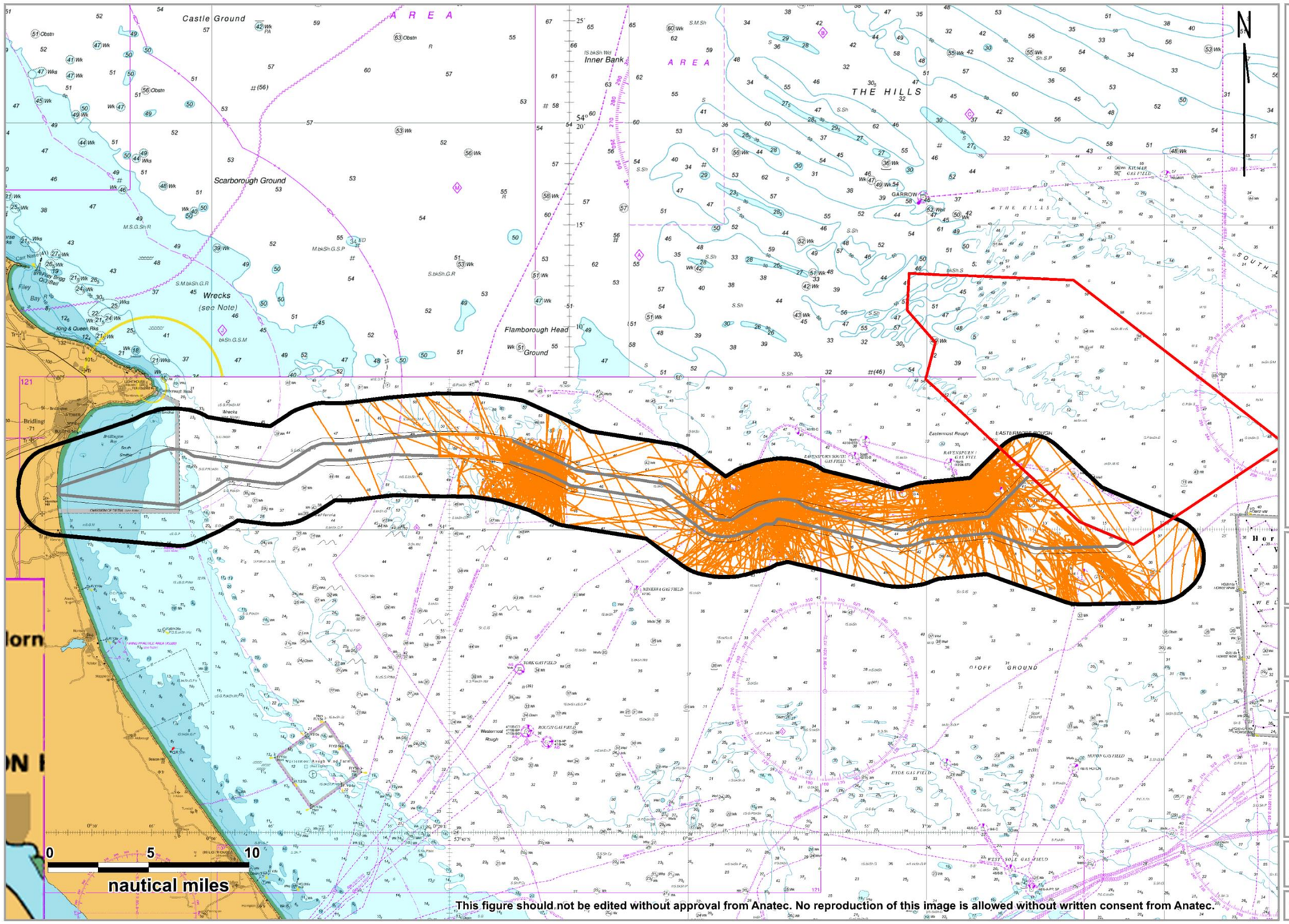
FIGURE TITLE
Tankers within cable corridor study area (28 days, summer & winter)

REVISION: REV 00 | **DATE:** 30/06/2021

CO-ORDINATE SYSTEM
Mercator WGS84

DRAWN: AB | **CHECKED:** JM

Figure 15.25 Tankers within Hornsea Four offshore ECC shipping and navigation study area (28 days summer and winter 2020/21)



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Ofshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area
- Temporary Working Area

Vessel Type
- Oil and Gas

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Oil and gas vessels within cable corridor study area (28 days, summer & winter)

REVISION: REV 00 | **DATE:** 30/06/2021

CO-ORDINATE SYSTEM
Mercator WGS84

DRAWN: AB | **CHECKED:** JM

Figure 15.26 Oil and gas vessels within Hornsea Four offshore ECC shipping and navigation study area (28 days summer and winter 2020/21)

15.2.3 Vessel Sizes

15.2.3.1 Vessel Length

249. Vessel LOA was available for approximately 99% of vessels recorded throughout the survey periods and ranged from 5 m for two RNLI lifeboats to 275 m for a crude oil tanker. Figure 15.27 illustrates the distribution of vessel lengths recorded throughout each survey period.

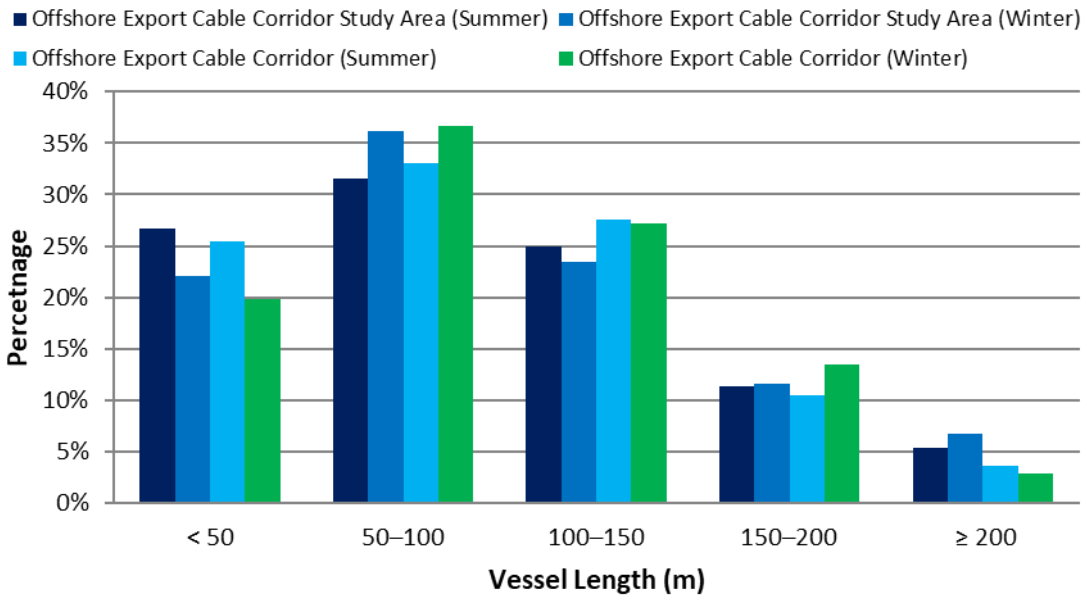
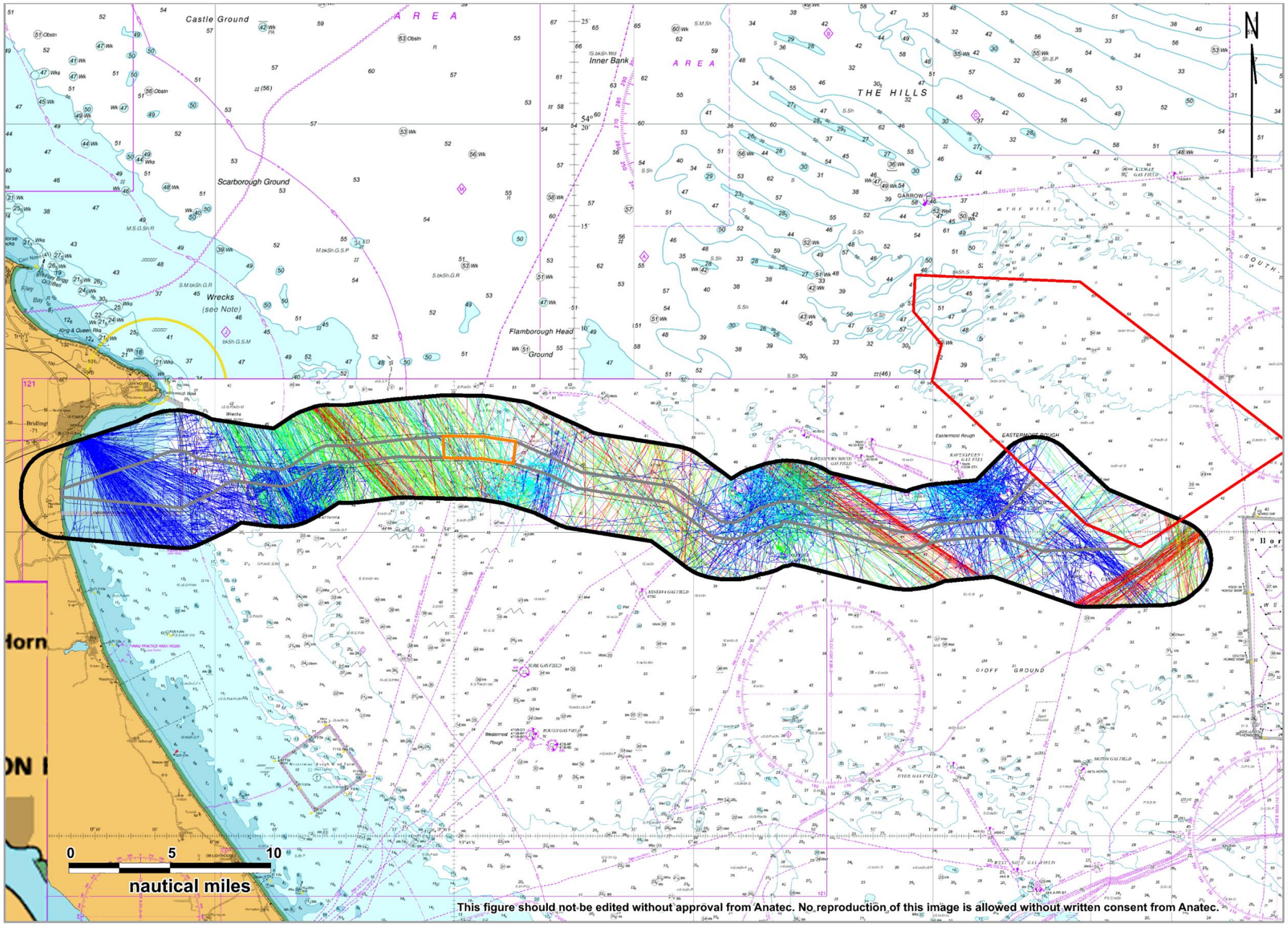


Figure 15.27 Vessel length distribution within Hornsea Four offshore ECC and shipping and navigation study area (28 days summer and winter 2020/21)

250. Excluding the small proportion of vessels for which a length was not available, the average length of vessels within the Hornsea Four offshore ECC shipping and navigation study area throughout the summer and winter survey periods were 93 m and 96 m, respectively.

251. Figure 15.28 presents a plot of vessel tracks (excluding temporary traffic) recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout the survey periods, colour-coded by length. It can be seen that vessels near the landfall were primarily smaller vessels (fishing).



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area
- Temporary Working Area

Vessel Length (m)
- Unspecified
- < 70
- 70-90
- 90-120
- 120-150
- >= 150

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Vessel traffic survey data by length within cable corridor study area (28 days, summer & winter)

REVISION: REV 00 | **DATE:** 30/06/2021

CO-ORDINATE SYSTEM
Mercator WGS84

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Figure 15.28 Vessel traffic survey data within Hornsea Four offshore ECC shipping and navigation study area colour-coded by vessel length (28 days summer and winter 2020/21)

15.2.3.2 Vessel Draught

252. Vessel draught was available for approximately 87% of vessel tracks recorded throughout the survey periods and ranged from 1.2 m for an ALB to 14.0 m for a self-discharging bulk carrier. Figure 15.29 illustrates the distribution of vessel draughts recorded throughout each survey period.

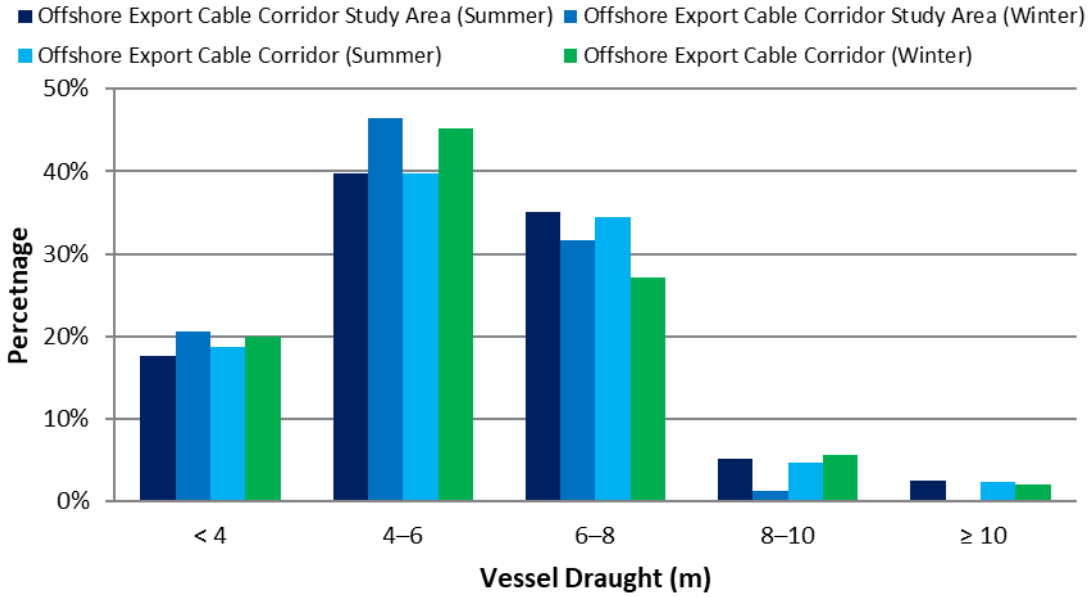


Figure 15.29 Vessel draught distribution within Hornsea Four offshore ECC shipping and navigation study area (28 days summer and winter 2020/21)

253. Excluding those vessels for which a draught was not available, the average draught of vessels within the Hornsea Four offshore ECC shipping and navigation study area throughout the summer and winter survey periods were 5.5 m and 5.1 m, respectively.

254. Figure 15.30 presents a plot of vessel tracks (excluding temporary traffic) recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout the survey periods, colour-coded by vessel draught.

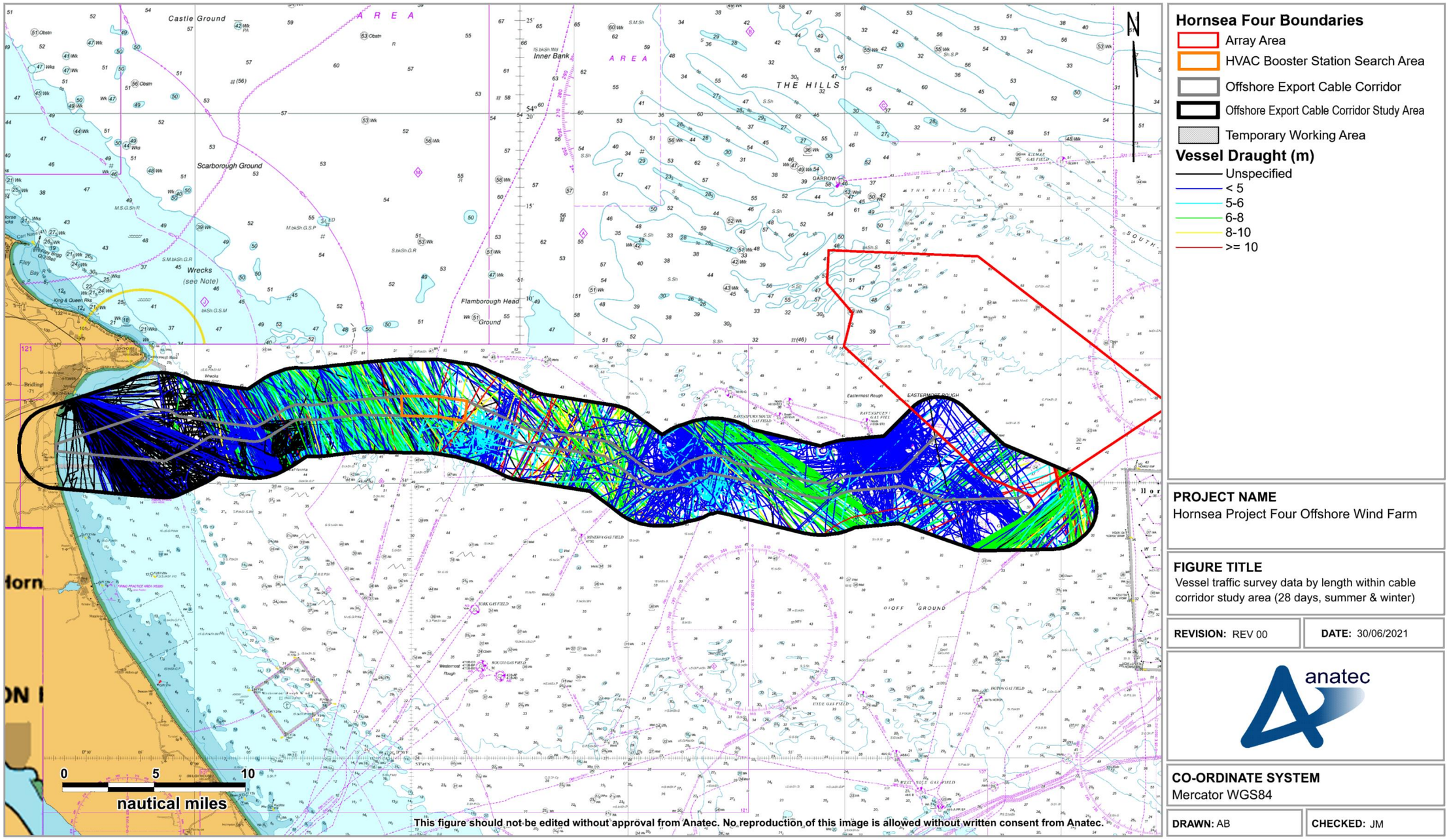


Figure 15.30 Vessel traffic survey data within Hornsea Four offshore ECC shipping and navigation study area colour-coded by vessel draught (28 days summer and winter 2020/21)

15.2.4 Anchored Vessels

255. Anchored vessels can be identified based upon the AIS navigational status which is programmed on the AIS transmitter on board a vessel. However, information is manually entered into the AIS, and therefore it is common for vessels not to update their navigational status if only at anchor for a short period of time.

256. For this reason, those vessels which travelled at a speed of less than 1 kt for more than 30 minutes had their corresponding vessel tracks individually checked for patterns characteristic of anchoring activity. After applying these criteria, one anchored vessel was identified on 26th July 2020, with the vessel broadcasting an AIS navigational status of "*at anchor*". The vessel was a crude oil tanker broadcasting a destination of Hound Point and can be seen at the western extent of the Hornsea Four offshore ECC shipping and navigation study area in Figure 15.25.

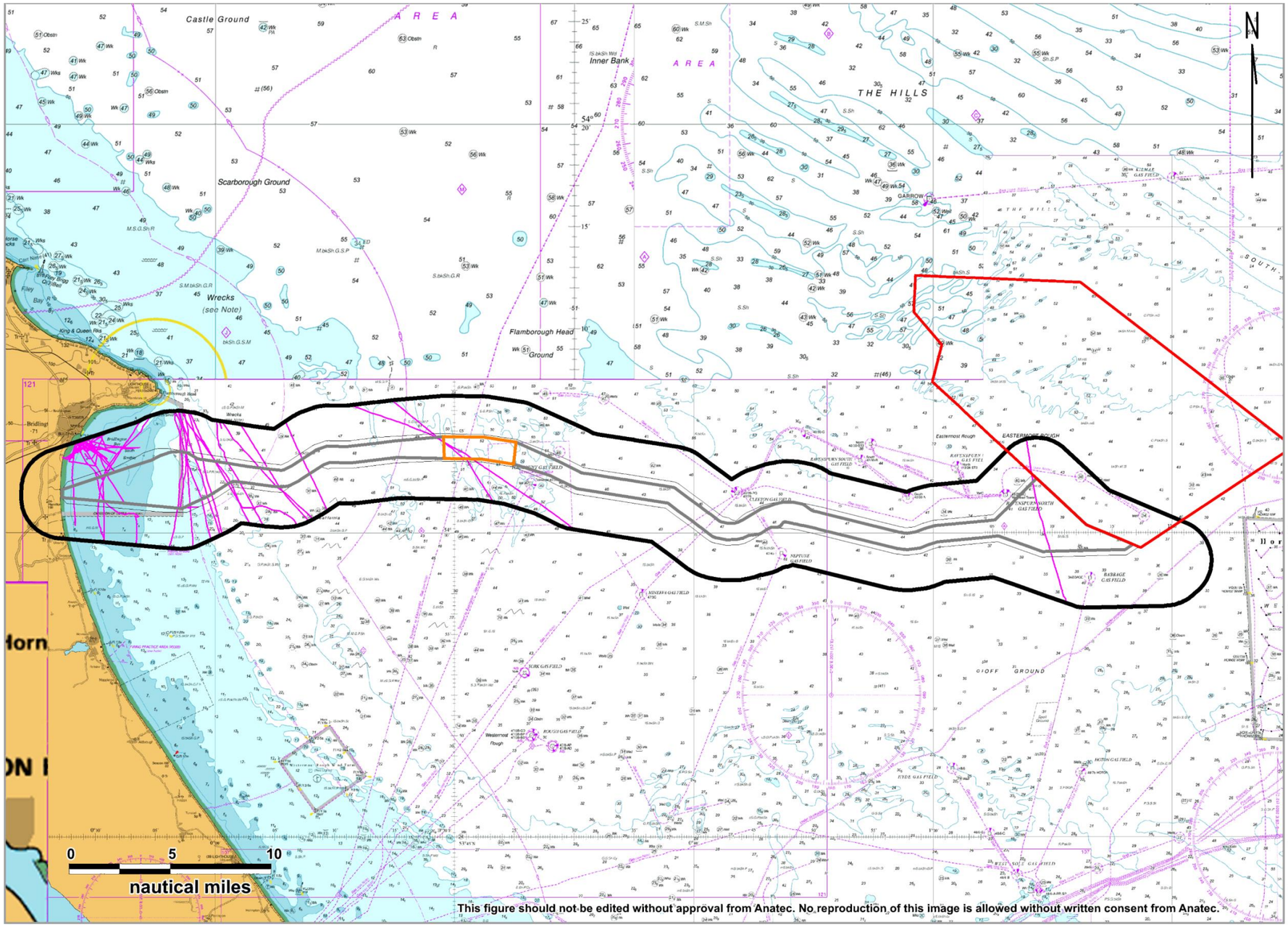
15.2.5 Recreational Vessel Activity

15.2.5.1 Vessel Traffic Survey Data

257. For the purposes of the NRA, recreational activity includes sailing and motor craft of between 2.4 and 24 m LOA.

258. Figure 15.31 presents a plot of recreational vessels recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout both survey periods.

259. Throughout the survey periods, an average of one unique recreational vessel per day passed within the Hornsea Four offshore ECC shipping and navigation study area. The majority of recreational vessels were transiting nearshore around Flamborough Head. Two recreational vessels were also recorded transiting through the Hornsea Four HVAC booster station search area further offshore.



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area
- Temporary Working Area

Vessel Type
- Recreational

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Recreational vessels within cable corridor study area (28 days, summer and winter)

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Figure 15.31 Recreational vessels within Hornsea Four offshore ECC shipping and navigation study area (28 days summer and winter 2020/21)

15.2.5.2 Royal Yachting Association Coastal Atlas

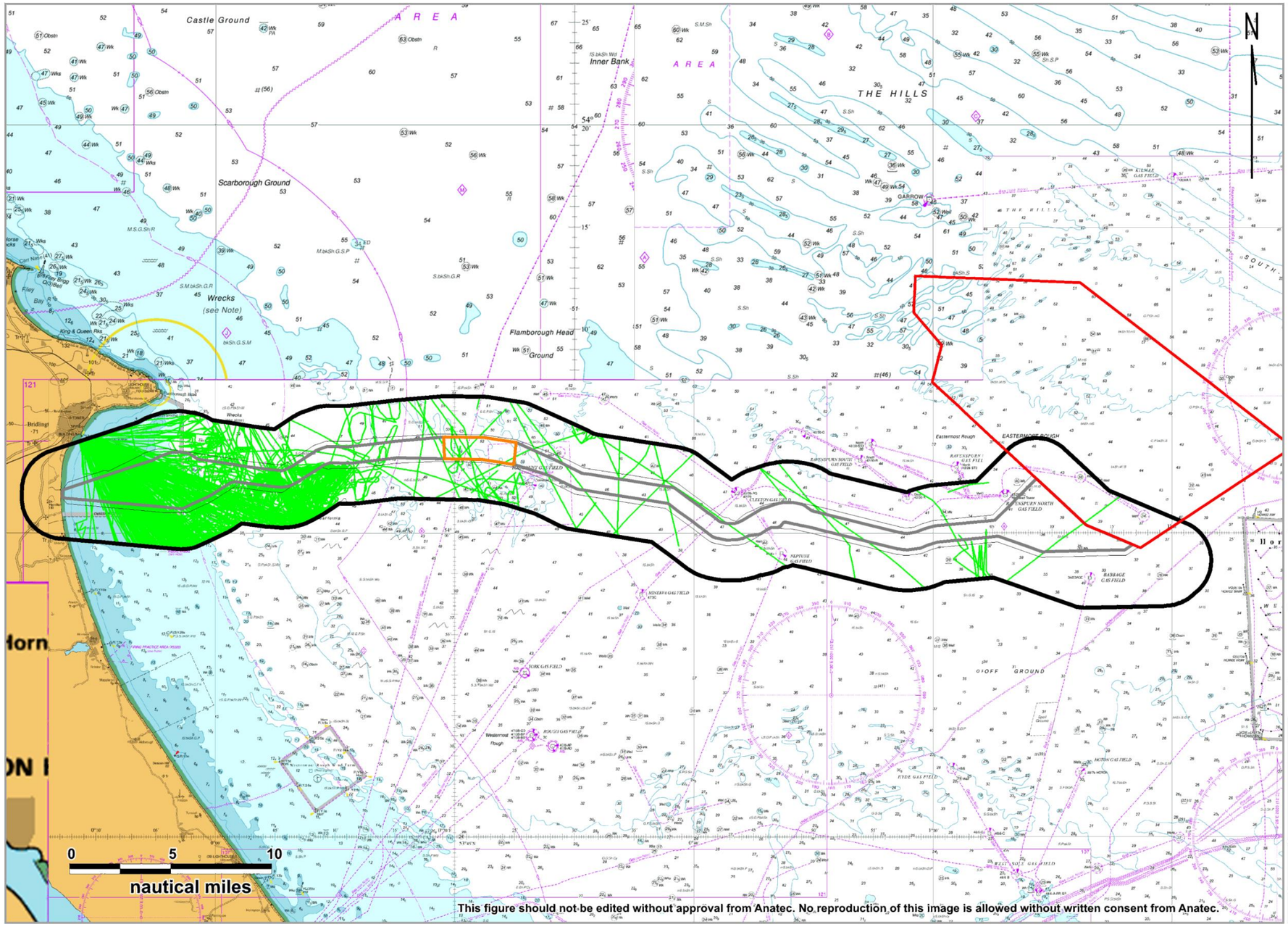
260. From the AIS intensity grid provided in the *UK Coastal Atlas of Recreational Boating 2.0* (RYA, 2019), there is a relatively high density of recreational traffic passing north-south within the nearshore area, as reflected in the vessel traffic survey data. It is noted that the AIS intensity grid only extends up to 12 nm offshore given that this is regarded as a reliable limit due to Very High Frequency (VHF) range, particularly for AIS Class B transponders.

261. The Coastal Atlas also includes generic recreational craft offshore routeing information which suggests that there may be eastbound routeing out of Bridlington Bay. Bridlington Bay includes a designated marina (Bridlington Harbour) and two RYA clubs (Royal Yorkshire Yacht Club and Yorkshire & Humberside Youth Sailing Association). The area containing Bridlington Bay is considered a general boating area.

15.2.6 Commercial Fishing Vessel Activity

262. Figure 15.32 presents a plot of commercial fishing vessels recorded within the Hornsea Four offshore ECC shipping and navigation study area throughout both survey periods.

263. Throughout the survey periods, an average of nine unique commercial fishing vessels per day passed within the Hornsea Four offshore ECC shipping and navigation study area. Commercial fishing vessel movements were characteristic of both fishing vessels in transit and engaged in fishing activity. Commercial fishing vessels were most prominent nearshore transiting in and out of Bridlington with low levels of commercial fishing vessels further offshore where tracks were characteristic of both active fishing and transiting vessels.



Hornsea Four Boundaries
- Array Area
- HVAC Booster Station Search Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Study Area
- Temporary Working Area

Vessel Type
- Fishing

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Fishing vessel within cable corridor study area (28 days, summer & winter)

REVISION: REV 00 | **DATE:** 30/06/2021

CO-ORDINATE SYSTEM
Mercator WGS84

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Figure 15.32 Commercial fishing vessels within Hornsea Four offshore ECC shipping and navigation study area (28 days summer and winter 2020/21)

15.3 Hornsea Four HVAC Booster Station Search Area

264. A number of tracks recorded during the Hornsea Four HVAC booster station search area survey periods were classified as temporary (non-routine), such as the tracks of the survey vessel; these have therefore been excluded from the analysis. Oil and gas vessels operating at permanent installations were retained in the analysis. Additionally, supporting oil and gas vessels associated with the drilling operations at the Tolmount gas field (winter only) were retained in the analysis given that although particular drilling operations are temporary in nature, they will be ongoing long-term. Nevertheless, key vessels associated with temporary drilling operations including the platform itself, the drilling rig and ERRV (none of which are in transit during such operations) have been excluded to avoid overinflating oil and gas vessel presence.

265. A plot of the vessel tracks recorded during a 14-day survey period in June 2020 (summer) colour-coded by vessel type and excluding temporary traffic, is presented in Figure 15.33. A plot of the vessel tracks recorded during a further 14-day survey period in March 2021 (winter), colour-coded by vessel type and excluding temporary traffic, is presented in Figure 15.34.

266. Plots of the vessel tracks for the summer and winter survey periods converted to density heat maps are presented in Figure 15.35 and Figure 15.36, respectively.

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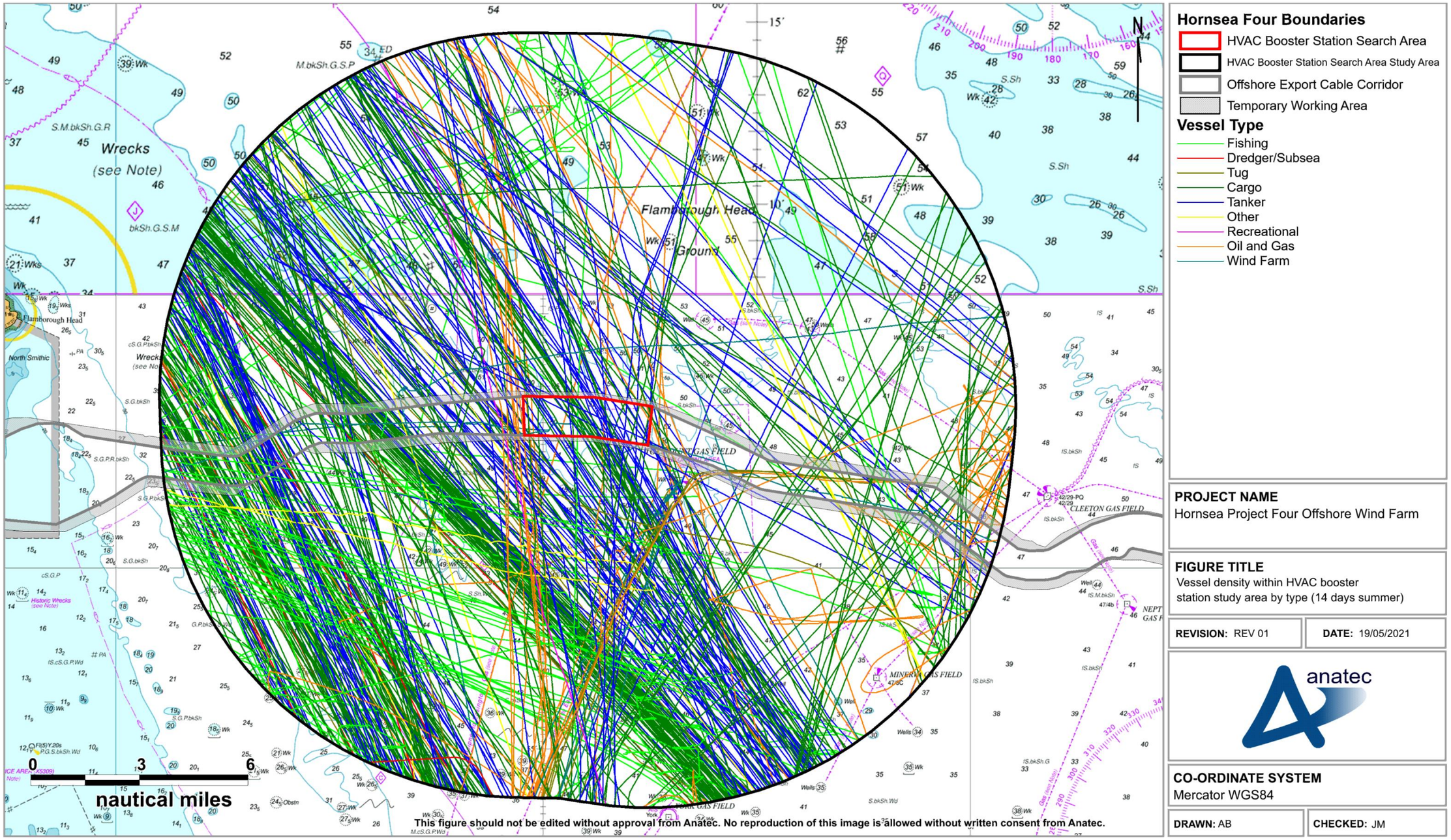


Figure 15.33 Vessel traffic survey data within Hornsea Four HVAC booster station search area shipping and navigation study area colour-coded by vessel type (14 days summer 2020)

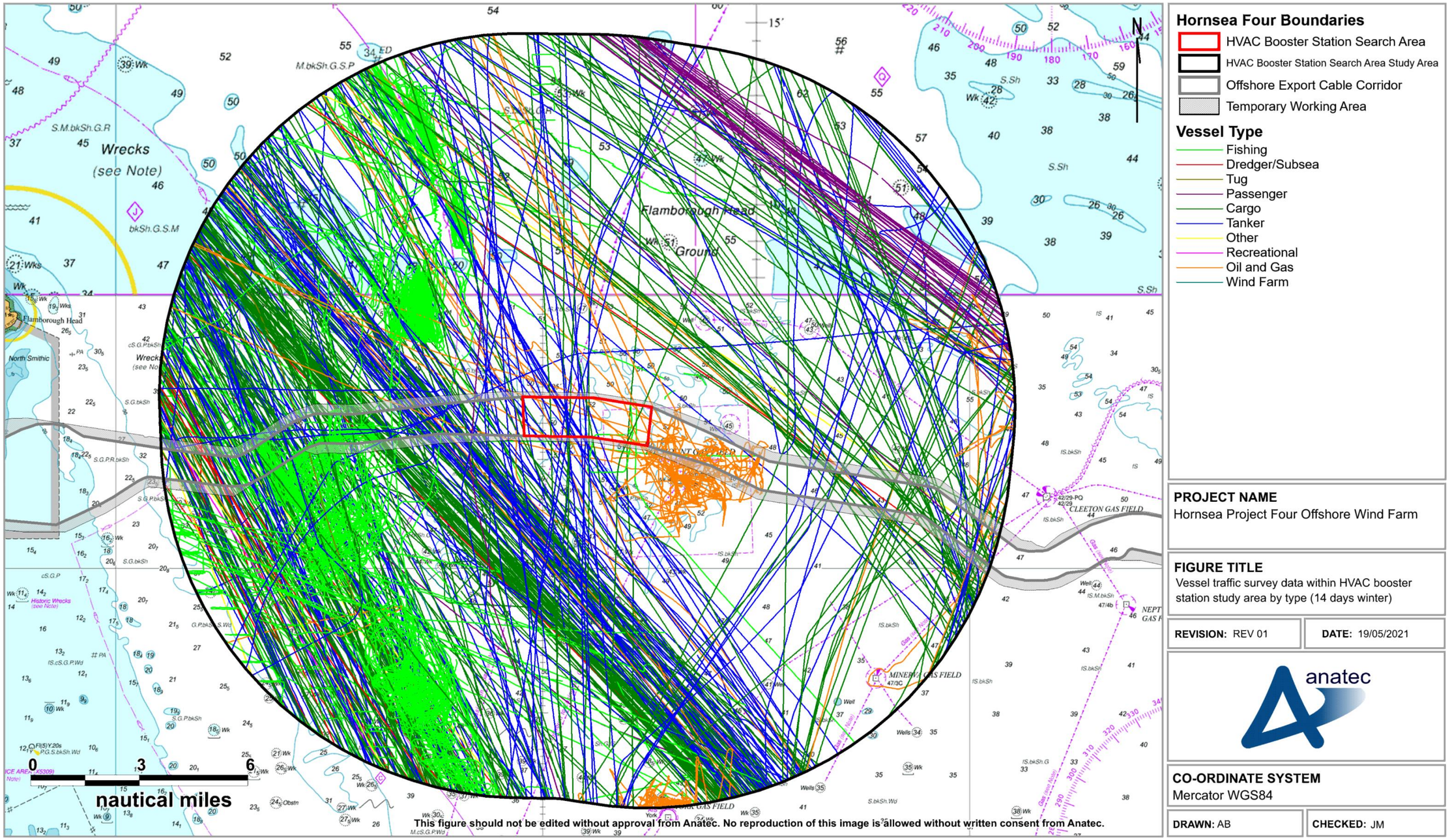


Figure 15.34 Vessel traffic survey data within Hornsea Four HVAC booster station search area shipping and navigation study area colour-coded by vessel type (14 days winter 2021)

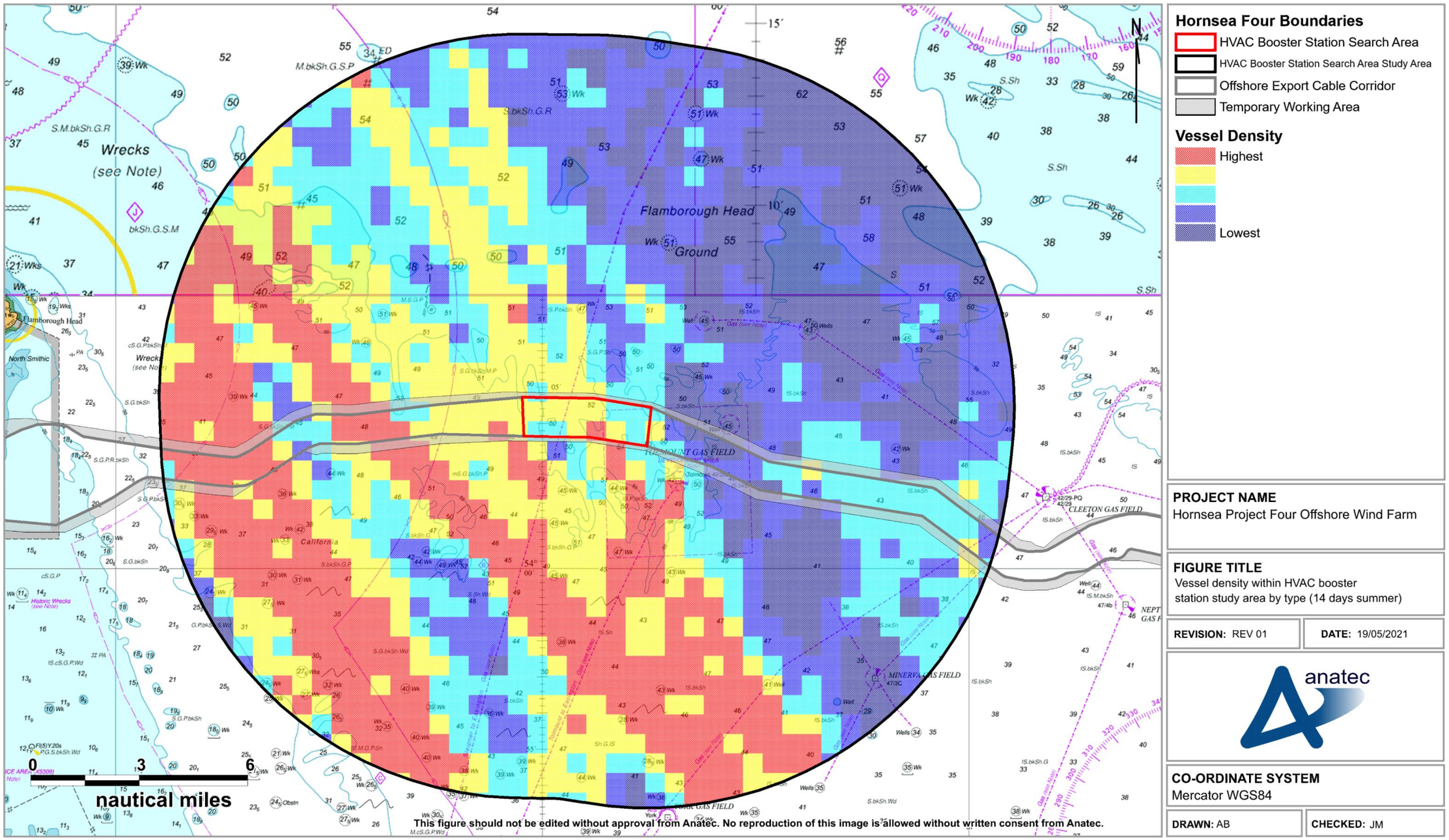


Figure 15.35 Vessel traffic density heat map within Hornsea Four HVAC booster station search area shipping and navigation study area excluding temporary traffic (14 days summer 2020)

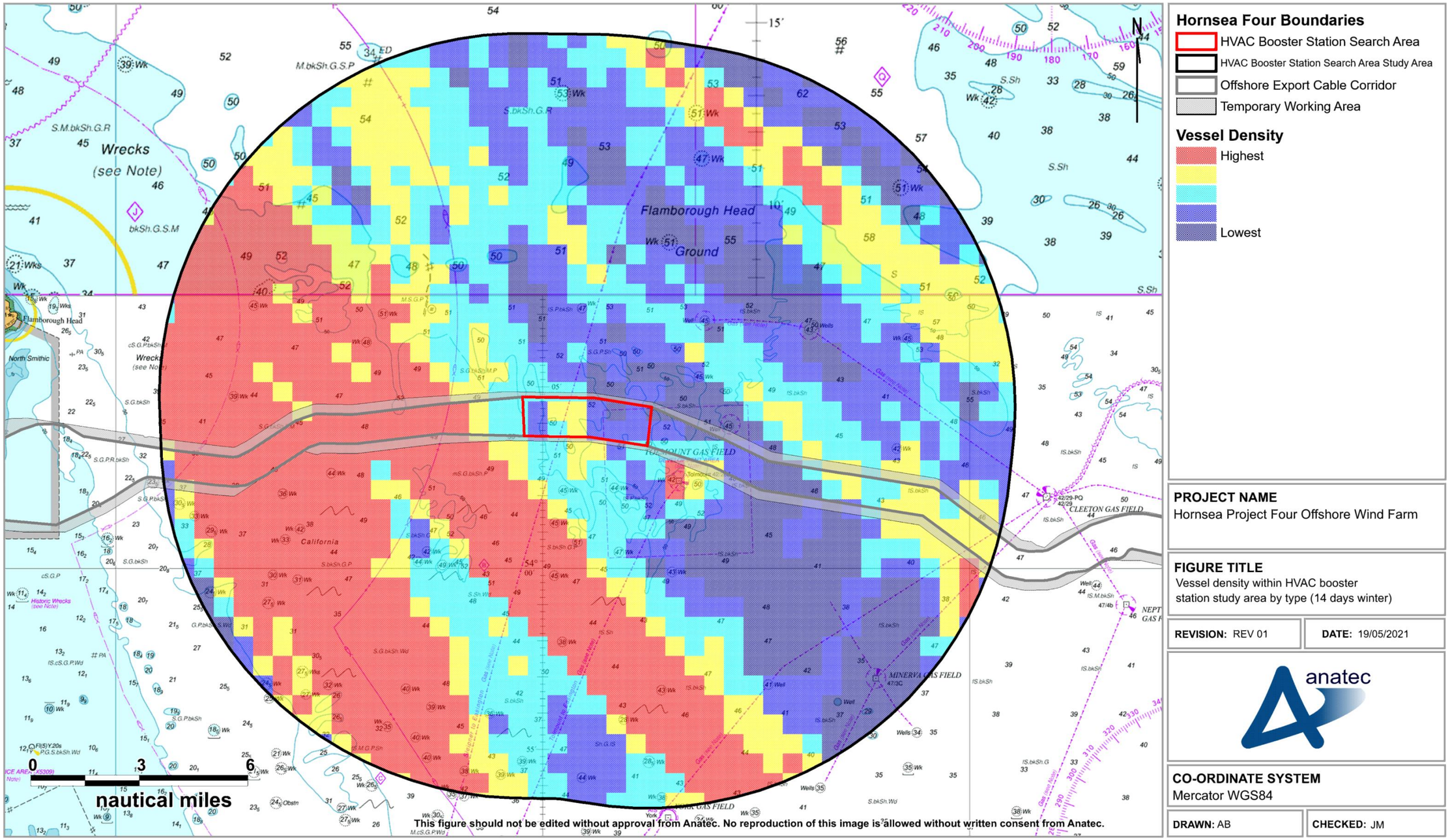


Figure 15.36 Vessel traffic density heat map within Hornsea Four HVAC booster station search area shipping and navigation study area excluding temporary traffic (14 days winter 2021)

15.3.1 Vessel Counts

267. For the 14 days analysed in the summer survey period, there were an average of 34 unique vessels per day recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area. In terms of vessels intersecting the Hornsea Four HVAC booster station search area itself, there was an average of five unique vessels per day.

268. Figure 15.37 illustrates the daily number of unique vessels recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area and the Hornsea Four HVAC booster station search area itself during the summer survey period. Throughout the summer survey period approximately 11% of vessel tracks recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area intersected the Hornsea Four HVAC booster station search area itself.

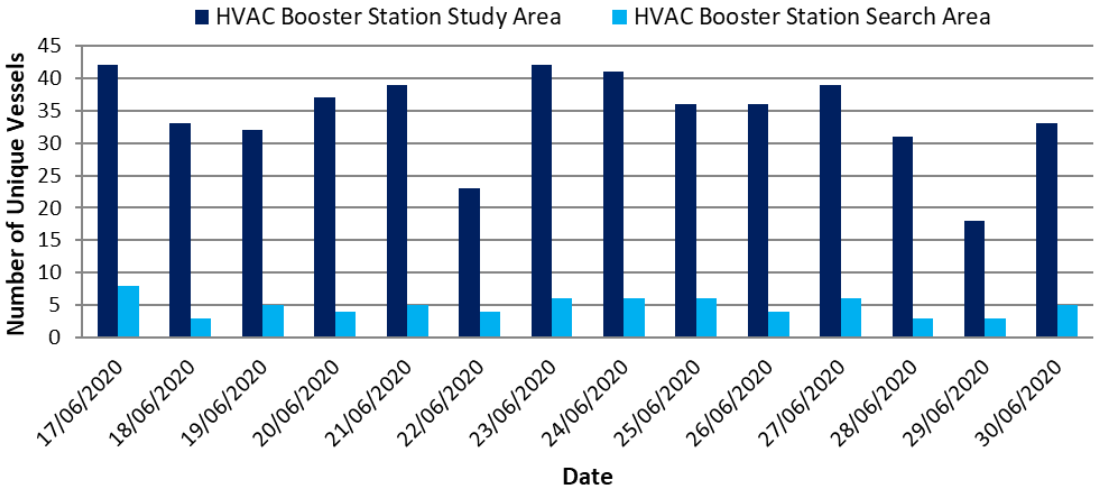


Figure 15.37 Unique vessels per day within Hornsea Four HVAC booster station search area and shipping and navigation study area (14 days summer 2020)

269. The busiest days recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the summer survey period were 17th and 23rd June 2020 when 42 unique vessels were recorded. The 17th June 2020 was also the busiest day recorded within the Hornsea Four HVAC booster station search area itself throughout the summer survey period with eight unique vessels recorded.

270. The quietest full day recorded throughout the summer survey period was 29th June 2020 when 18 unique vessels were recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area. The quietest full days recorded within the Hornsea Four HVAC booster station search area itself throughout the summer survey period were 18th, 28th and 29th June 2020 when three unique vessels were recorded.

271. For the 14 days analysed in the winter survey period, there were an average of 47 unique vessels per day recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area. In terms of vessels intersecting the Hornsea Four HVAC booster station search area itself, there was an average of four unique vessels per day.

272. Figure 15.38 illustrates the daily number of unique vessels recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area and the Hornsea Four HVAC booster station search area itself during the winter survey period. Throughout the winter survey period 8% of vessel tracks recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area intersected the Hornsea Four HVAC booster station search area itself.

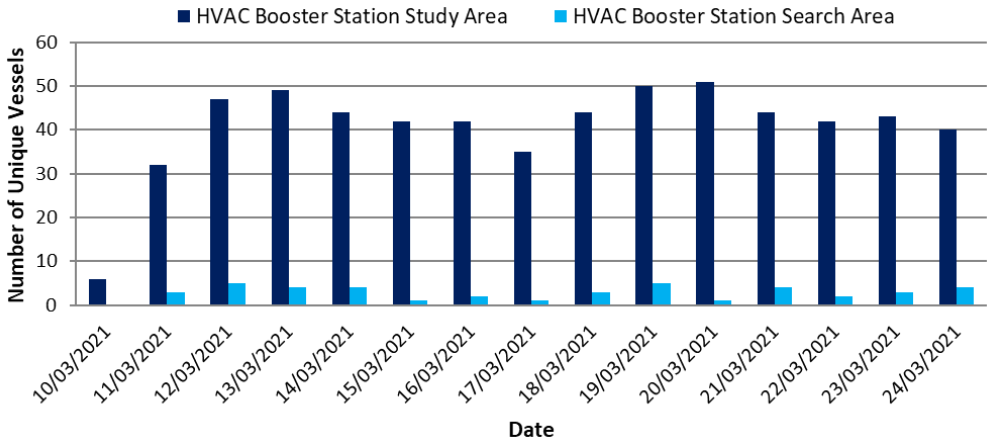


Figure 15.38 Unique vessels per day within Hornsea Four HVAC booster station search area and shipping and navigation study area (14 days winter 2021)

273. The busiest day recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the winter survey period was 20th March 2021 when 51 unique vessels were recorded. The busiest days recorded within the Hornsea Four HVAC booster station search area itself throughout the winter survey period were 12th and 19th March when five unique vessels were recorded.

274. The quietest full day recorded throughout the winter survey period was 11th March 2021 when 32 unique vessels were recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area. The quietest full days recorded within the Hornsea Four HVAC booster station search area itself throughout the winter survey period were 15th, 17th and 20th March 2021 with one unique vessel recorded.

15.3.2 Vessel Types

275. The distribution of the main vessel types recorded passing within the Hornsea Four HVAC booster station search area shipping and navigation study area is presented in Figure 15.39.

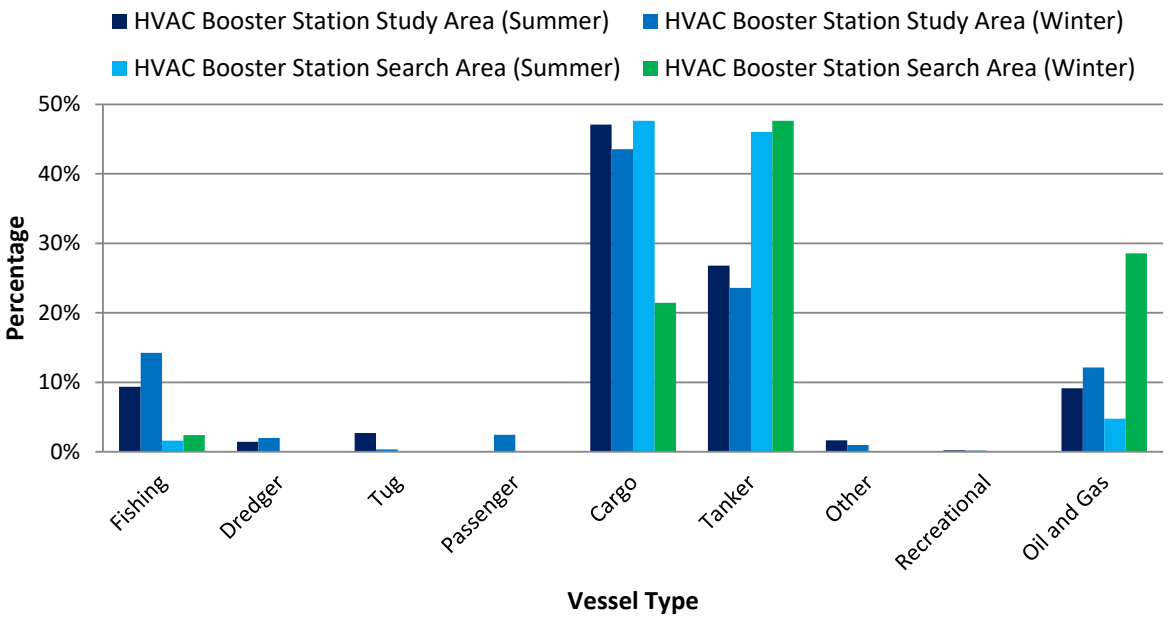


Figure 15.39 Vessel type distribution within Hornsea Four HVAC booster station search area and shipping and navigation study area (28 days summer and winter 2020/21)

276. Throughout the summer period, the main vessel types were cargo vessels (48% within the Hornsea Four HVAC booster station search area) and tankers (46%). Throughout the winter period, the main vessel types were tankers (48% within the Hornsea Four HVAC booster station search area), oil and gas vessels (29%) and cargo vessels (21%). Oil and gas activity was significantly greater in the winter period due to the start of drilling operations associated with the Tolmount gas field. It should be noted that the cargo vessel category includes commercial ferries which generally broadcast their vessel types on AIS as cargo. Details specific to commercial ferries are presented in Section 15.3.6.

15.3.2.1 Cargo Vessels

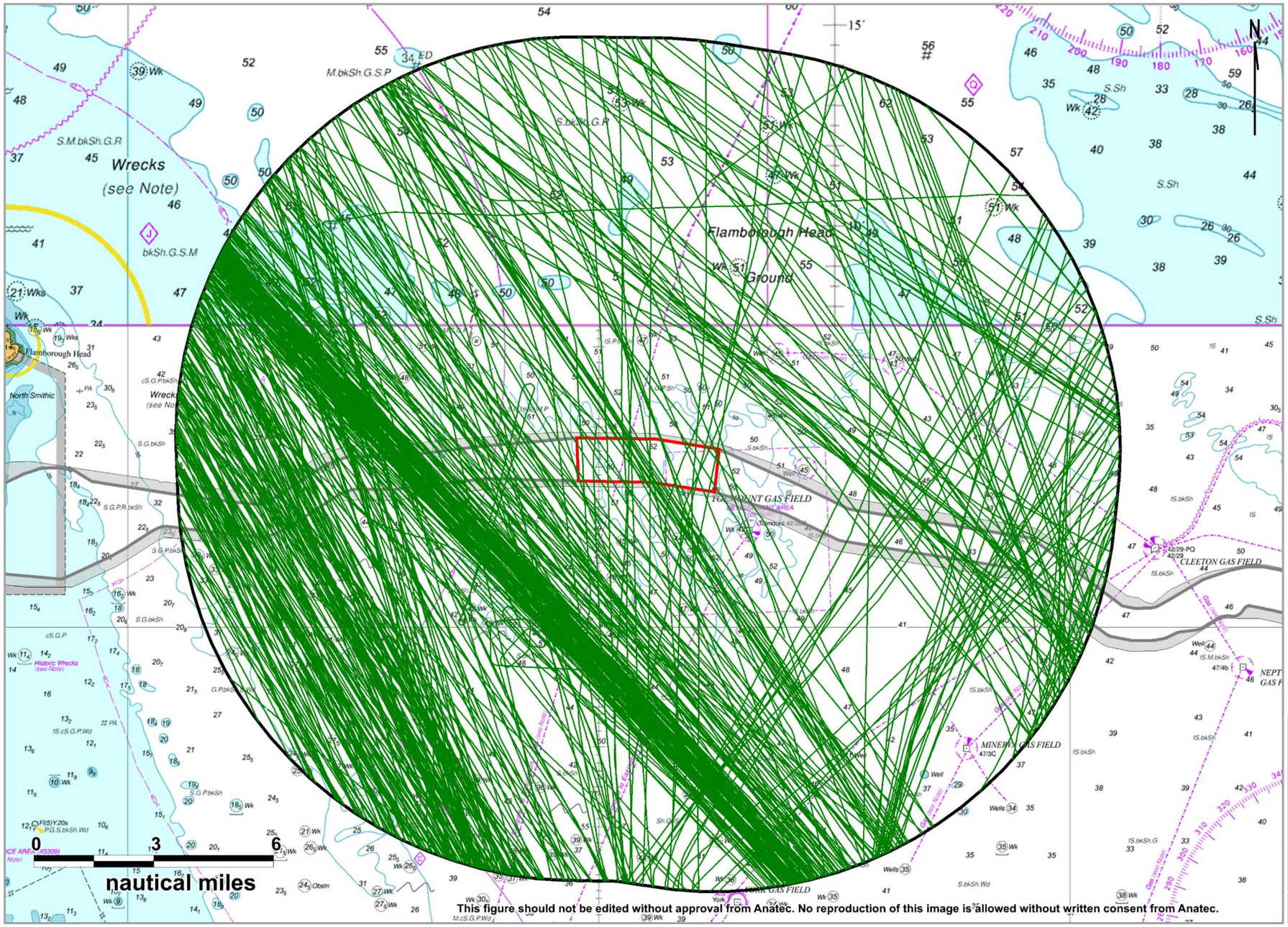
277. Figure 15.40 presents a plot of cargo vessels, including commercial ferries, recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout both survey periods.

278. Throughout the survey periods, an average of 18 unique cargo vessels per day passed within the Hornsea Four HVAC booster station search area shipping and navigation study area. Regular cargo vessels operating in proximity to the Hornsea Four HVAC booster station search area include Ro Ro vessels primarily operated by P&O Ferries, DFDS Seaways and Sea-Cargo running routes between Tees and Zeebrugge, Tees and Rotterdam, North Shields and Ijmuiden and Immingham and Tananger.

15.3.2.2 Tankers

279. Figure 15.41 presents a plot of tankers recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout both survey periods.

280. Throughout the survey periods, an average of 10 unique tankers per day passed within the Hornsea Four HVAC booster station search area shipping and navigation study area. The majority of tankers recorded throughout the survey period were on passage to oil and gas terminals throughout the UK and mainland Europe.



Hornsea Four Boundaries
- HVAC Booster Station Search Area
- HVAC Booster Station Search Area Study Area
- Offshore Export Cable Corridor
- Temporary Working Area

Vessel Type
- Cargo

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Cargo vessels within HVAC booster station study area by type (28 days summer & winter)

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CO-ORDINATE SYSTEM
Mercator WGS84

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Figure 15.40 Cargo vessels within Hornsea Four HVAC booster station search area shipping and navigation study area (28 days summer and winter 2020/21)

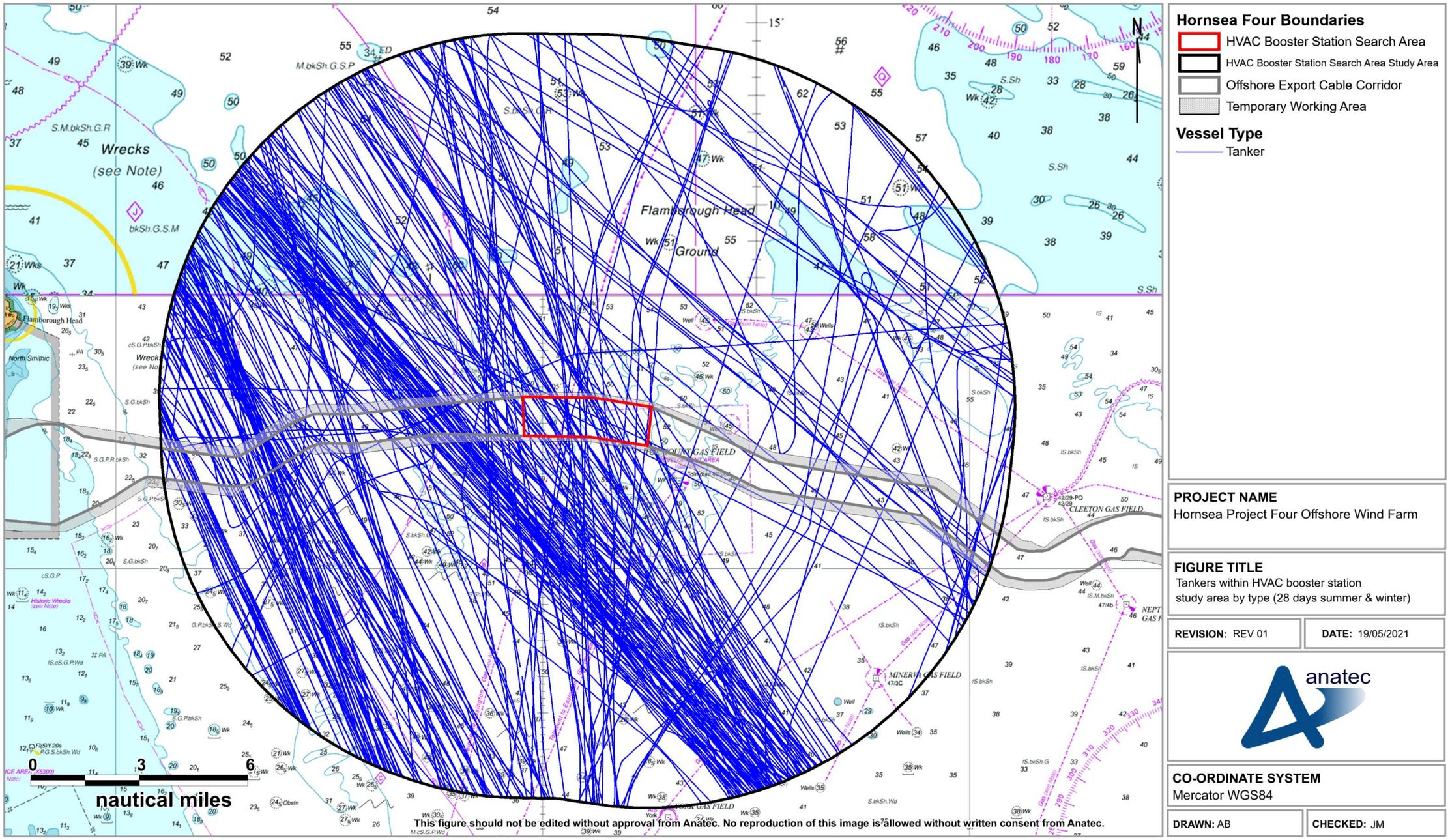

Figure 15.41 Tankers within Hornsea Four HVAC booster station search area shipping and navigation study area (28 days summer and winter 2020/21)

15.3.3 Vessel Sizes

15.3.3.1 Vessel Length

281. Vessel LOA was available for 99% of vessels recorded throughout the survey periods and ranged from 8 m for a small fishing vessel to 269 m for a crude oil tanker. Figure 15.42 illustrates the distribution of vessel lengths recorded throughout each survey period.

282. Excluding the small proportion of vessels for which a length was not available the average length of vessels within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the summer and winter survey periods were 103 m and 99 m, respectively.

283. Figure 15.43 presents a plot of all vessel tracks (excluding temporary traffic) recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the survey periods, colour-coded by vessel length.

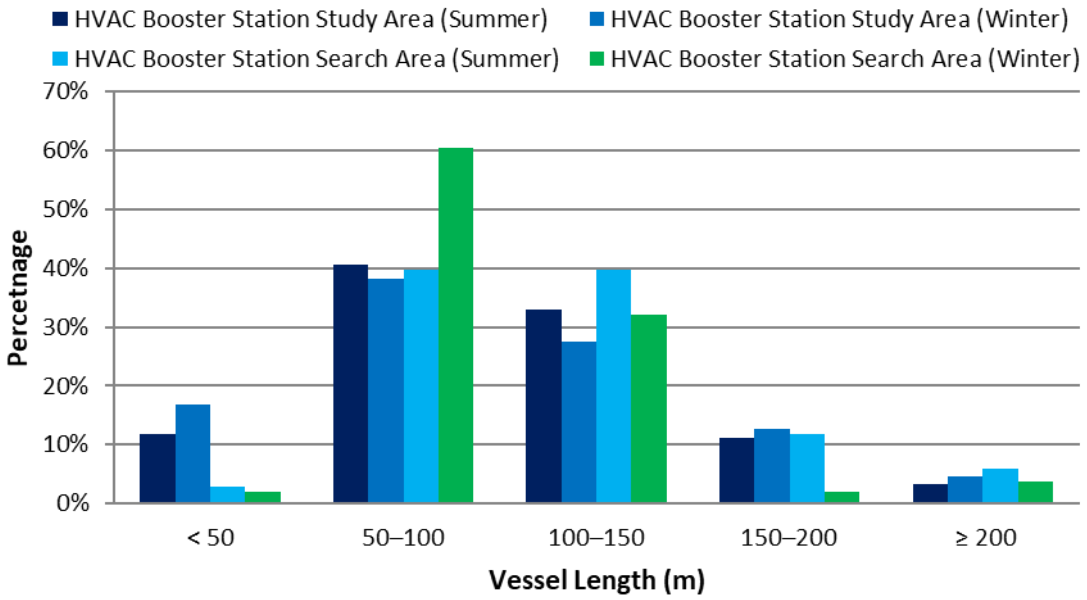

Figure 15.42 Vessel length distribution within Hornsea Four HVAC booster station search area and shipping and navigation study area (28 days summer and winter 2020/21)

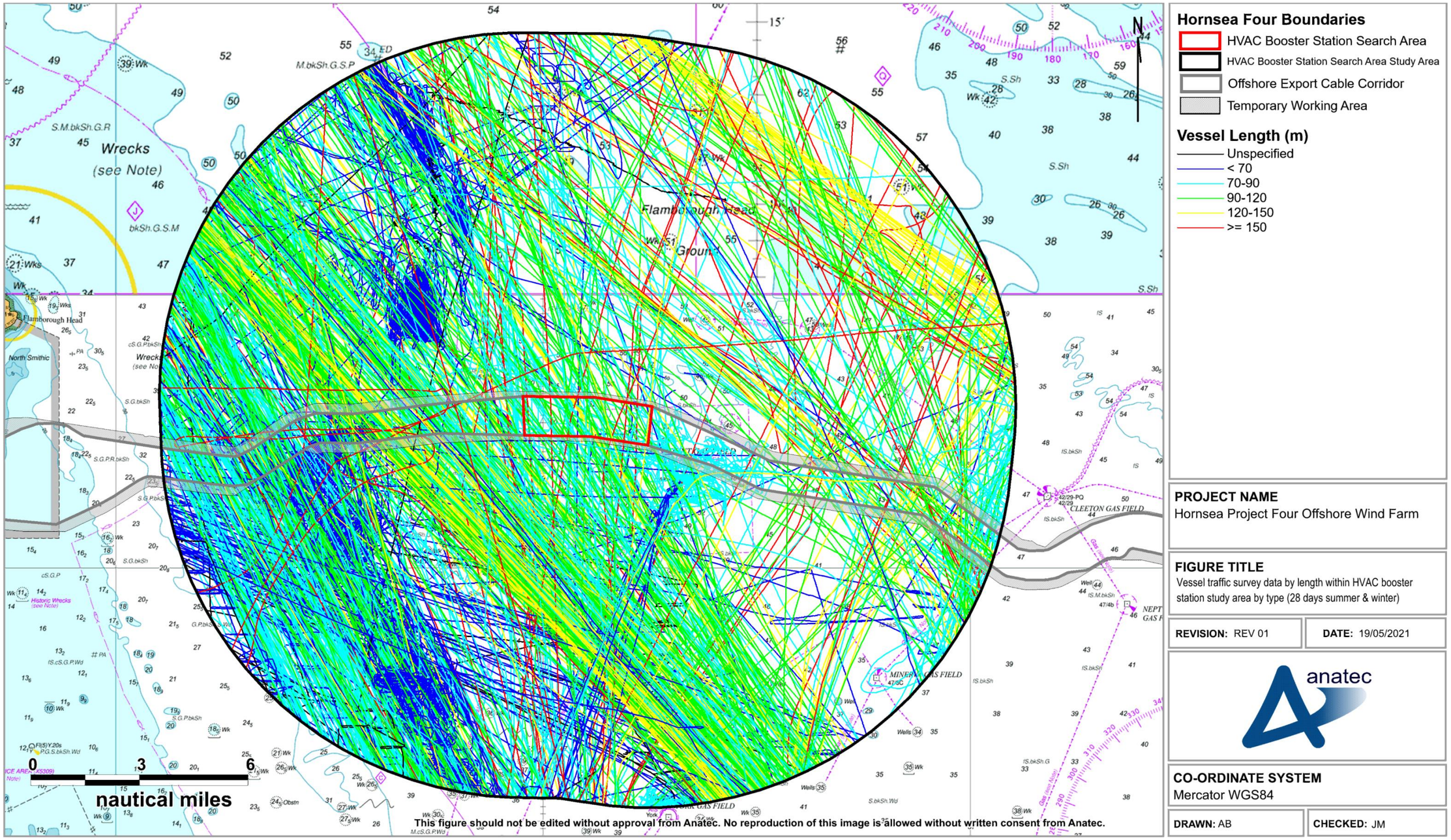

Figure 15.43 Vessel traffic survey data within Hornsea Four HVAC booster station search area shipping and navigation study area colour-coded by vessel length (28 days summer and winter 2020/21)

15.3.3.2 Vessel Draught

284. Vessel draught was available for approximately 86% of vessel tracks recorded throughout the survey periods and ranged from 1.2 m for a wind farm vessel to 13.5 m for a crude oil tanker. Figure 15.44 illustrates the distribution of vessel draughts recorded throughout each survey period.

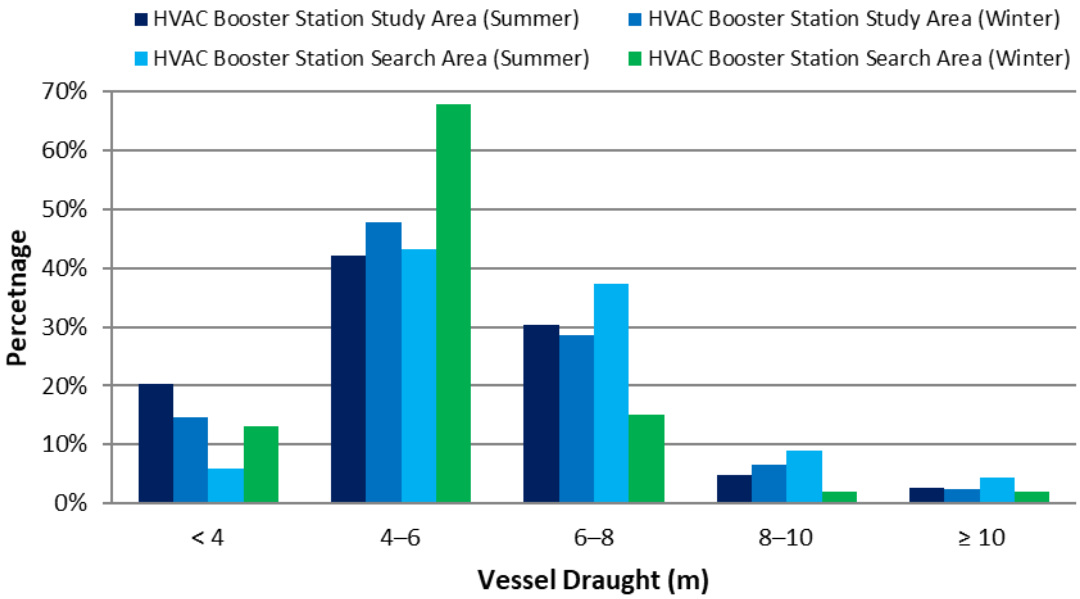

Figure 15.44 Vessel draught distribution within Hornsea Four HVAC booster station search area shipping and navigation study area (28 days summer and winter 2020/21)

285. Excluding those vessels for which a draught was not available (mainly non-AIS vessels), the average draught of vessels within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the summer and winter survey periods were 5.4 m and 5.6 m, respectively.

286. Figure 15.45 presents a plot of all vessel tracks (excluding temporary traffic) recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the survey periods, colour-coded by vessel draught.

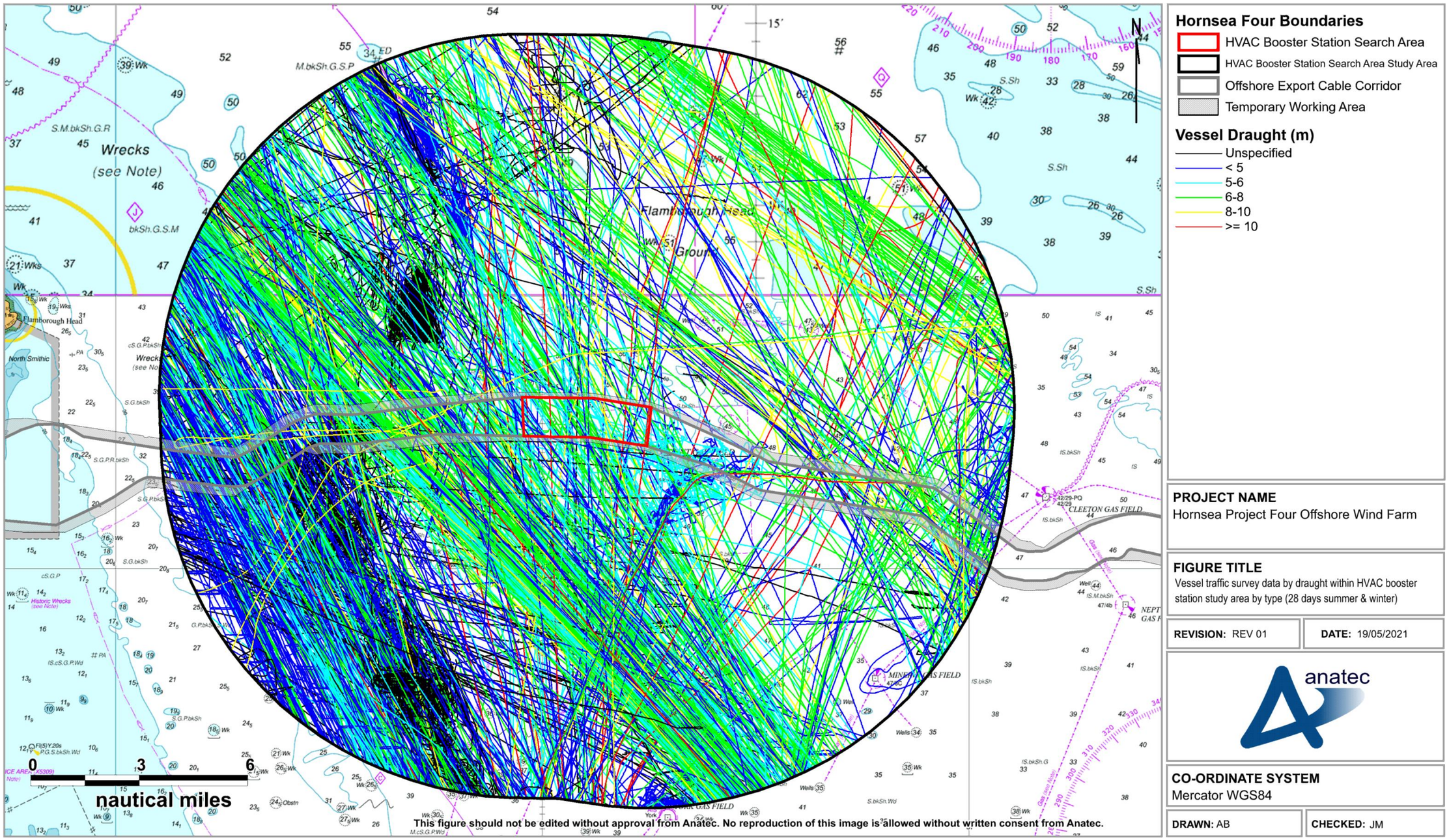

Figure 15.45 Vessel traffic survey data within Hornsea Four HVAC booster station search area shipping and navigation study area colour-coded by vessel draught (28 days summer and winter 2020/21)

15.3.4 Anchored Vessels

287. Anchored vessels can be identified based upon the AIS navigational status which is programmed on the AIS transmitter on board a vessel. However, information is manually entered into the AIS, and therefore it is common for vessels not to update their navigational status if only at anchor for a short period of time.

288. For this reason, those vessels which travelled at a speed of less than 1 kt for more than 30 minutes had their corresponding vessel tracks individually checked for patterns characteristic of anchoring activity. After applying these criteria, no vessels were deemed to be at anchor.

15.3.5 Vessel Routeing

15.3.5.1 Pre Wind Farm Main Routes

289. Main route identification was undertaken for the Hornsea Four HVAC booster station search area shipping and navigation study area. Twelve main commercial routes were identified as transiting through the Hornsea Four HVAC booster station search area shipping and navigation study area. Figure 15.46 presents a plot of the main routes and corresponding 90th percentiles within the Hornsea Four HVAC booster station search area shipping and navigation study area.

290. A brief description of the traffic on each of the main routes identified is provided in Table 15.2, including the main ports, noting that routes may include alternative ports.

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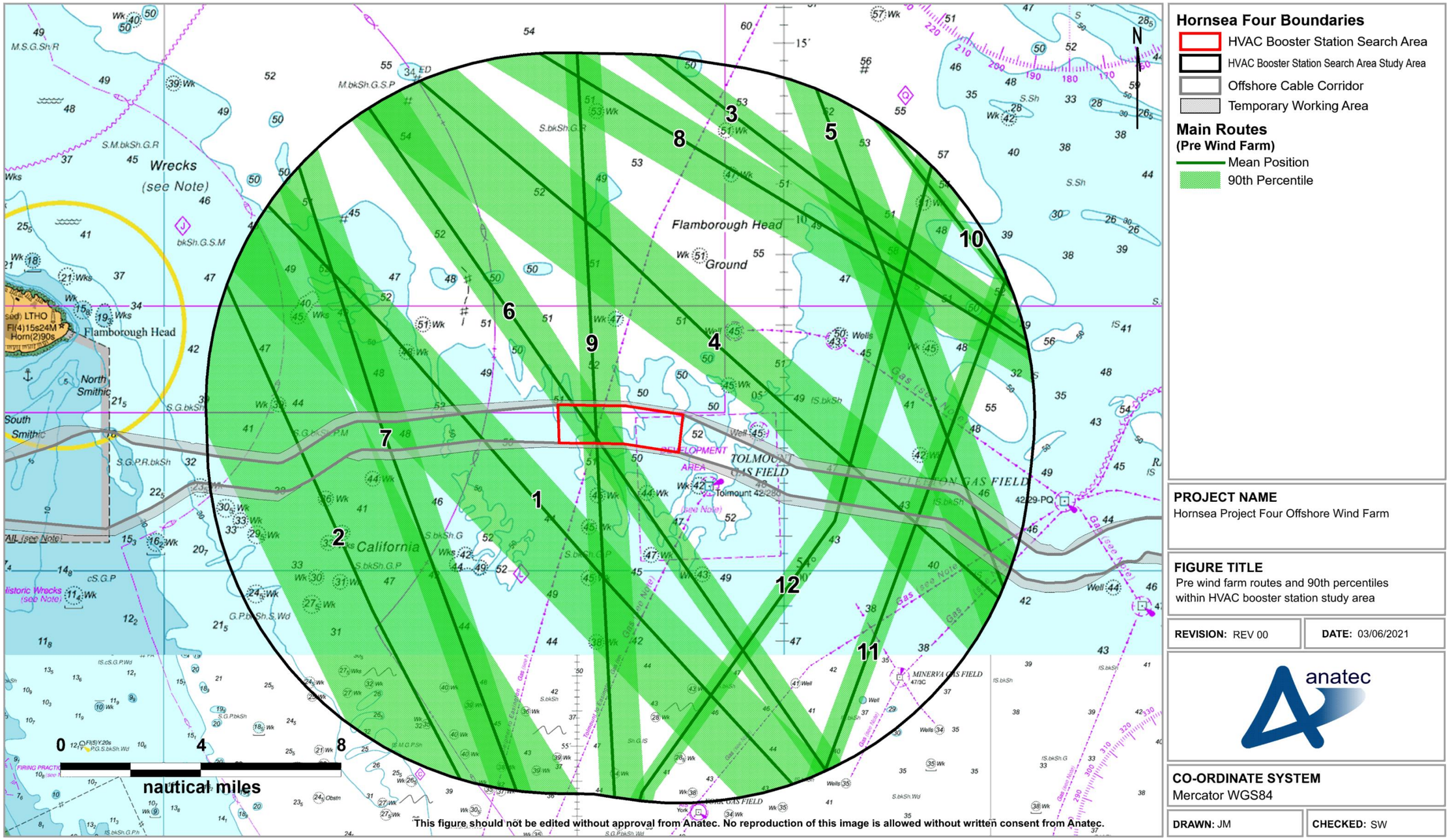


Figure 15.46 Pre wind farm main routes and 90th percentiles within Hornsea Four HVAC booster station search area shipping and navigation study area

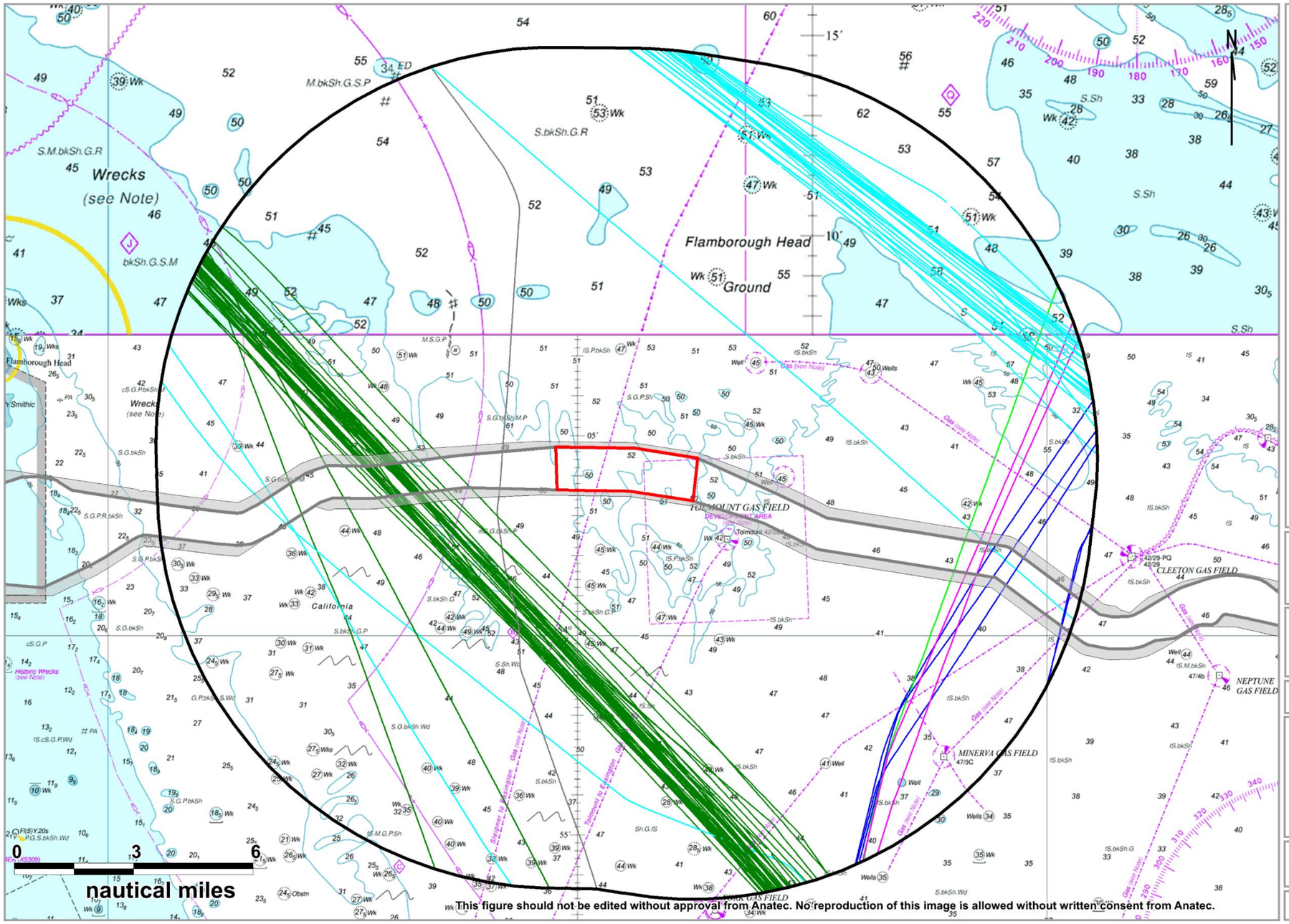
Table 15.2 Description of main routes identified within Hornsea Four HVAC booster station search area shipping and navigation study area

Route Number	Average Transits per Day	Description (main ports, also may include alternative ports)
1	9	**Tees–Rotterdam/Zeebrugge**. Route 1 is generally transited by cargo vessels (64%) and tankers (32%) and is a P&O Ferries and Euro Marine Carrier cargo ferry route between the Tees/Tyne and Rotterdam/Zeebrugge. The main vessels operating on this route are the *Bore Song* and *Estraden*.
2	8 to 9	**Tees–Rotterdam**. Route 2 is generally transited by cargo vessels (59%) and tankers (30%).
3	2*	**Newcastle–Amsterdam**. Route 3 is transited by passenger vessels (100%) and is a DFDS Seaways passenger ferry route between North Shields and Ijmuiden. The main vessels operating on this route are the *King Seaways* and *Princess Seaways*. It is noted that this is a continuation of Route 2 from the analysis of vessel routeing for the Hornsea Four array area (see Section 15.1.5).
4	1 to 2	**Tees–Amsterdam**. Route 4 is generally transited by cargo vessels (66%) and tankers (20%).
5	1	**Grangemouth–Rotterdam**. Route 5 is transited by cargo vessels (77%) and tankers (23%).
6	1	**Grangemouth–Rotterdam**. Route 6 is generally transited by tankers (55%) and cargo vessels (38%).
7	1	**Immingham–Moray Firth ports**. Route 7 is generally transited by cargo vessels (70%) and tankers (26%).
8	1	**Tees–Rotterdam**. Route 8 is transited by cargo vessels (75%) and tankers (25%).
9	1	**Immingham–north Norway ports**. Route 9 is transited by cargo vessels (43%), tankers (43%) and oil and gas vessels (14%).
10	0 to 1	**Grangemouth–Ghent (Belgium)**. Route 10 is generally transited by tankers (80%).
11	0 to 1	**Immingham–north Norway ports**. Route 11 is generally transited by cargo vessels (87%) and is a Sea-Cargo cargo ferry route between Immingham and Tananger. It is noted that this is a continuation of Route 5 from the analysis of vessel routeing for the Hornsea Four array area (see Section 15.1.5).
12	0 to 1	**Immingham–north Norway ports**. Route 12 is used by cargo vessels (73%) and tankers (27%).

(*) From the vessel traffic survey data, the overall average transits per day on this route was lower, owing to the lack of transits in the summer period. This was a result of the summer data predating Hornsea Project Two construction which has subsequently resulted in the route shifting to a position within the Hornsea Four HVAC booster station search area shipping and navigation study area. The shift in this route is illustrated in Figure 16.3 and is anticipated to be a permanent change.

15.3.6 Commercial Ferry Activity

291. Throughout the survey periods nine unique commercial ferries were identified, with three undertaking regular routes in both survey periods; each of these is among the main routes identified in Section 15.3.5. Figure 15.47 presents a plot of commercial ferries recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the survey periods, colour-coded by route.



Hornsea Four Boundaries
- HVAC Booster Station Search Area
- HVAC Booster Station Search Area Study Area
- Offshore Export Cable Corridor
- Temporary Working Area

Commercial Ferry Route
- Tees - Zeebrugge
- North Shields - Ijmuiden
- Immingham - Tananger
- Immingham - Gothenburg
- Hull - Helsinki
- Other

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Commercial Ferries within HVAC booster station study area by type (28 days summer & winter)

REVISION: REV 01 | **DATE:** 19/05/2021

CO-ORDINATE SYSTEM
Mercator WGS84

DRAWN: AB | **CHECKED:** JM

Figure 15.47 Commercial ferries within Hornsea Four HVAC booster station search area shipping and navigation study area (28 days summer and winter 2020/21)

292. The most frequently transited commercial ferry route was a primarily P&O Ferries operated route between the Tees and Zeebrugge/Rotterdam, with the *Estraden* and *Bore Song* making on average two transits per day between them within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the survey periods. The DFDS Seaways operated route between North Shields and Ijmuiden identified in Section 15.1.6 for the Hornsea Four array area vessel traffic analysis was also observed consistently in the winter period, reflecting a shift in its position following the commencement of Hornsea Project Two construction. A small number of transits by vessels on this North Shields-Ijmuiden route closer inshore were also observed and are considered to be adverse weather transits. These are considered further in Section 16.3.

15.3.7 Recreational Vessel Activity

15.3.7.1 Vessel Traffic Survey Data

293. For the purposes of the NRA, recreational activity includes sailing and motor craft of between 2.4 and 24 m LOA.

294. Figure 15.48 presents a plot of recreational vessels recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout both survey periods.

295. One recreational vessel was detected during the summer survey period and one was detected in the winter period.

15.3.7.2 Royal Yachting Association Coastal Atlas

296. The limit of the AIS intensity grid provided in the *UK Coastal Atlas of Recreational Boating 2.0* (RYA, 2019) is approximately 1.5 nm west of the Hornsea Four HVAC booster station search area. However, given the proximity of the AIS intensity grid, it can be deduced that there is a relatively low density of recreational traffic passing in proximity to the Hornsea Four HVAC booster station search area, as reflected in the vessel traffic survey data.

297. The Coastal Atlas also suggests that there may be eastbound routeing out of Bridlington Bay passing in proximity to the Hornsea Four HVAC booster station search area.

15.3.8 Commercial Fishing Vessels

298. Figure 15.49 presents a plot of fishing vessels recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout both survey periods.

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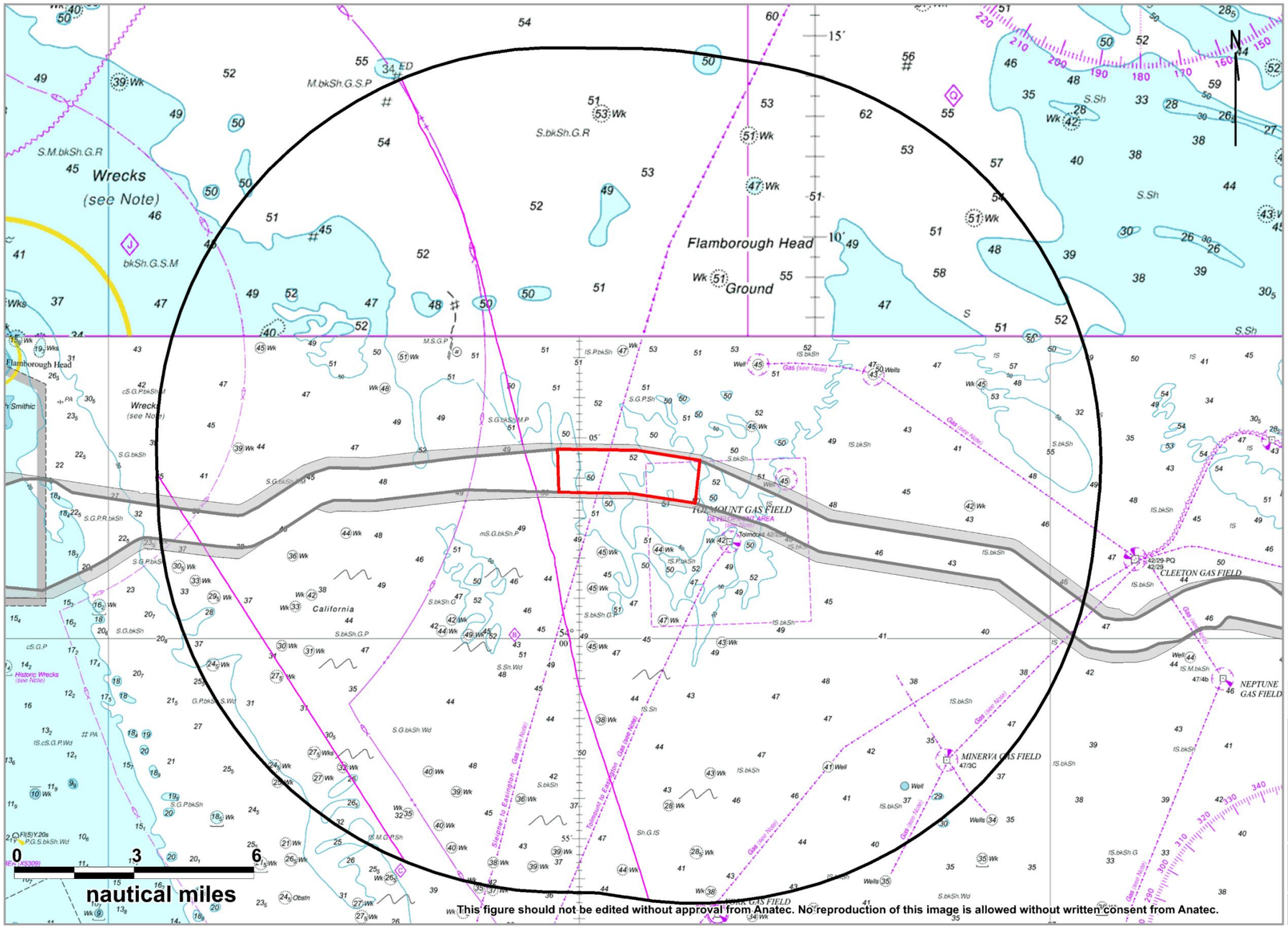


Hornsea Four Boundaries
- HVAC Booster Station Search Area
- HVAC Booster Station Search Area Study Area
- Offshore Export Cable Corridor
- Temporary Working Area

Vessel Type
- Recreational

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

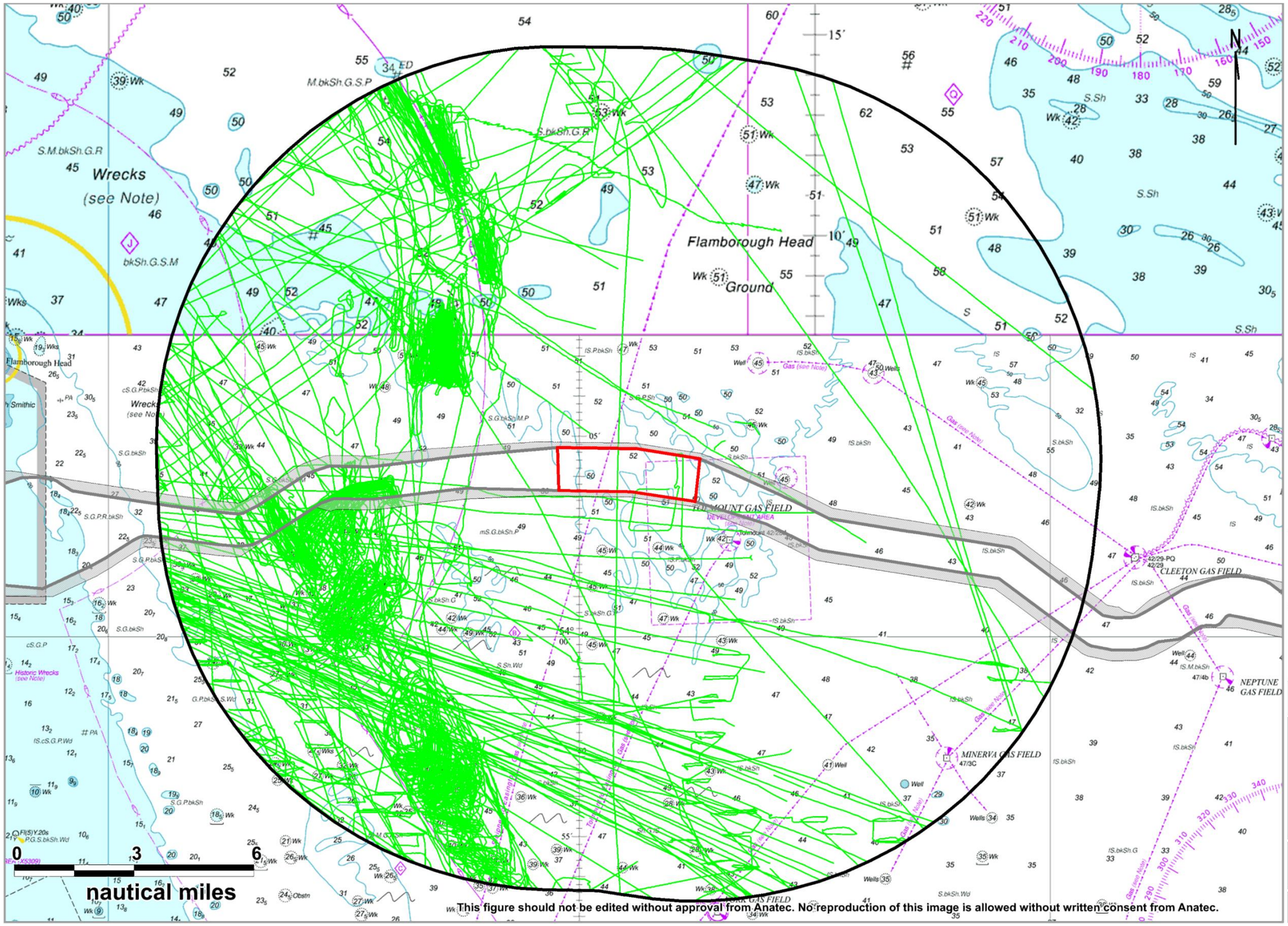
FIGURE TITLE
Recreational Vessels within HVAC booster station study area by type (28 days summer & winter)

REVISION: REV 01 | **DATE:** 19/05/2021

CO-ORDINATE SYSTEM
Mercator WGS84

DRAWN: AB | **CHECKED:** JM

Figure 15.48 Recreational vessels within Hornsea Four HVAC booster station search area shipping and navigation study area (28 days summer and winter 2020/21)



Hornsea Four Boundaries
- HVAC Booster Station Search Area
- HVAC Booster Station Search Area Study Area
- Offshore Export Cable Corridor
- Temporary Working Area

Vessel Type
- Fishing

PROJECT NAME
Hornsea Project Four Offshore Wind Farm

FIGURE TITLE
Fishing Vessels within HVAC booster station study area by type (28 days summer & winter)

REVISION: REV 01 | **DATE:** 19/05/2021

CO-ORDINATE SYSTEM
Mercator WGS84

DRAWN: AB | **CHECKED:** JM

Figure 15.49 Commercial fishing vessels within Hornsea Four HVAC booster station search area shipping and navigation study area (28 days summer and winter 2020/21)

299. Throughout the survey periods, an average of five unique fishing vessels per day passed within the Hornsea Four HVAC booster station search area shipping and navigation study area. A total of three fishing vessels were recorded on Radar, with the rest recorded on AIS, including a large proportion of fishing vessels under the mandatory 15 m length for AIS broadcast.

300. Fishing vessel movements were characteristic of both fishing vessels in transit and engaged in fishing activity. Fishing vessels were most prominent nearshore transiting in and out of Bridlington west of the Hornsea Four HVAC booster station search area and north of the Hornsea Four HVAC booster station search area where a moderate density of active fishing was observed. Active fishing was more prominent during the winter period than the summer period.

301. Flag State (nationality) information was available for all fishing vessels recorded on AIS within the Hornsea Four HVAC booster station search area shipping and navigation study area. The nationalities identified were the UK (97%), France (2%) and Netherlands (1%).

302. Fishing method information was also researched and available for 89% of fishing vessels recorded on AIS within the Hornsea Four HVAC booster station search area shipping and navigation study area. Of the fishing vessel methods identified, the most common were pots and traps (36%), boat dredges (30%) and demersal trawlers (11%).