RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Environmental Statement

Volume 7

Appendix 14-2 Navigational Risk Assessment

June 2024

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Dogger Bank South
Offshore Wind Farms
Navigational Risk Assessment

Prepared by	Anatec Limited
Presented to	RWE
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01	6th January 2023	Updated following RHDHV review
02	23rd January 2023	Updated following RWE review
03	23rd March 2023	Updated following further RWE review
04	4th April 2023	Updated following further RWE review
05	13th April 2023	Final for PEIR
06	17th November 2023	Updated for ES
07	21st November 2023	Updated following RHDHV review
08	20th December 2023	Updated following RWE review
09	19th March 2024	Final for ES (Anatec)

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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 European Union (EU) fishing vessels over 15m length are required to carry AIS.
Cable burial risk assessment	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.
Design envelope	A description of the range of possible elements that make up the design options under consideration. This envelope is used to define the Projects for Environmental Impact Assessment purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Embedded mitigation measure	A commitment made by Dogger Bank South (DBS) to reduce and/ or eliminate the potential for significant risks.
Environmental Statement (ES)	A document reporting the findings of the Environmental Impact Assessment (EIA) and produced in accordance with the EIA Directive as transposed into United Kingdom (UK) law by the EIA Regulations.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Future case	The assessment of risk based on the predicted growth in future shipping densities and traffic types as well as foreseeable changes in the marine environment.
Hazard	A potential threat to human life, health, property, or the environment.
International Maritime Organization (IMO) routeing measure	A predetermined shipping route established by the IMO.
Main commercial route	Defined transit route (mean position) of commercial vessels identified within the specified shipping and navigation study area.
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 combination of realistic parameters for the Projects anticipated to produce the worst-case consequences.
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 Risk Assessment (FSA).

Term	Definition
Offshore Renewable Energy Installation (OREI)	As defined by Marine Guidance Note (MGN) 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, OREI can mean offshore wind turbines and the associated electrical infrastructure such as offshore substations.
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.
The Applicants	The Applicants for the Projects are RWE Renewables UK Dogger Bank South (East) Limited and RWE Renewables UK Dogger Bank South (West) Limited. The Applicants are themselves jointly owned by the RWE Group of companies (51% stake) and Masdar (49% stake).
Significance of risk	The combination of frequency of occurrence and severity of consequence of a hazard.
Special Area of Conservation (SAC)	A protected area in the UK designated under one of several regulations to make a significant construction to conserving the habitats and species identified in the European Council Directive 92/43/EEC.
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.
User	The sufferer of a risk arising from a hazard.
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
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ALB	All-Weather Lifeboat
ARPA	Automatic Radar Plotting Aid
ATBA	Area to be Avoided
BWEA	British Wind Energy Association
CAA	Civil Aviation Authority
CBA	Cost Benefit Analysis
CD	Chart Datum
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
CTV	Crew Transfer Vessel
DBS	Dogger Bank South
DC	Direct Current
DECC	Department of Energy and Climate Change
DESNZ	Department for Energy Security and Net Zero
DfT	Department for Transport
dML	Deemed Marine Licence
DSC	Digital Selective Calling
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ERCoP	Emergency Response Cooperation Plan
ES	Environmental Statement
ESP	Electrical Switching Platform
ESRI	Environmental Systems Research Institute
ETRS89	European Terrestrial Reference System 1989
FLO	Fisheries Liaison Officer
FSA	Formal Safety Assessment
GIS	Geographical Information System
GLA	General Lighthouse Authority
GMDSS	Global Maritime Distress and Safety System

Abbreviation	Definition
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
GT	Gross Tonnage
HF	High Frequency
HMCG	His Majesty's Coastguard
HRA	Helicopter Refuge Area
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ILB	Inshore Lifeboat
IMO	International Maritime Organization
IPS	Intermediate Peripheral Structure
kt	Knot
kHz	Kilohertz
LAT	Lowest Astronomical Tide
LOA	Length Overall
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
Metocean	Meteorological Ocean
MF	Medium Frequency
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MMO	Marine Management Organisation
MoD	Ministry of Defence
MRCC	Maritime Rescue Coordination Centre
MSI	Maritime Safety Information
MSL	Mean Sea Level
NAVTEX	Navigational Telex
nm	Nautical Mile
nm^2	Square Nautical Mile
NPS	National Policy Statement
NRA	Navigational Risk Assessment

Abbreviation	Definition
NSIP	Nationally Significant Infrastructure Project
NUC	Not Under Command
OCP	Offshore Collector Platform
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
PLL	Potential Loss of Life
PNT	Positioning, Navigation, and Timing
Racon	Radar Beacon
Radar	Radio Detection and Ranging
RAM	Restricted in Ability to Manoeuvre
RNLI	Royal National Lifeboat Institution
RoPax	Roll-on/Roll-off Passenger
RoRo	Roll-on/Roll-off Cargo
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SLoO	Single Line of Orientation
SOLAS	International Convention for the Safety of Life at Sea
SONAR	Sound Navigation Ranging
SOV	Service Operations Vessel
SPS	Significant Peripheral Structure
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency
VTS	Vessel Traffic Service
WGS84	World Geodetic System 1984

1 Introduction

1.1 Background

1. Anatec was commissioned by RWE Renewables UK DBS East Ltd and RWE Renewables UK DBS West Ltd ('The Applicants') to undertake a Navigational Risk Assessment (NRA) for the proposed Dogger Bank South (DBS) East and DBS West offshore wind farms, collectively referred to as DBS offshore wind farms (hereafter referred to as 'the Projects'). The Projects consist of the DBS Array Areas and Offshore Export Cable Corridor, with the latter potentially including an electrical switching platform (ESP), located within an export cable platform search area. This NRA presents information on the Projects relative to the existing and estimated future navigation activity and forms the technical appendix to **Volume 7, Chapter 14: Shipping and Navigation (application ref: 7.14)**.

1.2 Navigational Risk Assessment

2. An Environmental Impact Assessment (EIA) is a process which identifies the environmental effects of a proposed development, 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) including the methodology document (Annex 1), this NRA includes:

- Outline of methodology applied in the NRA;
- Summary of consultation undertaken with shipping and navigation stakeholders to date;
- Lessons learnt from previous offshore wind farm developments;
- Summary of the project description relevant to shipping and navigation;
- Baseline characterisation of the existing environment;
- Discussion of potential impacts on navigation, communication and position fixing equipment;
- Cumulative and transboundary overview;
- Future case vessel traffic characterisation;
- Collision and allision risk modelling;
- Assessment of navigational risk (following the Formal Safety Assessment (FSA) process);
- Outline of embedded mitigation measures; and
- Completion of the MGN 654 Checklist.

3. Potential hazards are considered for each phase of development as follows:

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

4. The assessment of the Projects is based on a parameter-based design envelope approach, which is recognised in:

- Overarching National Policy Statement (NPS) for Energy (EN-1) (Department for Energy Security and Net Zero (Department for Energy Security and Net Zero (DESNZ)), 2023b);
- NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023a); and
- Planning Inspectorate Advice Note Nine: Rochdale Envelope (The Planning Inspectorate, 2018).

5. It is noted that the revised Overarching NPS (EN-1) and NPS for Renewable Energy (EN-3) (DESNZ, 2023a & 2023b) was published in November 2023, following previous consultation on draft versions earlier in 2023. These documents retain much of the policy outlined in the previous 2011 NPS and emphasises the importance of stakeholder engagement early and throughout the life of a development.

6. The shipping and navigation baseline has been developed and risk assessment undertaken based upon the information available and responses received at the time of preparation, including the Maximum Design Scenario (MDS) as discussed above.

2 Guidance and Legislation

2.1 Legislation

7. Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIP) specific to shipping and navigation is contained in the NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023). Additionally, planning policy on NSIPs for ports is contained in the NPS for Ports (Department for Transport (DfT), 2012). **Volume 7, Chapter 14: Shipping and Navigation (application ref: 7.14)** summarises the relevant matters within NPS EN-3 and the NPS for Ports, and where they are considered in the Environmental Statement (ES).

2.2 Primary Guidance

8. 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 International Maritime Organization (IMO) Rule-Making Process* (IMO, 2018).

9. 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, UK territorial seas or the UK Exclusive Economic Zone (EEZ).

10. The MCA require that their methodology (Annex 1 to 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 (see section 3.2). Across **Volume 7, Chapter 14: Shipping and Navigation (application ref: 7.14)** and the NRA both base and future case levels of risk have been identified and the measures required to ensure the future case remains broadly acceptable or tolerable with mitigation.

2.3 Other Guidance

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

- *MGN 372 Amendment 1 (Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs* (MCA, 2022);
- *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Guideline G1162 Guidance on the Marking of Offshore Man-Made Structures* (IALA, 2021 (a));

- *IALA Recommendation O-139 on The Marking of Man-Made Offshore Structures* (IALA, 2021 (b));
- *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 (c)); and
- *UK Marine Policy Statement* (HM Government, 2011).

2.4 Lessons Learnt

12. There is considerable benefit for the Applicants in the sharing of lessons learnt within the offshore industry. The NRA, and in particular the risk assessment undertaken in section 17, 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. This includes the shipping and navigation chapters of the ES for the Round 3 Dogger Bank offshore wind farm developments.

3 Navigational Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

13. A shipping and navigation user may only be exposed to a risk caused by a hazard if there is a pathway through which a risk may be transmitted between the source activity and the user. In cases where a user is exposed to a risk, the overall significance of risk to the user is determined. This process incorporates a degree of subjectivity. The assessments presented herein for shipping and navigation users have considered the following criteria:

- Baseline data and assessment;
- Expert opinion;
- Level of stakeholder concern;
- Time and/or distance of any deviation;
- Number of transits of specific vessels and/or vessel types; and
- Lessons learnt from existing offshore developments.

14. It is noted that, with regards to commercial fishing vessels, the methodology and assessment has been applied to hazards considering commercial fishing vessels in transit. A separate methodology and assessment have been applied in **Volume 7, Chapter 13: Commercial Fisheries (application ref: 7.13)** to consider hazards on commercial fishing vessels including safety risks which are directly related to commercial fishing activity (rather than commercial fishing vessels in transit) and risks of a commercial nature.

3.2 Formal Safety Assessment Process

15. The IMO FSA process (IMO, 2018) as approved by the IMO in 2018 under Maritime Safety Committee – Marine Environment Protection Committee (MEPC).2/circ. 12/Rev.2 has been applied to the risk assessment within this NRA and informs **Volume 7, Chapter 14: Shipping and Navigation (application ref: 7.14).**

16. The FSA process 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 by **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 assessment (investigation of the causes and initiating events and risks of the more important hazards identified in Step 1);
- Step 3 – Risk control options (identification of measures to control and reduce the identified risks);
- 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

3.2.1 Hazard Workshop Methodology

17. A key tool used in the NRA process is the Hazard Workshop which ensures that all hazards are identified, and the corresponding risks qualified in discussion with relevant consultees. **Table 3-1** and **Table 3-2** define the severity of consequence and the frequency of occurrence rankings that have been used to assess risks within the hazard log, completed based on the outputs of the Hazard Workshop.

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 risks – limited to users
3	Moderate	Multiple minor or single serious injury	Damage not critical to operations	Tier 2 limited external assistance required	Local reputational risks
4	Serious	Multiple serious injuries or single fatality	Damage resulting in critical impact on operations	Tier 2 regional assistance required	National reputational risks
5	Major	More than one fatality	Total loss of property	Tier 3 national assistance required	International reputational risks

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

18. The severity of consequence and frequency of occurrence are then used to define the significance of risk via a tolerability matrix approach as shown in **Table 3-3**. The significance of risk is defined as Broadly Acceptable (low risk), Tolerable (intermediate risk), or Unacceptable (high risk).

Table 3-3 Tolerability Matrix and Risk Rankings

Severity of Consequence						
	5	Tolerable	Tolerable	Unacceptable	Unacceptable	Unacceptable
	4	Broadly Acceptable	Tolerable	Tolerable	Unacceptable	Unacceptable
	3	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable	Unacceptable
	2	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable
	1	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable
		1	2	3	4	5
		Frequency of Occurrence				

(red)	Unacceptable (high risk)
(orange)	Tolerable (intermediate risk)
(green)	Broadly Acceptable (low risk)

19. Once identified, the significance of risk associated with a hazard will be assessed to ensure it is ALARP. Further risk control measures may be required to further mitigate a hazard in accordance with the ALARP principles. Broadly Acceptable and Tolerable with Mitigation risks are ALARP, whilst Unacceptable risks are not considered to be ALARP.

3.3 Methodology for Cumulative Risk Assessment

20. The hazards identified in the FSA will also be assessed for cumulative risks with the inclusion of other projects and proposed developments. Given the varying type, status and location of developments, a tiered approach to cumulative risk assessment has been applied, which splits developments into tiers depending upon:

- Project status;
- Proximity to the Projects;
- Level of interaction with baseline traffic relevant to the Projects;
- Leve of concern raised during consultation; and
- Data confidence.

21. The tiers are summarised in **Table 3-4**, with the level of assessment undertaken for each tier included. It is noted that an aggregate of the criterion is used to determine the tier of each development. The maximum distance within which developments are considered for the cumulative risk assessment is dependent upon the type of development:

- Offshore wind farms – up to 50 nautical miles (nm) from the DBS Array Areas and up to 5nm from the Offshore Export Cable Corridor;
- Oil and gas infrastructure – up to 10nm from the DBS Array Areas and up to 5nm from the Offshore Export Cable Corridor;

- Marine aggregate dredging areas – up to 25nm from the DBS Array Areas and up to 5nm from the Offshore Export Cable Corridor; and
- Sub-sea cables – up to 2nm from the DBS Array Areas and up to 2nm from the Offshore Export Cable Corridor.

22. These distances have been selected on the basis that at greater distances there is no direct pathway between the Projects and other developments.

23. The cumulative screening is provided in section 14.

Table 3-4 Cumulative Development Screening Summary

Tier	Minimum Development Status	Distance from the Projects	Interaction with Baseline Traffic	Consultation Responses	Data Confidence Level	Level of Cumulative Risk Assessment
1	Consented or under determination	*Offshore wind farms:* ▪ Up to 25nm from the DBS Array Areas; ▪ Up to 2nm from the Offshore Export Cable Corridor; or ▪ Up to 5nm from the export cable platform search area. *Oil and gas infrastructure:* ▪ Up to 5nm from the DBS Array Areas; ▪ Up to 2nm from the Offshore Export Cable Corridor; or ▪ Up to 2nm from the export cable platform search area. *Marine aggregate dredging areas:* ▪ Up to 15nm from the DBS Array Areas; ▪ Up to 2nm from the Offshore Export Cable Corridor; or ▪ Up to 2nm from the export cable platform search area. *Sub-sea cables:* ▪ Up to 2nm from the DBS Array Areas; ▪ Up to 2nm from the Offshore Export Cable Corridor; or ▪ Up to 2nm from the export cable platform search area.	▪ May impact a main commercial route passing within 1nm of the DBS Array Areas or the ESP; and/or ▪ Interacts with traffic which may be directly displaced by the DBS Array Areas or the ESP.	Raised as having possible cumulative effect during consultation.	High	Quantitative cumulative re-routeing of main commercial routes

Tier	Minimum Development Status	Distance from the Projects	Interaction with Baseline Traffic	Consultation Responses	Data Confidence Level	Level of Cumulative Risk Assessment
2	Consented or under determination	▪ May impact a main commercial route passing within 1nm of the DBS Array Areas and/or interacts with traffic which may be directly displaced by the DBS Array Areas. *Offshore wind farms:* ▪ Between 25 and 50nm from the DBS Array Areas; ▪ Between 2 and 5nm from the Offshore Export Cable Corridor; or ▪ Between 5 and 10nm from the export cable platform search area. *Oil and gas infrastructure:* ▪ Between 5 and 10nm from the DBS Array Areas; ▪ Between 2 and 5nm from the Offshore Export Cable Corridor; or ▪ Between 2 and 5nm from the export cable platform search area. *Marine aggregate dredging areas:* ▪ Between 15 and 25nm from the DBS Array Areas; ▪ Between 2 and 5nm from the Offshore Export Cable Corridor; or ▪ Between 2 and 5nm from the export cable platform search area. *Sub-sea cables:* ▪ Up to 2nm from the DBS Array Areas; ▪ Up to 2nm from the Offshore Export Cable Corridor; or ▪ Up to 2nm from the export cable platform search area.	▪ May impact a main commercial route passing within 1nm of the DBS Array Areas or the ESP; and/or ▪ Interacts with traffic which may be directly displaced by the DBS Array Areas or the ESP.	Raised as having possible cumulative effect during consultation.	Medium	Qualitative cumulative re-routeing of main commercial routes

Tier	Minimum Development Status	Distance from the Projects	Interaction with Baseline Traffic	Consultation Responses	Data Confidence Level	Level of Cumulative Risk Assessment
3	Scoped or under examination	▪ Does not impact a main commercial route passing within 1nm of the DBS Array Areas and does not interact with traffic which may be directly displaced by the DBS Array Areas. *Offshore wind farms:* ▪ Up to 50nm from the DBS Array Areas; ▪ Up to 5nm from the Offshore Export Cable Corridor; or ▪ Up to 10nm from the export cable platform search area. *Oil and gas infrastructure:* ▪ Up to 10nm from the DBS Array Areas; ▪ Up to 5nm from the Offshore Export Cable Corridor; or ▪ Up to 5nm from the export cable platform search area. *Marine aggregate dredging areas:* ▪ Up to 30nm from the DBS Array Areas; ▪ Up to 5nm from the Offshore Export Cable Corridor; or ▪ Up to 5nm from the export cable platform search area. *Sub-sea cables:* ▪ Up to 2nm from the DBS Array Areas; ▪ Up to 2nm from the Offshore Export Cable Corridor; or ▪ Up to 2nm from the export cable platform search area.	▪ Does not impact a main commercial route passing within 1nm of the DBS Array Areas or the ESP; and/or ▪ Does not interact with traffic which may be directly displaced by the DBS Array Areas or the ESP.	No concerns raised.	Low	Qualitative assumptions of routeing only

3.4 Study Areas

24. A separate 10nm buffer has been applied to each of the DBS Array Areas; the 10nm buffer applied to the DBS East Array Area is hereafter referred to as the 'DBS East study area' and the 10nm buffer applied to the DBS West Array Area is hereafter referred to as the 'DBS West study area'. Separate buffers have been defined due to coverage limitations for vessel traffic data collection from the on-site survey vessel (see section 5.2).

25. The radius of 10nm is standard for shipping and navigation assessment and has been used in the majority of UK offshore wind farm NRAs. These study areas have been defined in order to provide local context to the analysis of risks by capturing the relevant routes, vessel traffic movements and historical incident data within and in proximity to the Projects. Navigational features wholly or partially outside the study area are considered where appropriate.

26. Additionally, a minimum 2nm buffer has been applied to the Offshore Export Cable Corridor, hereafter referred to as the 'Offshore Export Cable Corridor study area'. This study area omits the portion of the Offshore Export Cable Corridor funnelling out to the western boundary of DBS West noting that this area is fully captured by the DBS West study area.

27. A minimum 10nm buffer has been applied to the export cable platform search area, hereafter referred to as the 'export cable platform search area study area'.

28. The DBS East, DBS West, and Offshore Export Cable Corridor study areas are presented in **Figure 3-2**. The export cable platform search area study area is presented in **Figure 3-3**.

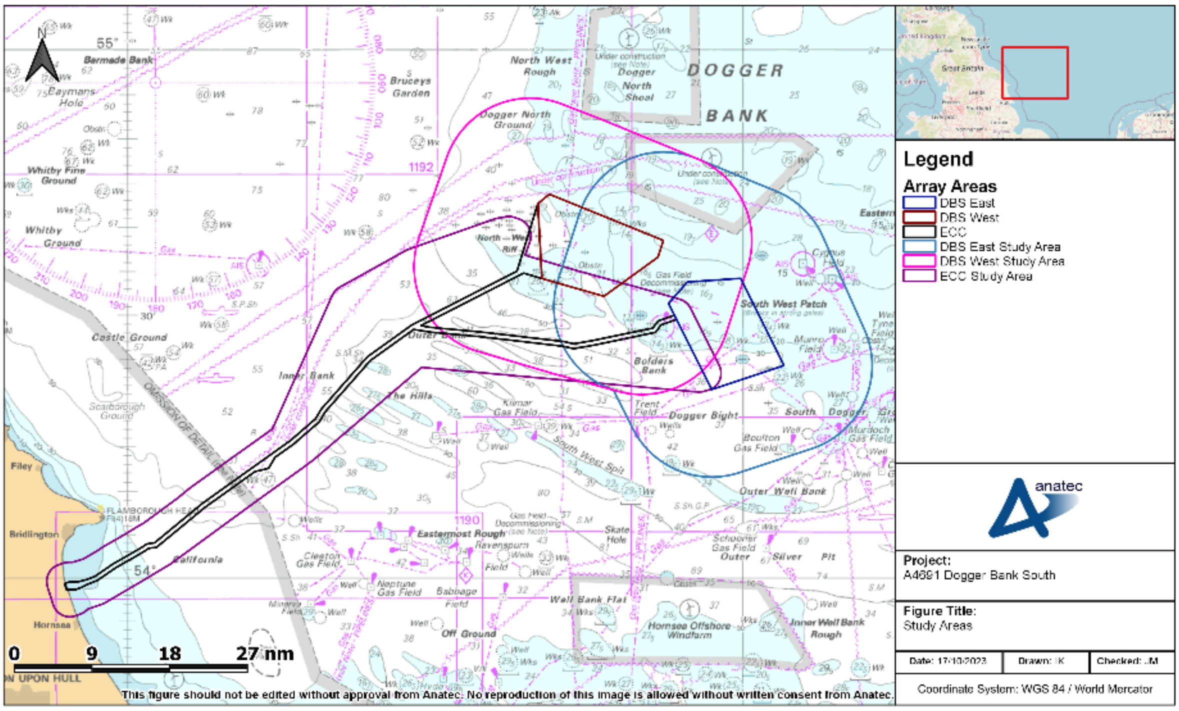

Figure 3-2 Overview of Study Areas

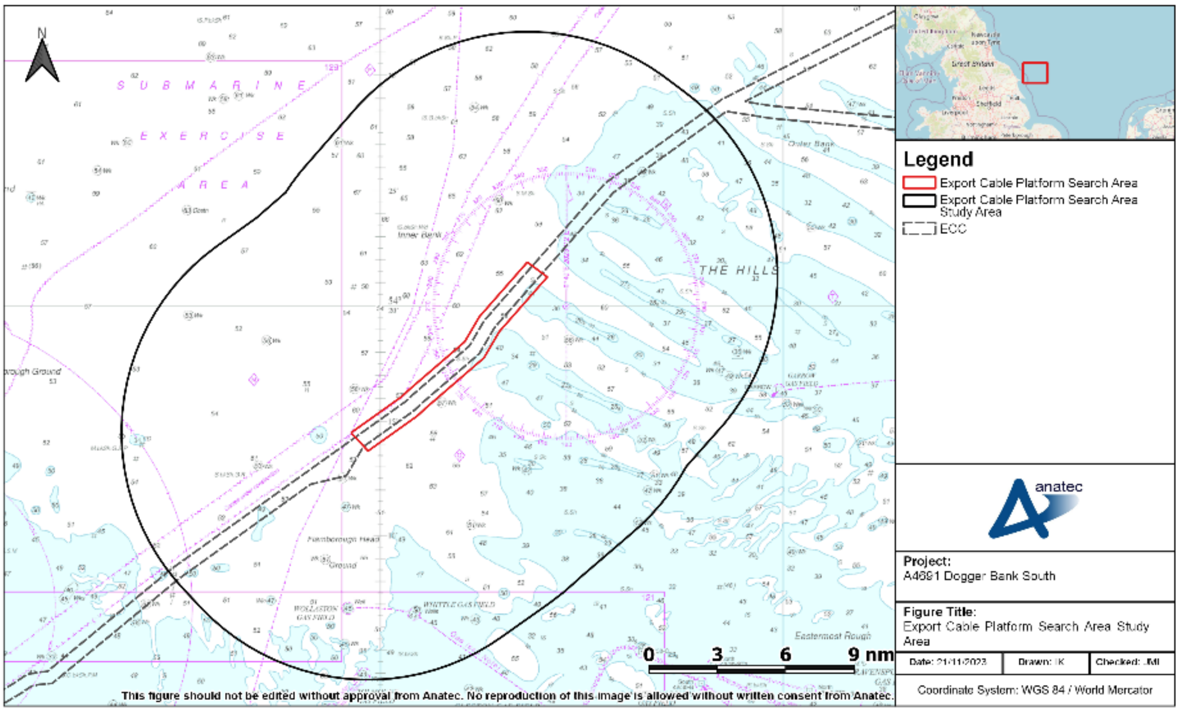

Figure 3-3 Overview of the Export Cable Platform Search Area Study Area

4 Consultation

4.1 Stakeholders Consulted in the Navigational Risk Assessment Process

29. 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;
- UK Major Ports Group;
- Perenco;
- DEME Group;
- Neptune Energy; and
- Tidewater.

30. The key issues raised including via dedicated meetings, the Scoping Opinion (Planning Inspectorate, 2022), and section 42 consultation and where they are addressed are provided in **Volume 7, Appendix 14-1: Shipping and Navigation Consultation Responses (application ref: 7.14.14.1)**.

31. Meetings have included the Hazard Workshops (see section 4.2) and standalone consultation meetings held both prior to, and following, the Scoping and PEIR stages.

32. As well as consulting with the organisations outlined, 33 Regular Operators identified from the vessel traffic surveys were provided with an overview of the Projects and offered the opportunity to provide feedback. Specific questions were included to aid Regular Operators wishing to make a response, including in relation to changes in routeing. The Regular Operator letter is presented in full in Appendix D.

33. The full list of Regular Operators identified and subsequently contacted is provided below, with the UK Chamber of Shipping also provided information for circulation with members:

- Sentinel Marine;
- DFDS Seaways;
- Vroon Offshore;
- Tidewater;
- Nørresundby Rederi;
- Solstad;
- Atlantica Shipping;
- Golden Energy;
- Smyril Line;
- Eckero Rederi;
- HJH Shipping;
- Aggregate Industries;
- Sea Cargo;
- Muller Rederij;
- Samskip;
- Multraship;
- Jebsen Shipping;
- Altera;
- Western Shipping;
- Nordic Hamburg;

- OS Energy;
- MF Shipping;
- Doehle;
- Vogelsang Jan Reederei;
- Navalis;
- Com Sea;
- Boskalis;
- CMA CGN;
- Vadero Shipping;
- Eimskip;
- Island Offshore;
- Remoy; and
- Finnlines.

4.2 Hazard Workshops

34. A key element of the consultation undertaken were the Hazard Workshops, intended as a meeting of local and national marine stakeholders to identify and discuss potential shipping and navigation hazards. Using the information gathered from the Hazard Workshops, a hazard log was produced to be used as input into the risk assessment undertaken in section 17. This ensured that expert opinion and local knowledge was incorporated into the hazard identification process and that the hazard log was site-specific.

4.2.1 Hazard Workshop Attendance

35. Two Hazard Workshops have been undertaken – one prior to the PEIR stage and one following project design changes made for the ES stage.

36. The first Hazard Workshop was held in London on 25th April 2023, featuring a hybrid of in-person and remote attendance. The second Hazard Workshop was held remotely on 9th November 2023. The following organisations attended at least one of the Hazard Workshops:

- MCA;
- UK Chamber of Shipping;
- Cruising Association;
- UK Major Ports Group;
- Perenco;
- DEME Group;
- Neptune Energy; and
- Tidewater.

4.2.2 Hazard Workshop Process and Hazard Log

37. During the Hazard Workshops, key maritime hazards associated with the construction, operation and maintenance and decommissioning of the Projects were identified and discussed. Where appropriate, hazards were considered by vessel type to ensure risk control options could be identified on a type-specific basis.

38. Following the first Hazard Workshop, the risks associated with the identified hazards were ranked in the hazard log based upon the discussions held during the workshop. Where appropriate, mitigation measures were identified, including any additional

measures required to reduce the risks to ALARP. The hazard log was then provided to attendees for comment.

39. Following the second Hazard Workshop, the hazard log was reviewed and updated based upon the discussions held during the workshop and again provided to attendees.

40. The hazard log has been used to inform the risk assessment undertaken in section 17 of the NRA, and is presented in full in Appendix B.

5 Data Sources

41. This section summarises the main data sources used to characterise the shipping and navigation baseline relative to the Projects.

5.1 Summary of Data Sources

42. The main data sources used to characterise the shipping and navigation baseline relative to the Projects are outlined in **Table 5-1**.

Table 5-1 Data Sources Used to Inform the Shipping and Navigation Baseline

Data	Source(s)	Purpose
Vessel traffic	Summer vessel traffic survey data consisting of Automatic Identification System (AIS), Radio Detection and Ranging (Radar) and visual observations for the DBS East study area (14 days, 3 to 17 July 2022) recorded from a dedicated survey vessel on-site.	Characterising vessel traffic movements within and in proximity to the DBS Array Areas in line with MGN 654 (MCA, 2021) requirements.
	Summer vessel traffic survey data consisting of AIS, Radar and visual observations for the DBS West study area (14 days, 17 to 31 July 2022) recorded from a dedicated survey vessel on-site.	
	Winter vessel traffic survey data consisting of AIS, Radar and visual observations for the DBS East study area (14 days, 16 to 30 October 2022) recorded from a dedicated survey vessel on-site.	
	Winter vessel traffic survey data consisting of AIS, Radar and visual observations for the DBS West study area (14 days, 30 October to 13 November 2022) recorded from a dedicated survey vessel on-site.	
	Summer vessel traffic data consisting of AIS for the Offshore Export Cable Corridor study area (14 days, 17 to 31 July 2022) recorded from shore based receivers and a dedicated survey vessel at DBS West.	
	Winter vessel traffic data consisting of AIS for the Offshore Export Cable Corridor study area (14 days, 30 October to 13 November 2022) recorded from shore based receivers and a dedicated survey vessel at DBS West.	
	Winter vessel traffic survey data consisting of AIS, Radar and visual observations for the export cable platform search area study area (14 days, 24 January to 07 February 2023) recorded from a dedicated survey vessel on-site.	Characterising vessel traffic movements within and in proximity to Export cable platform search area in line with MGN 654 (MCA, 2021) requirements.

Data	Source(s)	Purpose
	Summer vessel traffic survey data consisting of AIS, Radar and visual observations for the export cable platform search area study area (14 days, 17 June to 01 July 2023) recorded from a dedicated survey vessel on-site.	
	Anatec's ShipRoutes database (2023).	Secondary source for characterising marine traffic movements including cumulatively within and in proximity to the DBS Array Areas.
	Winter vessel traffic survey data consisting of AIS, Radar and visual observations for the DBS East study area (14 days, 13 to 27 January 2022) recorded from a dedicated survey vessel on-site.	
	Winter vessel traffic survey data consisting of AIS, Radar and visual observations for the DBS West study area (14 days, 28 January to 13 February 2022) recorded from a dedicated survey vessel on-site.	
	Vessel traffic data consisting of AIS for the DBS East and DBS West study areas (April to July 2022) recorded from a survey vessel on-site.	
	UK ports: ship arrivals (Department for Transport (DfT), 2023).	Characterising vessel traffic movements in relation to ports local to the Projects.
Maritime incidents	Maritime Accident Investigation Branch (MAIB) marine accidents database (2002 to 2021).	Review of maritime incidents within and in proximity to the Projects.
	Royal National Lifeboat Institution (RNLI) incident data (2013 to 2022).	
	DfT UK civilian Search and Rescue (SAR) helicopter taskings (2015 to 2022).	
Marine aggregate dredging	Marine aggregate dredging areas (licenced and active) (The Crown Estate, 2023).	Characterising marine aggregate dredging areas within and in proximity to the Projects.
Other navigational features	Admiralty Charts 266, 1187, 1191, and 1192 (United Kingdom Hydrographic Office (UKHO), 2023).	Characterising other navigational features in proximity to the Projects.
	Admiralty Sailing Directions North Sea (West) Pilot NP54 (UKHO, 2021).	
Weather	Wind direction data from the Applicants.	Characterising weather conditions in proximity to the Project.
	Significant wave height data from the Applicants and C2Wind.	
	Tidal data from Admiralty Charts 266 and 1191.	
	Visibility data from EHDV and EHJA stations.	

5.2 Vessel Traffic Surveys

5.2.1 Array Areas

43. Three vessel traffic surveys have been undertaken for the DBS Array Areas, consisting of two winter surveys (14 days at each array area in January/February 2022 and October/November 2022) and one summer survey (14 days at each array area in July 2022).

44. The first winter vessel traffic survey and summer vessel traffic survey were undertaken by the guard vessel *Star of Hope*, while the second winter vessel traffic survey was undertaken by the guard vessel *Karima*. For each survey, the survey vessel was situated at the DBS East Array Area for 14 full days and the DBS West Array Area for 14 full days.

45. The first winter vessel traffic survey was undertaken prior to the start of offshore construction works for the Dogger Bank A offshore wind farm (see section 7.1) and was undertaken more than 24 months prior to the time of the Application. Therefore, this survey is considered as a secondary source only, with the summer and second winter vessel traffic surveys (totalling 28 days at each of the DBS Array Areas) serving as the MGN 654 compliant vessel traffic data.

46. A number of vessel tracks recorded during the survey periods were deemed as temporary (non-routine) in nature, such as the tracks of the survey vessels themselves and the tracks of vessels associated with the ongoing construction of Dogger Bank A, and these vessels were therefore excluded from the vessel traffic baseline. Other temporary traffic excluded from the analysis included the tracks of a vessel undertaking a geophysical survey.

47. The vessel traffic survey data collected for the DBS Array Areas is assessed in full in section 10.1.

5.2.2 Export Cable Platform Search Area

48. Two vessel traffic surveys have been undertaken for the export cable platform search area, consisting of a winter survey in January/February 2023, and a summer survey in June 2023.

49. The winter vessel survey was undertaken by the *Karima*, whilst the summer vessel survey was undertaken by the *Star of Hope.* For each survey, the survey vessel was situated at the centre of the export cable platform search area.

50. As with the array area vessel surveys, a number of vessel tracks recorded during the survey periods were deemed as temporary. These vessels were again excluded from the vessel traffic baseline.

51. The vessel traffic survey data collected for the export cable platform search area is assessed in full in section 10.3.

5.3 Data Limitations

5.3.1 Automatic Identification System Data

52. 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 500GT not engaged on international voyages, passenger vessels irrespective of size built on or after 1st July 2002, and fishing vessels over 15 metres (m) length overall (LOA).

53. Therefore, for the vessel traffic surveys larger vessels were recorded on AIS, while smaller vessels without AIS installed (including fishing vessels under 15m LOA and recreational craft) were recorded, where possible, on the Automatic Radar Plotting Aid (ARPA) Radar on board the survey vessel. A proportion of smaller vessels also carry AIS voluntarily, typically utilising a Class B AIS device.

54. Throughout the summer surveys, approximately 96% of vessel tracks were recorded via AIS with the remaining 4% recorded via Radar. Throughout the winter surveys, approximately 98% of vessel tracks were recorded via AIS with the remaining 2% recorded via Radar.

5.3.2 Historical Incident Data

55. Although all UK commercial vessels are required to report accidents to the Marine Accident Investigation Branch (MAIB), non-UK vessels do not have to report unless they are in a UK port or within 12nm territorial waters (noting that the shipping and navigation study area is not located within 12nm 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.

56. The Royal National Lifeboat Institution (RNLI) incident data cannot be considered comprehensive of all incidents in the study areas. Although hoaxes and false alarms are excluded, any incident to which a RNLI resource was not mobilised has not been accounted for in this dataset.

5.3.3 United Kingdom Hydrographic Office Admiralty Charts

57. The United Kingdom Hydrographic Office (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 Project Description Relevant to Shipping and Navigation

58. The NRA reflects the design envelope which is detailed in full in **Volume 7**, **Chapter 5: Project Description (application ref: 7.5)**. The following subsections outline the maximum extent of the Projects for which any shipping and navigation hazards are assessed.

6.1 Dogger Bank South Array Areas

59. The DBS Array Areas are located approximately 55nm east of the Yorkshire coast. The total area covered by the DBS Array Areas is 205 square nautical miles (nm^2), with the DBS East Array Area covering $102nm^2$, and the DBS West Array Area covering $103nm^2$. Charted water depths within the DBS Array Areas range between 12 and 36m below Chart Datum (CD). The total area covered by the Offshore Export Cable Corridor is approximately $64nm^2$, with charted water depths ranging between zero (nearshore) and 69m below CD.

60. The key coordinates defining the boundary of the Offshore Development Area are illustrated in **Figure 6-1** and provided in **Table 6-1** using World Geodetic System 1984 (WGS84).

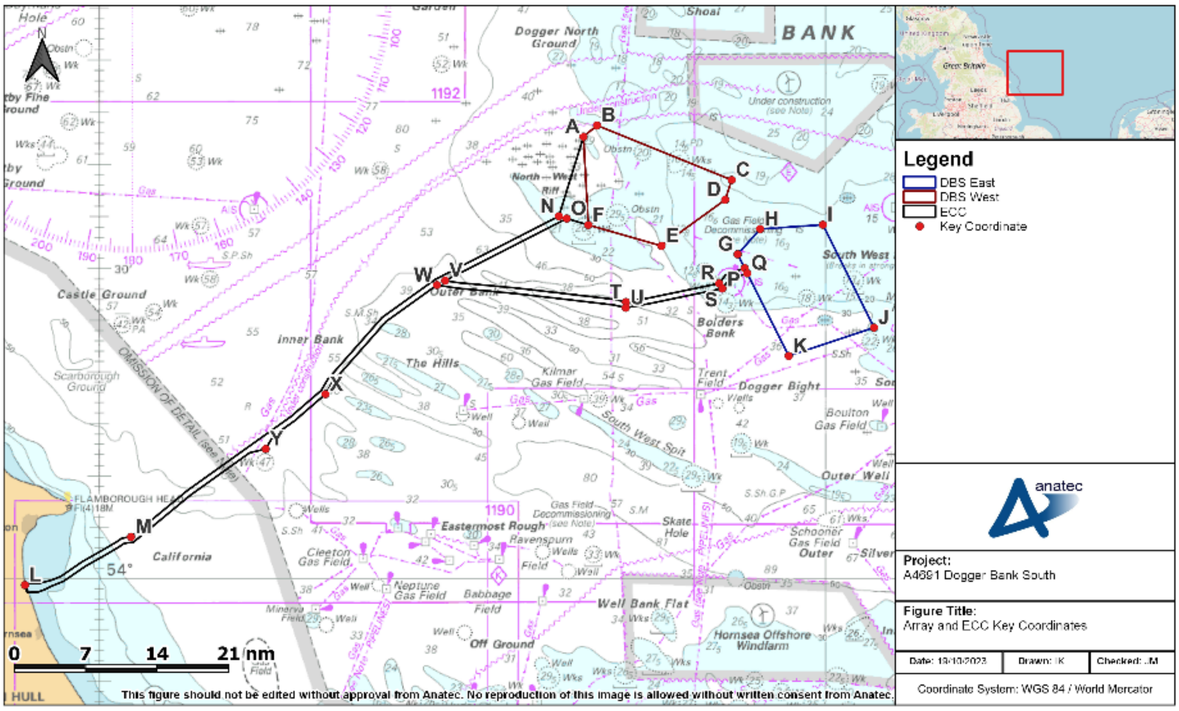

Figure 6-1 Key Coordinates for the Offshore Development Area

Table 6-1 Key Coordinates for the Offshore Development Area

Point	Latitude	Longitude		Point	Latitude	Longitude
A	54° 42′ 41.24″ N	001° 20′ 03.04″ E		N	54° 35′ 03.28″ N	001° 15′ 58.88″ E
B	54° 43′ 45.70″ N	001° 22′ 17.34″ E		O	54° 34′ 49.94″ N	001° 17′ 16.62″ E
C	54° 38′ 32.07″ N	001° 44′ 33.30″ E		P	54° 30′ 03.24″ N	001° 46′ 42.44″ E
D	54° 36′ 38.22″ N	001° 43′ 29.49″ E		Q	54° 29′ 34.11″ N	001° 47′ 07.63″ E
E	54° 32′ 12.21″ N	001° 32′ 56.72″ E		R	54° 28′ 35.37″ N	001° 42′ 28.94″ E
F	54° 34′ 12.92″ N	001° 20′ 50.49″ E		S	54° 28′ 06.14″ N	001° 43′ 00.55″ E
G	54° 31′ 23.80″ N	001° 45′ 32.72″ E		T	54° 26′ 47.90″ N	001° 27′ 04.24″ E
H	54° 33′ 49.50″ N	001° 49′ 15.70″ E		U	54° 26′ 14.91″ N	001° 27′ 02.72″ E
I	54° 34′ 14.05″ N	001° 59′ 38.39″ E		V	54° 28′ 51.34″ N	000° 57′ 10.28″ E
J	54° 24′ 19.83″ N	002° 08′ 05.61″ E		W	54° 28′ 26.01″ N	000° 55′ 48.68″ E
K	54° 21′ 35.80″N	001° 53′ 59.58″ E		X	54° 17′ 54.38″ N	000° 37′ 23.41″ E
L	53° 59′ 22.22″ N	000° 12′ 18.59″ W		Y	54° 12′ 35.66″ N	000° 27′ 29.53″ E
M	54° 04′ 02.99″ N	000° 05′ 13.72″ E				

61. It is noted that the DBS Array Areas have been refined from the PEIR stage, with the western extent of the DBS West Array Area reduced and a separation between the DBS Array Areas created. Various drivers contributed to this refinement including shipping and navigation – the refinement creates additional sea room to minimise vessel displacement and give users additional options for safe navigation.

6.2 Surface Infrastructure

6.2.1 Indicative Worst Case Array Layout

62. Up to 208 surface structures would be installed, across the two Projects, consisting of 200 wind turbines and eight platforms. One of the platforms may be located within the export cable platform search area.

63. Although the final locations of array infrastructure have not yet been defined, two indicative array layout options are considered in this NRA – one incorporating a full build out of the DBS Array Areas, and another which demonstrates the minimum spacing. The characteristics of the two layouts are summarised in **Table 6-2**.

Table 6-2 Summary of Parameters and Relevant Hazards for Each Array Layout

	Layout A	Layout B
Parameter		
Level of build out	Full	Partial
Number of structures	208	208
Minimum spacing (excluding perimeter)	3,000m	830m
Dense perimeter	Yes	No
Hazard		
Vessel displacement and increased third-party vessel to vessel collision risk	✓	
Third-party to project vessel collision risk	✓	
Creation of vessel to structure allision risk (external)	✓	
Creation of vessel to structure allision risk (internal)		✓
Reduction in emergency response provision including SAR capability		✓

64. The full build out and minimum spacing array layouts are presented in **Figure 6-2** and **Figure 6-3**, respectively.

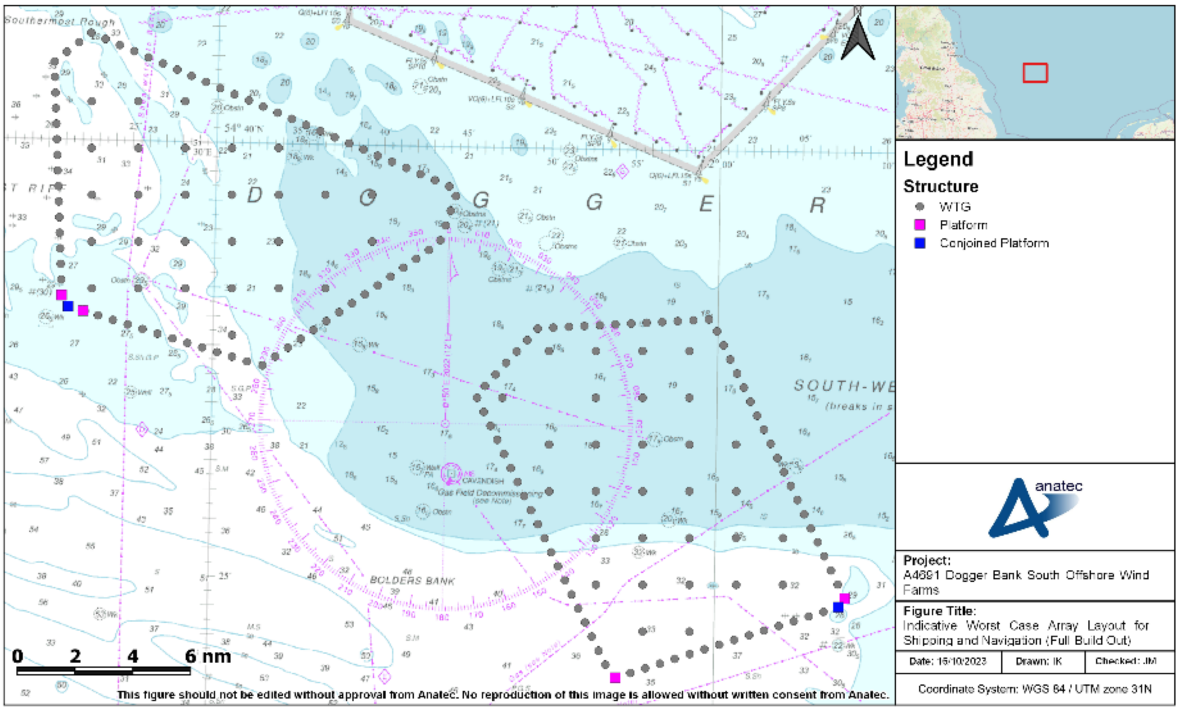

Figure 6-2 Indicative Worst Case Array Layout for Shipping and Navigation (Layout A)

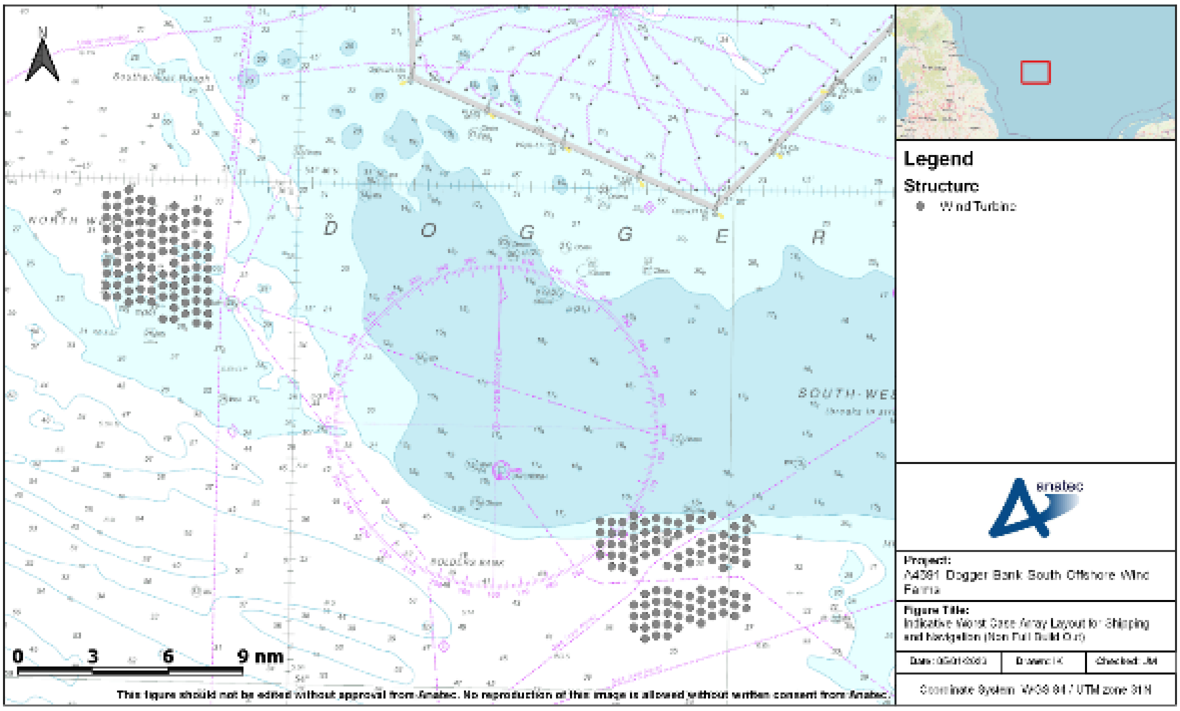

Figure 6-3 Indicative Worst Case Array Layout for Shipping and Navigation (Layout B)

65. The final array layout would be MGN 654 compliant (inclusive of a safety justification for a Single Line of Orientation (SLoO) should this be brought forward) and would be agreed with the MCA and Trinity House post consent. An allowance for micrositing

within a 50m radius of any wind turbine would be included. There are no plans to designate the DBS Array Areas as Areas to be Avoided (ATBA).

66. For the purposes of this NRA bridge links used between platforms (see Section 6.2.3) are modelled as a single larger structure, i.e., two adjacent platforms.

6.2.2 Wind Turbines

67. The wind turbines within the indicative array layouts each have an indicative rotor diameter of 344m and a minimum blade tip height of 34m above Mean Sea Level (MSL), noting that these values represent the worst case for shipping and navigation.

68. Four-legged piled jacket foundations have been considered as the MDS for shipping and navigation as this foundation type provides the maximum structure dimensions at the sea surface. The MDS wind turbine measurements assuming use of four-legged piled jacket foundations are provided in **Table 6-3**.

Table 6-3 MDS for Shipping and Navigation – Wind Turbines

Parameter	MDS for shipping and navigation
Foundation type	Four-legged piled jacket
Dimensions at sea surface	27.5×27.5m
Maximum upper blade tip height (MHWS)	394m
Minimum air gap (above MSL)	34m
Indicative rotor diameter	344m

69. Other foundation types under consideration include monopiles. Descriptions of each foundation type under consideration are provided in **Volume 7, Chapter 5: Project Description (application ref: 7.5)**.

6.2.3 Platforms

70. The OCPs, ESP, and accommodation platform may be installed on up to eight-legged jacket or monopile foundations. For the potential ECR platform only, gravity base foundations remain a third option, but all would have maximum topside dimensions of 125×100m.

71. Bridge links may be used to link adjacent platforms within the DBS Array Areas, with such platforms separated by up to 100m. For the purposes of collision and allision risk modelling, the most sensitive positions within Layout A have been defined for bridge links with a single structure encompassing adjacent platforms (250×100m) modelled. Bridge links are considered qualitatively where required in the risk assessment.

72. The maximum height of a bridge link will be 105m above MHWS.

73. While the OCPs and accommodation would only be located within the DBS Array Areas, the ESP may be located within either the DBS Array Areas or the Offshore Export Cable Corridor, and specifically within the export cable platform search area. To inform the collision and allision risk modelling, a worst case location for the ESP has been defined at the southern extent of the export cable platform search area where the highest density main commercial route in the region passes in closest proximity.

74. The worst case location of the ESP is presented in **Figure 6-4**.

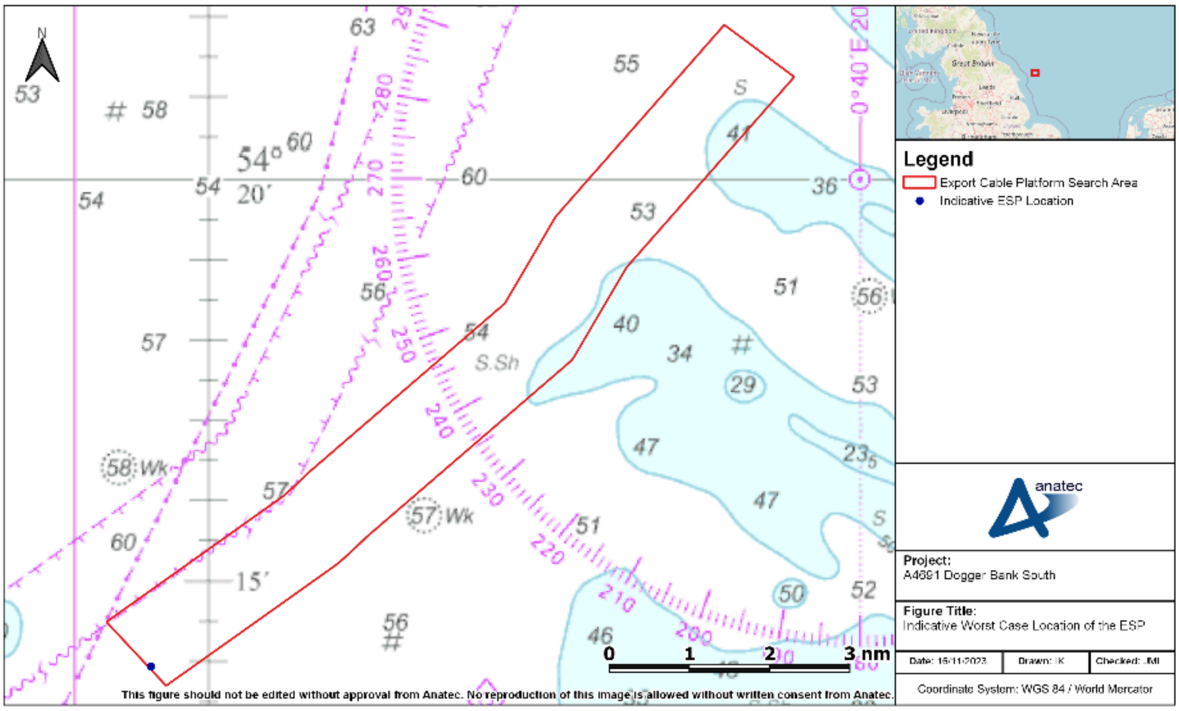

Figure 6-4 Indicative Worst Case Location of the ESP

6.3 Sub-sea Cables

75. Various types of sub-sea cables would be installed and may be categorised as either array cables, inter-platform cables, or offshore export cables. Each of these is summarised in the following subsections, noting that array cables will carry High Voltage Alternating Current (HVAC) only, offshore export cables will carry High Voltage Direct Current (HVDC) only, and inter-platform cables may carry either HVAC or HDVC.

6.3.1 Array Cables

76. The array cables would connect individual wind turbines to OCPs. Up to 350nm of array cables would be required, with the final length dependent on the final array layout. There would be no array cable crossings of other sub-sea cables, although

there would be up to 40 pipeline crossings. All array cables would be installed within the DBS Array Areas.

6.3.2 Inter-Platform Cables

77. The inter-platform cables would connect the OCPs to each other with a combined length of up to 185nm. There would be up to 23 cable or pipeline crossings per inter-platform cable.

6.3.3 Offshore Export Cables

78. The offshore export cables would carry the energy generated by the wind turbines from the DBS Array Areas to shore. Up to four offshore export cables would be required with a length of up to 83nm per offshore export cable for DBS West, and up to 102nm per offshore export cable for DBS East, with these cables to be installed within the Offshore Export Cable Corridor. There would be up to 11 cable or pipeline crossings per offshore export cable. There would be an indicative separation between offshore export cables of 50m.

6.3.4 Cable Burial

79. Where available, the primary means of cable protection would be by seabed burial. The extent and method by which the sub-sea cables would be buried will depend on the results of a detailed seabed survey of the final sub-sea cable routes and associated cable burial risk assessment. The target burial depth for each type of sub-sea cable is:

- Array cables – 0.5 to 1m;
- Inter platform cables – 0.5 to 1.5m;
- Export cables – 0.5 to 1.5m.

80. Cable burial would involve either jet-trenching, ploughing, mechanical trenching, dredging, mass flow excavation, rock cutting, surface laid/self-burying, or vertical injection techniques.

81. Where cable burial is not possible, alternative cable protection methods may be deployed which would again be determined within the cable burial risk assessment.

82. Cable protection includes either one of, or a combination of, rock or gravel burial, concrete mattresses, flow energy dissipation devices, dredged material, protective aprons or coverings, bagged solutions, cable installed in pipe/duct, and/or surface laid/self-burying.

83. The indicative proportion of protection required is up to 10% for array and inter-platform cables, and up to 20% for the offshore export cables. The indicative height of cable protection is 1.0m for the array cables and 1.4m for the export and inter-platform cables, including for all cable crossings.

6.4 Construction Phase

84. The DBS Array Areas may be built out sequentially or concurrently. A sequential build out would last for approximately up to five years for each DBS Array Area inclusive of site preparation, with up to a two-year lag between the start of construction for each. Therefore, the maximum offshore construction phase duration would be seven years. A concurrent build out would last for approximately five years inclusive of site preparation.

85. An application for safety zones during the construction phase would be sought post-consent, including 500m around ongoing construction activities and 50m around installed structures pre commissioning (see section 20).

86. A maximum of 138 construction vessels may be located on-site simultaneously, with a maximum of 7,512 round trips to port throughout the construction phase. **Table 6-4** provides a breakdown of the installation activities and vessel types during the construction phase.

Table 6-4 Breakdown of Construction Vessel Peak Numbers

Vessel Type	Peak Number On-Site Simultaneously Per Spread	Max Return Trips
Site preparation vessels	3	78
Scour/filter layer installation vessels	6	175
Gravity base foundation ballast vessels	1	11
Foundation installation vessels	24	267
Transition piece installation vessels	9	33
WTG installation spread	20	148
Commissioning vessels	3	78
Accommodation vessels	2	2
Array cable vessels	24	351
Export cable vessels	12	1,912
Landfall cable installation vessels	1	3
Substation installation vessels	4	24
Substation foundation vessels	8	48
Other vessels	20	4,380
Total	**137**	**7,510**

87. Additionally, a maximum of 730 return trips per year per Project may be made by helicopters during the construction phase.

6.5 Operations and Maintenance Phase

88. The maximum operational life of the Projects is 32 years (associated with a sequential build out of DBS West and DBS East). Throughout the operation and maintenance phase, a maximum of 21 operation and maintenance vessels may be located on-site simultaneously with a maximum of 473 annual round trips to port. **Table 6-5** provides a breakdown of the installation activities and vessel types during the operation and maintenance phase.

Table 6-5 Breakdown of Operation and Maintenance Vessel Peak Numbers

Vessel Type	Peak Number On-Site Simultaneously	Maximum Annual Round Trips to Port
Jack-up vessels	3	16
Service Operations Vessels (SOV)	2	104
Accommodation vessels	2	104
Crew Transfer Vessels (CTV)	2	104
Lift vessels	2	16
Cable maintenance vessels	2	1
Auxiliary vessels	8	128
Total	**21**	**473**

89. Additionally, a maximum of 20 return trips annually may be made by helicopters during the operation and maintenance phase.

6.6 Decommissioning Phase

90. Decommissioning works would generally be the reverse of the construction works and involve similar types and numbers of vessels. The decommissioning duration of the offshore infrastructure may take up to five years, and it is assumed as a worst case that all sub-sea cables would be left *in situ*. However, the best environmental option would be considered at the time of decommissioning.

91. A Decommissioning Plan will be developed prior to decommissioning with the nature of the works determined by legislation and guidance at the time.

6.7 Maximum Design Scenario

92. The MDS for each shipping and navigation hazard is provided in **Table 6-6** and is based on the parameters described in the previous subsections.

Table 6-6 MDS for Shipping and Navigation by Hazard

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
Vessel displacement and increased vessel to vessel collision risk between third-party vessels	Construction/decommissioning	▪ Concurrent construction of DBS East and DBS West of up to five years and decommissioning of up to five years or if sequential build of DBS East and DBS West then up to seven year period for construction and decommissioning of up to seven years; ▪ Full build out of the DBS Array Areas (i.e., Layout A); ▪ Buoyed construction/decommissioning area encompassing the maximum extent of the DBS Array Areas; ▪ Presence of 500m construction safety zones and 50m pre commissioning safety zones; ▪ Up to four offshore export cables each of 83nm (DBS West) or 102nm (DBS East) length (including two fibre optic cables which will split from the export cables at landfall); ▪ Indicative separation of 50m between offshore export cables; and ▪ Up to 137 construction/decommissioning vessels on-site simultaneously.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk.
	Operation and maintenance	▪ Maximum operational life of 32 years; ▪ Full build out of the DBS Array Areas (i.e., Layout A); ▪ Presence of 500m safety zones during major maintenance; and ▪ Up to 21 operation and maintenance vessels on-site simultaneously and up to 473 annual round trips to port.	

<table>
<tr><th>Potential Hazard</th><th>Phase(s)</th><th>MDS for Shipping and Navigation</th><th>Justification</th></tr>
<tr><td rowspan="2">Increased vessel to vessel collision risk between a third-party vessel and a project vessel</td><td>Construction/decommissioning</td><td>▪ Concurrent construction of DBS East and DBS West of up to seven years and decommissioning of up to five years;
▪ Full build out of the DBS Array Areas (i.e.; Layout A);
▪ Buoyed construction/decommissioning area encompassing the maximum extent of the DBS Array Areas;
▪ Presence of 500m construction safety zones and 50m pre commissioning safety zones;
▪ Up to four offshore export cables each of 83nm (DBS West) or 102nm (DBS East) length (including two fibre optic cables which will split from the export cables at landfall);
▪ Indicative separation of 50m between offshore export cables; and
▪ Up to 137 construction/decommissioning vessels on-site simultaneously and up to 7512 round trips to port.</td><td rowspan="2">Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.</td></tr>
<tr><td>Operation and maintenance</td><td>▪ Maximum operational life of 32 years;
▪ Full build out of the DBS Array Areas (i.e.; Layout A);
▪ Presence of 500m safety zones during major maintenance; and
▪ Up to 21 operation and maintenance vessels on-site simultaneously and up to 473 annual round trips to port.</td></tr>
</table>

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
Vessel to structure allision risk	Operation and maintenance	▪ Maximum operational life of 32 years; ▪ Full build out of the DBS Array Areas (i.e., Layout A for external allision risk); ▪ Minimum spacing of 830m between array structures (i.e., Layout B for internal allision risk); ▪ OCP and accommodation platform locations as per Figure 6-2; ▪ ESP location as per Figure 6-4; ▪ Up to 200 wind turbines on four-legged piled jackets with sea surface dimensions of 27.5×27.5m; and ▪ Up to eight platforms with topside dimensions of 125×100m or 250×100m where a bridge link is used.	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk.

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
Reduction of under keel clearance due to cable protection	Operation and maintenance	▪ Maximum operational life of 32 years; ▪ Up to 350nm of array cables; ▪ Up to 185nm of inter-platform cables; ▪ Up to four offshore export cables each of 83nm (DBS West) or 102nm (DBS East) length; ▪ Indicative separation of 50m between offshore export cables; ▪ Indicative maximum proportion of array cable protection requirement of 10%; ▪ Indicative maximum proportion of inter-platform cable protection requirement of 10%; ▪ Indicative maximum proportion of export cable protection requirement of 20%; ▪ Up to 40 crossings of array cables; ▪ Up to 24 crossings per inter-platform cable; ▪ Up to 70 crossings per offshore export cable; ▪ Indicative height of protection for array cables (including crossings) of 1.0m; ▪ Indicative height of protection for inter-platform cables (including crossings) of 1.4m; and ▪ Indicative height of protection for offshore export cables (including crossings) of 1.4m.	Largest possible extent of sub-sea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on under keel clearance.

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
Anchor interaction with sub-sea cables	Operation and maintenance	▪ Maximum operational life of 32 years; ▪ Up to 350nm of array cables; ▪ Up to 185nm of inter-platform cables; ▪ Up to four offshore export cables each of 83nm (DBS West) or 102nm (DBS East) length; ▪ Indicative separation of 50m between offshore export cables; ▪ Indicative maximum proportion of array cable protection requirement of 20%; ▪ Indicative maximum proportion of inter-platform cable protection requirement of 20%; ▪ Indicative maximum proportion of export cable protection requirement of 20%; ▪ Up to 40 crossings of array cables; ▪ Up to 24 crossings per inter-platform cable; ▪ Up to 70 crossings per offshore export cable; ▪ Indicative height of protection for array cables (including crossings) of 1.0m; ▪ Indicative height of protection for inter-platform cables (including crossings) of 1.4m; and ▪ Indicative height of protection for offshore export cables (including crossings) of 1.4m.	Largest possible extent of sub-sea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on anchor interaction with sub-sea cables.

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
Reduction of emergency response capability (including SAR access)	Operation and maintenance	▪ Maximum operational life of 32 years; ▪ Up to 200 wind turbines; ▪ Up to eight platforms; ▪ Minimum spacing of 830m between array structures (i.e., Layout B); ▪ Single line of orientation in array layout; and ▪ Up to 21 operation and maintenance vessels on-site simultaneously and up to 473 annual round trips to port.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability.

7 Navigational Features

93. The navigational features within and in proximity to the Projects are presented in **Figure 7-1.**

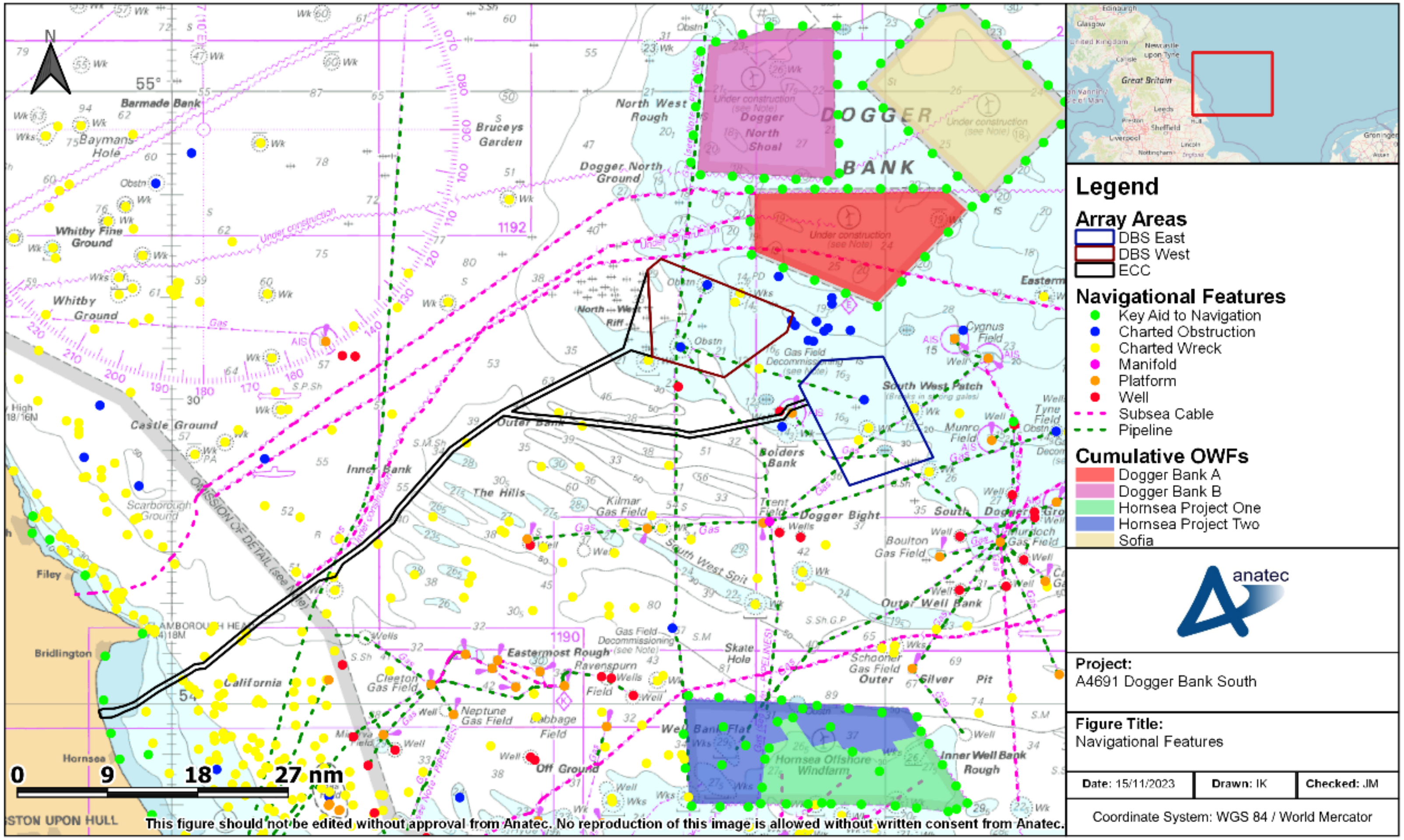

Figure 7-1 Navigational Features

7.1 Other Offshore Wind Farms

94. Dogger Bank A is located approximately 4.1nm to the north-east of the DBS Array Areas and is currently under construction, with offshore works commencing in May 2022 (Dogger Bank Wind Farm, 2022). It covers an area of approximately 150nm^2 and will comprise 95 wind turbines once commissioned, with this anticipated in 2024. Dogger Bank B (9.2nm north) and Sofia (18.6nm north-east) are also under construction, with offshore works commencing in February 2023 and May 2023, respectively.

95. Other offshore wind farms further from the DBS Array Areas, including those yet to enter construction phase (as of November 2023), are presented in **Figure 7-2.** These include the Dogger Bank C and D, and the Hornsea developments.

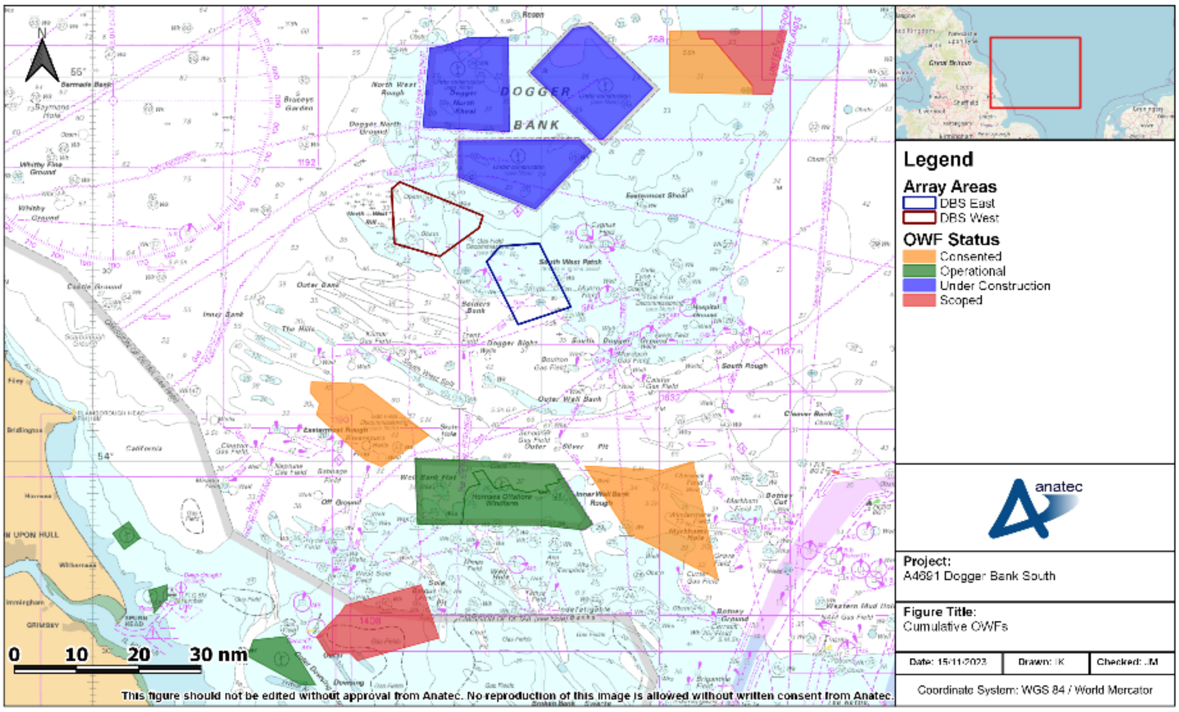

Figure 7-2 Planned and Existing Offshore Wind Farms (as of November 2023)

7.2 Key Aids to Navigation

96. Dogger Bank A, Dogger Bank B, and Sofia are marked with buoyed construction areas, featuring various cardinal marks and special marks. These will be removed following commissioning of the developments, with this anticipated in 2024 for Dogger Bank A, and 2025/26 for Dogger Bank B and Sofia. A special mark is also located at the Munro Gas Field, marking the location of a well.

7.3 Oil and Gas Infrastructure

97. Various oil and gas infrastructure associated with the nearby gas fields, including wells, platforms and manifolds, are located in proximity to the DBS Array Areas. The closest platform to the DBS Array Areas is Cavendish, located approximately 1.6nm south of the DBS East Array Area and directly south of the Offshore Export Cable Corridor.

98. Other nearby oil and gas infrastructure include the:

- Munro platform approximately 6.0nm east of the DBS East Array Area;
- Cygnus platforms approximately 7.2nm and 9.2nm north-east of the DBS East Array Area;
- Trent platform approximately 9.3nm south-west of the DBS East Array Area; and
- Boulton platform approximately 9.6nm south-east of the DBS East Array Area.

99. It is acknowledged that some of the fields these platforms are associated with could be decommissioned prior to the start of construction, although the Cygnus gas field is a recent development and therefore is expected to remain *in situ* during the Projects' life.

100. The closest surface piercing oil and gas infrastructure to the export cable platform search area is the Garrow platform, located approximately 11.3nm to the east.

7.4 Sub-sea Pipelines

101. Sub-sea pipelines connect the oil and gas infrastructure in proximity to the DBS Array Areas. A sub-sea pipeline connecting the Shearwater gas field and Bacton Gas Terminal (the SEAL pipeline) passes north-south through the DBS West Array Area. Three additional sub-sea pipelines are also located within the DBS West Array Area but are disused; one of these also runs through the DBS East Array Area and is one of three sub-sea pipelines within the DBS East Array Area, with two of these disused.

102. Two of the disused sub-sea pipelines also intersect the Offshore Export Cable Corridor, as do the Shearwater to Bacton and Sleipner to Easington (Lengeled) gas pipelines.

103. No sub-sea pipelines intersect with the export cable platform search area, with the closest running directly passed the southern extent between Easington and wells in the Nelson oil field.

7.5 Sub-sea Cables

104. Currently under installation sub-sea cables are located to the north and north-west of the DBS West Array Area, connecting to Dogger Bank A. These sub-sea cables pass alongside the Offshore Export Cable Corridor for much of its length and intersect over a distance of approximately 6.2nm. One of these cables passes approximately

500m west of the south-western corner of the export cable platform search area. There is also a sub-sea cable passing through Dogger Bank A which passes approximately 200m north of the DBS West Array Area, and a sub-sea cable located approximately 8.4nm east of the DBS Array Areas, connecting the Cygnus and Murdoch platforms.

7.6 Charted Wrecks and Obstructions

105. Various charted wrecks and obstructions are located in proximity to the DBS Array Areas. There are three charted obstructions located within the DBS Array Areas – two within the DBS West Array Area, and one within the DBS East Array Area. The shallowest of these features is a charted wreck at 15m below CD.

106. There are also six charted wrecks located within the Offshore Export Cable Corridor (excluding overlap with the DBS Array Areas), with the shallowest of these features a charted wreck at 23m below CD.

107. No charted wrecks or obstructions are located within the export cable platform search area, with the closest located approximately 700m to the east.

7.7 Other Navigational Features

7.7.1 Vessel Arrivals

108. The number of vessel arrivals at ports in the region, as reported by DfT, is presented in **Figure 7-3**. 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.

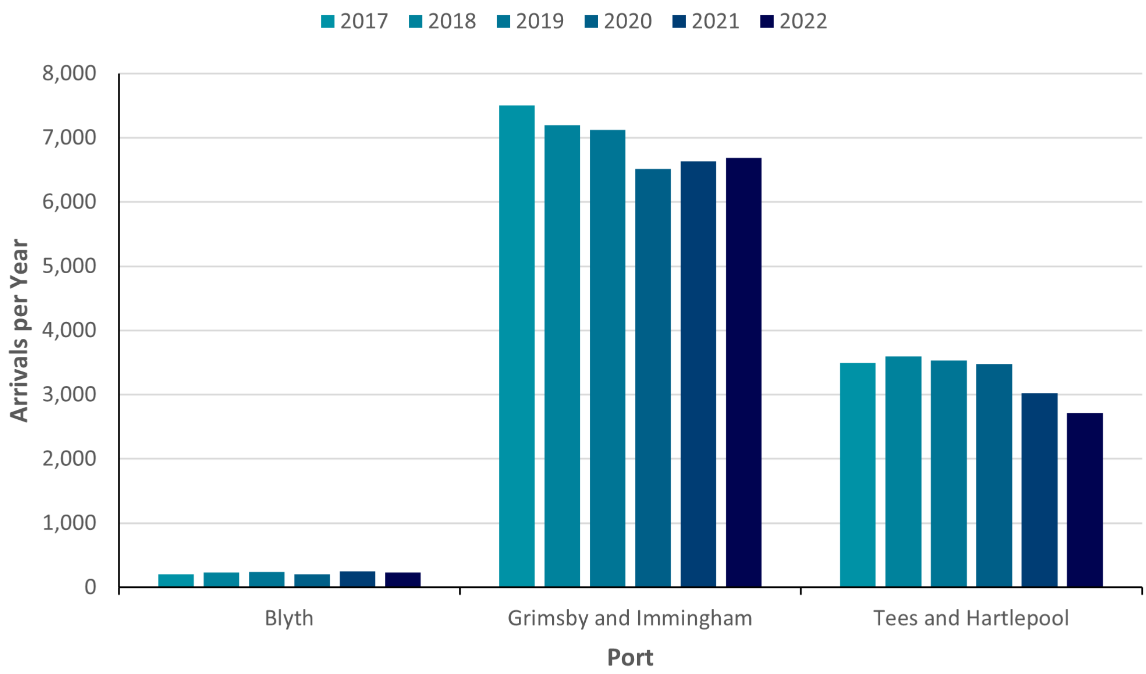

Figure 7-3 Vessel Arrivals to Commercial Ports in Proximity to the Projects

109. Grimsby and Immingham are the most frequented commercial ports in the area followed by Tees and Hartlepool, although all ports experienced a slight downward trend in vessel arrivals from 2020 (likely associated with the COVID-19 pandemic).

7.7.2 Marine Aggregate Dredging Areas

110. Marine aggregate dredging areas in the southern North Sea are located well south of the Offshore Development Area, with the closest approximately 25nm south of the Offshore Export Cable Corridor.

7.7.3 Designated Anchorage Areas

111. There are no designated anchorage areas located within or in proximity to the Offshore Development Area.

7.7.4 Military Practice and Exercise Areas

112. The Offshore Export Cable Corridor overlaps with a submarine exercise area. This area is used to for training by submarines operated by the Royal Navy. There are also practice and exercise areas (PEXA) for aircraft overlapping the DBS Array Areas.

7.7.5 Spoil Ground and Other Dumping Grounds

113. There no spoil grounds or other dumping grounds located within, or in proximity to, the Offshore Development Area.

8 Meteorological Ocean Data

114. This section presents meteorological and oceanographic (metocean) statistics local to the Projects. The data presented in this section has been used as input to the collision and allision risk modelling (see section 16).

8.1 Wind

115. The proportion of the wind direction within each 30-degree interval for a location in the DBS East Array Area is presented in **Figure 8-1** in the form of a wind rose, with similar data from the DBS West Array Area and the ESP presented in **Figure 8-2** and **Figure 8-3** respectively. It can be seen from all sites that wind is predominately from the south-west.

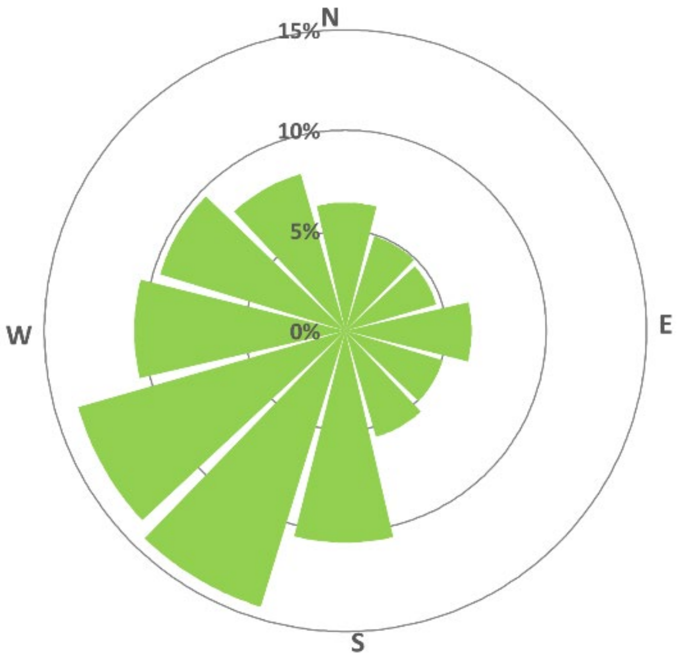

Figure 8-1 Wind Direction Distribution (DBS East)

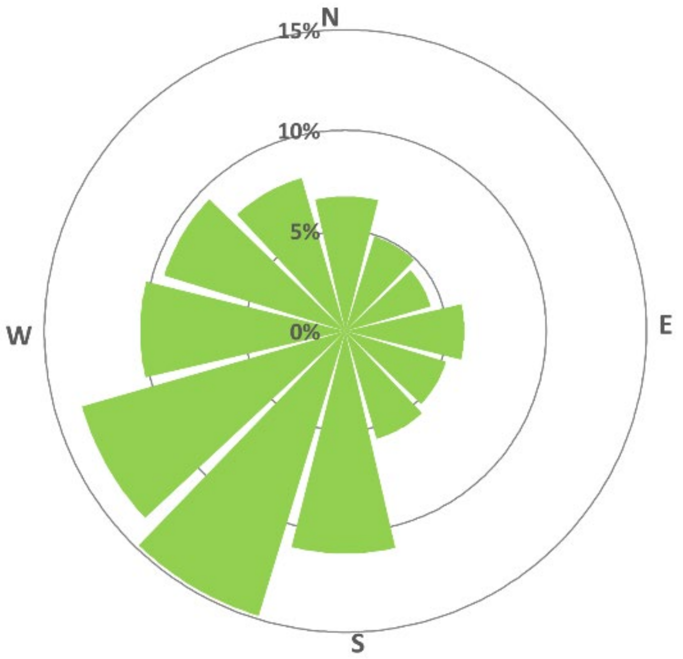

Figure 8-2 Wind Direction Distribution (DBS West)

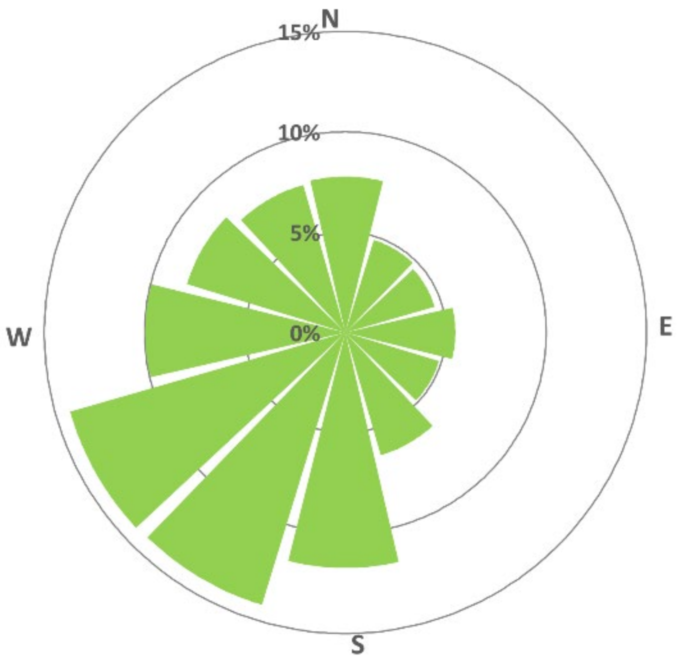

Figure 8-3 Wind Direction Distribution (ESP)

8.2 Wave

116. The proportion of the sea state within each of three defined ranges, using the output from metocean measurement devices that were deployed at the DBS Array Areas from March 2022 to April 2023, is presented in **Table 8-1**. Export cable platform

search area data have been taken from metocean reporting by C2Wind (C2Wind, 2023).

Table 8-1 Sea State Data

Sea State (Significant Wave Height)	Array Areas Proportion (%)	ESP Proportion (%)
Calm (<1 m)	33.5	36.2
Moderate (1 to 5 m)	66.4	63.2
Severe (≥5 m)	0.2	0.6

8.3 Visibility

117. Based on information provided by the EHDV and EHJA Dutch METAR stations and DECC reporting (DECC, 2016), the proportion of poor visibility (defined as the proportion of a year where the visibility can be expected to be less than 1km) is 1.3% for the DBS Array Areas and the export cable platform search area.

8.4 Tide

118. From UKHO Admiralty Charts 266 and 1191, currents within and in proximity to the DBS Array Areas and export cable platform search area are set in a generally north-west to south-west on the flood tide and the same on the ebb tide. The greatest flood peak tidal rate is 1.4 knots (kt) and the greatest peak ebb tidal rate is 2.5kt. The peak speed and corresponding direction data for the flood and ebb tides for the relevant tidal diamonds for the DBS Array Areas on UKHO Admiralty Charts 266 and 1191 are presented in **Table 8-2**; and the relevant tidal diamonds for the export cable platform search area on UKHO Admiralty Chart 1191 are presented in **Table 8-3**.

Table 8-2 Peak Flood and Ebb Tidal Data in Proximity to the DBS Array Areas

UKHO Admiralty Chart	Tidal Diamond	Flood		Ebb	
		Direction (°)	Speed (kt)	Direction (°)	Speed (kt)
266	D	313	0.5	313	1
	E	130	0.6	130	1.2
	F	259	0.3	223	0.6
	G	126	0.5	133	0.9
	J	295	0.5	295	0.8
1191	N	165	0.3	344	0.6
	P	332	0.8	151	1.4

UKHO Admiralty Chart	Tidal Diamond	Flood		Ebb	
		Direction (°)	Speed (kt)	Direction (°)	Speed (kt)
	T	141	0.7	145	1.2

Table 8-3 Peak Flood and Ebb Tidal Data in Proximity to the Export Cable Platform Search Area

UKHO Admiralty Chart	Tidal Diamond	Flood		Ebb	
		Direction (°)	Speed (kt)	Direction (°)	Speed (kt)
1191	J	148	1.4	148	2.5
	L	153	1	151	1.8
	M	173	0.7	173	1.5
	P	332	0.8	151	1.4
	Q	169	0.7	149	1.5
	S	147	0.5	147	1.1
	T	141	0.7	145	1.2

119. Based upon the available data, no hazards are expected at high water that would not also be expected at low water, and vice versa. The wind farm structures are not expected to result in any additional risk on the existing tidal streams in relation to their effect on existing shipping and navigation users.

9 Emergency Response and Incident Overview

120. This section summarises the existing Search and Rescue (SAR) resources in the region, and issues being considered in relation to the Projects.

9.1 Search and Rescue Helicopters

121. In July 2022, the Bristow Group were awarded a new ten-year contract by the MCA (as an executive agency of the DfT) beginning in September 2024 to provide helicopter SAR operations in the UK. Bristow have been operating the service since April 2015.

122. The SAR helicopter service is currently operated out of ten base locations around the UK, with the closest to the DBS Array Areas located approximately 83nm south-west at Humberside. This base operates two Sikorsky S92 helicopters.

123. The DfT has produced data on civilian SAR helicopter activity in the UK by the Bristow Group on behalf of the MCA between April 2015 and March 2022.

124. The locations of SAR helicopter taskings within the DBS Array Areas, Offshore Export Cable Corridor, and export cable platform search area study areas are presented in **Figure 9-1**, colour-coded by tasking type, along with the location of the Humberside helicopter base.

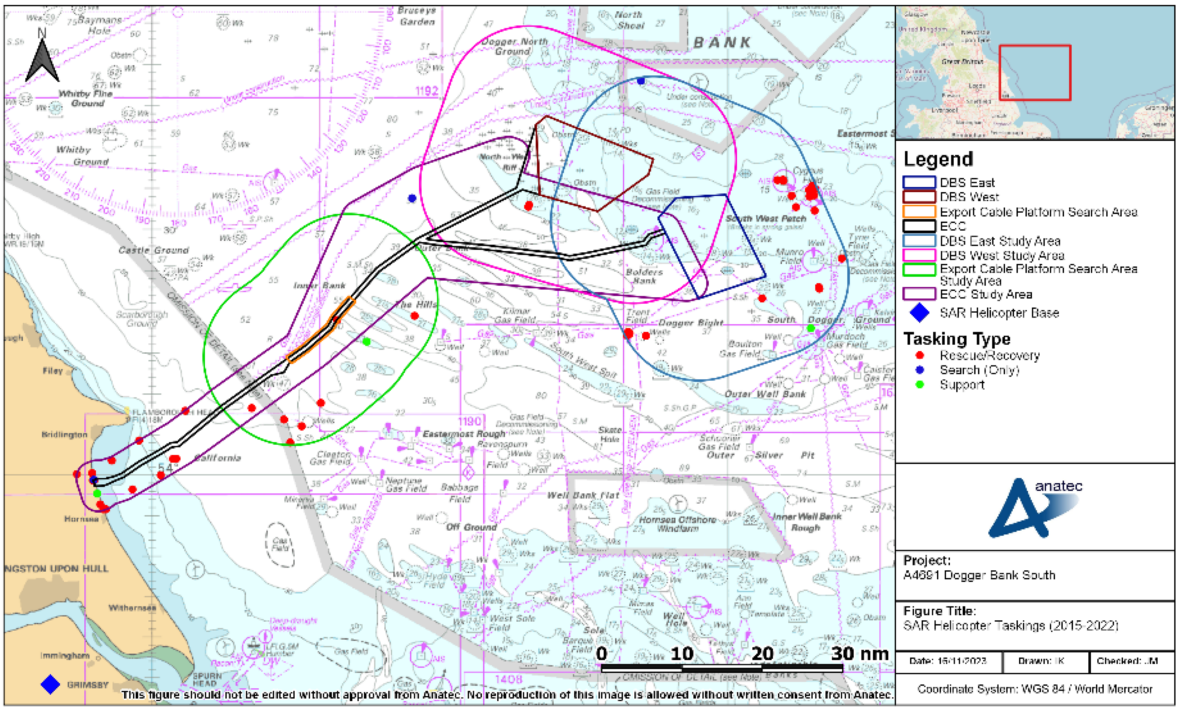

Figure 9-1 SAR Helicopter Taskings Within Study Areas (April 2015 to March 2022)

125. There were 36 SAR taskings within the DBS East study area between April 2015 and March 2022, corresponding to an average of five SAR taskings per year. Two were search, two were support and the remaining 32 were rescue/recovery. Most of the rescue/recovery incidents occurred in close proximity to the Cygnus gas field. No helicopter taskings were located within the DBS East Array Area itself. All taskings originated from the Humberside base.

126. There were four SAR taskings within the DBS West study area between April 2015 and March 2022, corresponding to an average of one SAR tasking every one to two years. Two were search, while the other two were rescue/recovery to the south of the DBS West Array Area. No helicopter taskings were located within the DBS West Array Area itself. All taskings originated from the Humberside base.

127. There were 21 SAR taskings within the Offshore Export Cable Corridor study area between April 2015 and March 2022, corresponding to an average of three SAR taskings per year. Two were search, one was support and the remaining 18 were rescue/recovery. Seventeen of the 21 taskings were located within 22nm of the landfall. Three were located within the Offshore Export Cable Corridor itself. All taskings originated from the Humberside base.

128. There were eight taskings within the export cable platform search area study area between April 2015 and March 2022, corresponding to an average of one SAR tasking per year. All apart from one support tasking were rescue/recovery. One tasking – a rescue/recovery – was located within the export cable platform search area itself.

9.2 Royal National Lifeboat Institution

129. The RNLI is organised into six regions, with the relevant region for the DBS Array Areas being the ‘North and East’. Based out of more than 230 stations, there are over 400 active lifeboats across the RNLI fleet, including both All-Weather Lifeboats (ALB) and Inshore Lifeboats (ILB).

130. **Figure 9-2** presents the RNLI stations in proximity to the DBS Array Areas as well as the incidents documented by the RNLI that occurred within the DBS Array Areas during the period 2013 to 2022 (inclusive), colour-coded by incident type. **Figure 9-3** presents the same data, colour-coded by casualty type. It is noted that incidents which were deemed hoaxes or false alarms have been excluded from the analysis.

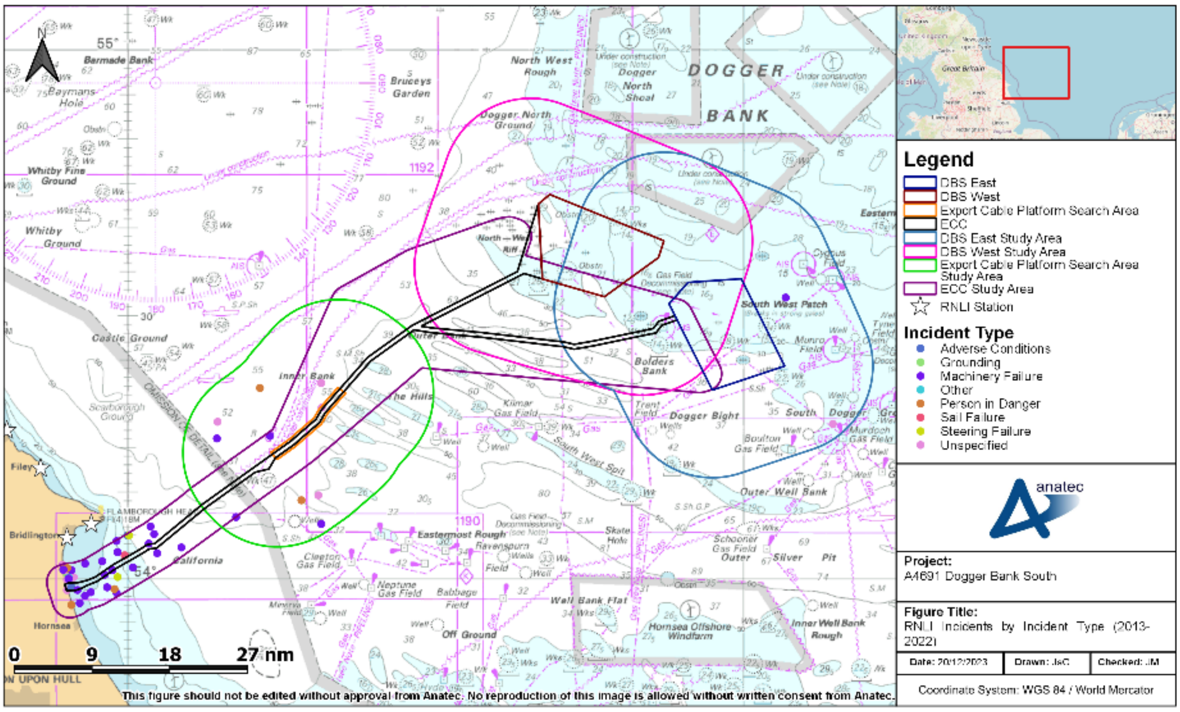

Figure 9-2 RNLI Incidents by Incident Type (2013 to 2022)

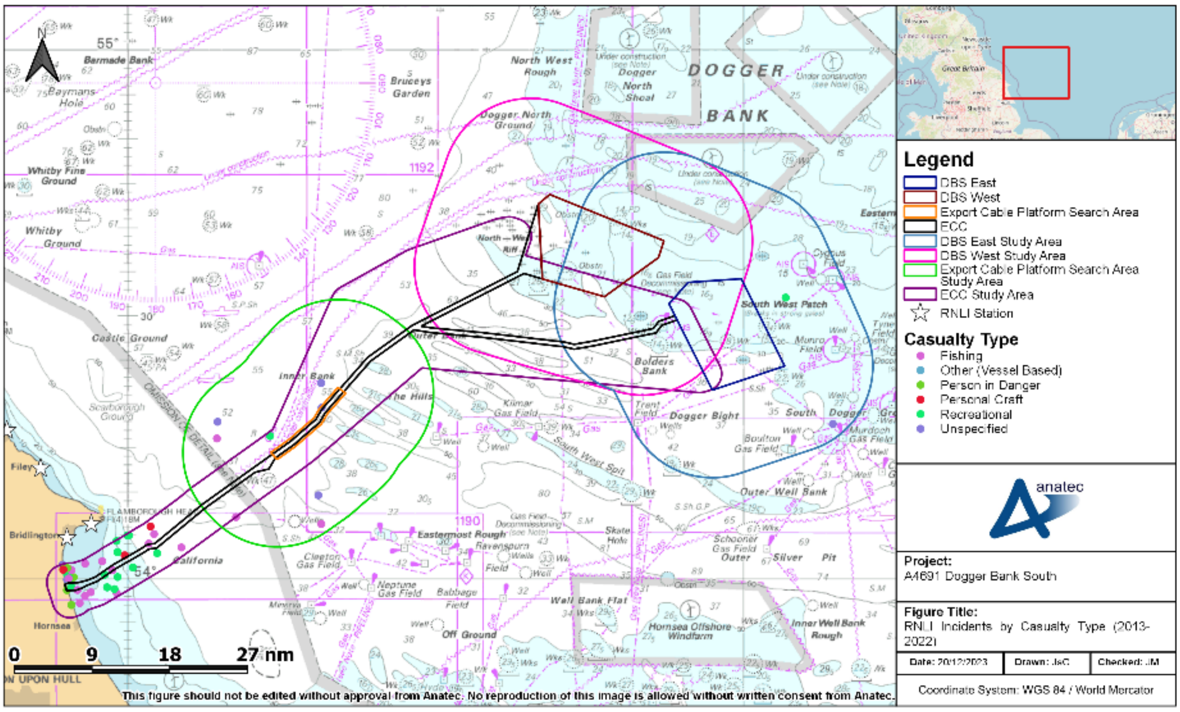

Figure 9-3 RNLI Incidents by Casualty Type (2013 to 2022)

131. The closest RNLI station to the DBS Array Areas is at Flamborough (approximately 55nm south-west of the DBS Array Areas), where an ILB is available. Bridlington, located 3.3nm further south-west, also has a RNLI station, where both an ALB and

ILB are available; this station is also the closest to the Offshore Export Cable Corridor, located approximately 4.8nm north. Other RNLI stations on this stretch of the UK east coast include Filey, Scarborough, Withernsea, and Whitby. Given that the RNLI have an operational limit of 100nm, it is anticipated that an incident occurring in proximity to the DBS Array Areas could result in a response from a RNLI asset, although the distribution of the reported RNLI incidents suggests that only incidents occurring within the 15nm of the Offshore Export Cable Corridor closest to shore are likely to result in a RNLI response.

132. There was a single documented incident responded to by the RNLI within the DBS East study area between 2013 and 2022, occurring approximately 3.3nm to the east of the DBS East Array Area itself. This incident occurred in 2019, involving a sailing vessel that experienced machinery failure, and was responded to by the Scarborough RNLI station.

133. There were no documented incidents responded to by the RNLI within the DBS West study area between 2013 and 2022.

134. A total of 43 incidents were responded to by the RNLI within the Offshore Export Cable Corridor study area between 2013 and 2022. This corresponds to an average of four to five per year; however, as noted above the majority of incidents (approximately 93%) occurred within 15nm of the coast whilst the number of incidents further offshore was much lower. The most common incident types recorded were "*machinery failure*" (63%) and "*person in danger*" (17%). Excluding "*person in danger*" and non-vessel based incidents, the most common vessel types recorded were recreational vessels (48%) followed by fishing vessels (36%) and personal craft (12%). Four incidents were responded to by the RNLI within the Offshore Export Cable Corridor itself.

135. A total of nine incidents were responded to by the RNLI within the export cable platform search area study area between 2013 and 2022, corresponding to an average of one incident per year. The most common incident types recorded was "*machinery failure*" with four counts, with two instances of "*person in danger*" also observed – the other three incidents were unspecified. There were three instances of fishing vessel incidents, and one each of recreational, passenger, and wind farm vessels. One incident was recorded within the export cable platform search area itself, of unspecified casualty and incident types.

9.3 Maritime Rescue Coordination Centres and Joint Rescue Coordination Centres

136. His 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).

137. The HMCG coordinates SAR operations through a network of 11 Maritime Rescue Coordination Centres (MRCC), including a Joint Rescue Coordination Centre (JRCC) based in Hampshire.

138. All of the MCA's operations, including SAR, are divided into 18 geographical regions. Area 6 – '*East of England (Yorkshire, Humberside & Lincolnshire)*' – covers the east coast of England between Yorkshire and The Wash and therefore covers the area encompassing the Offshore Development Area. The Humber MRCC is located within Area 6 approximately 57nm south-west of the DBS Array Areas, as illustrated in **Figure 9-4**, and coordinates the SAR response for maritime and coastal emergencies within the district boundary.

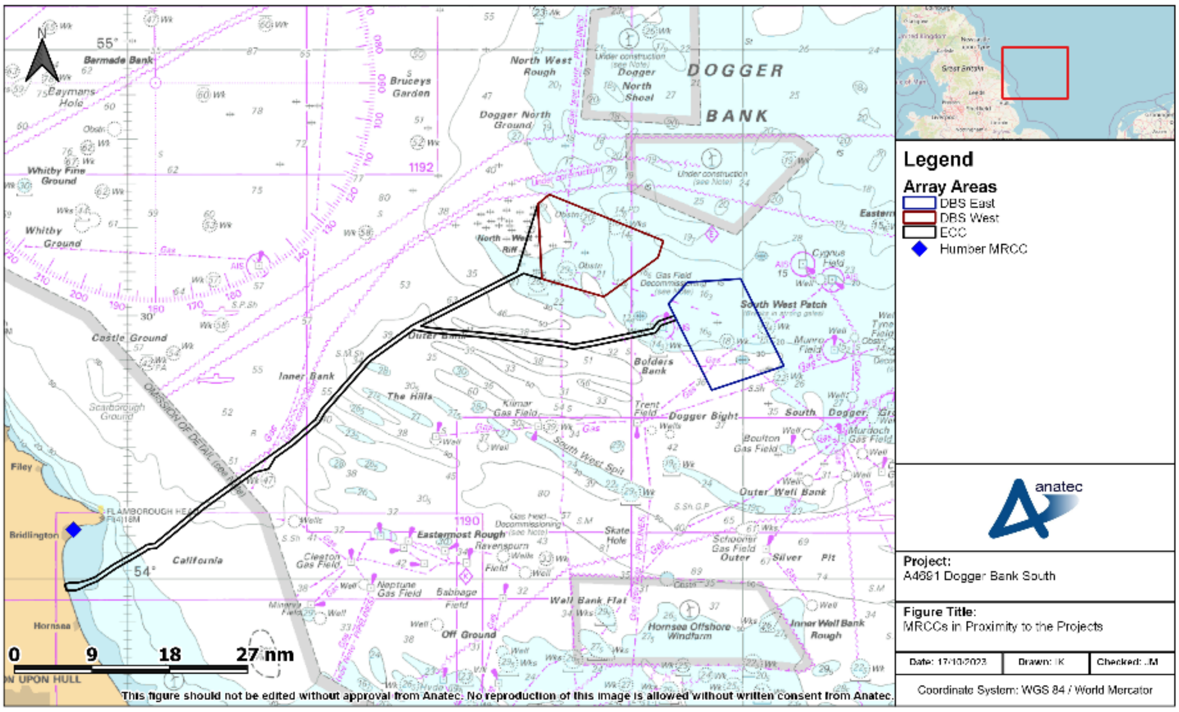

Figure 9-4 MRCC Location in Proximity to the Offshore Development Area

9.4 Global Maritime Distress and Safety System

139. The Global Maritime Distress and Safety System (GMDSS) is a maritime communications system used for emergency and distress messages, vessel to vessel routeing communications and vessel to shore routine communications. It is implemented globally and vessels engaged in international voyages are obliged to carry GMDSS certified communication equipment.

140. There are four GMDSS sea areas, with the areas applicable in proximity to the UK shown in **Figure 9-5**. Vessels in proximity to the DBS Array Areas would be located within sea area A2.

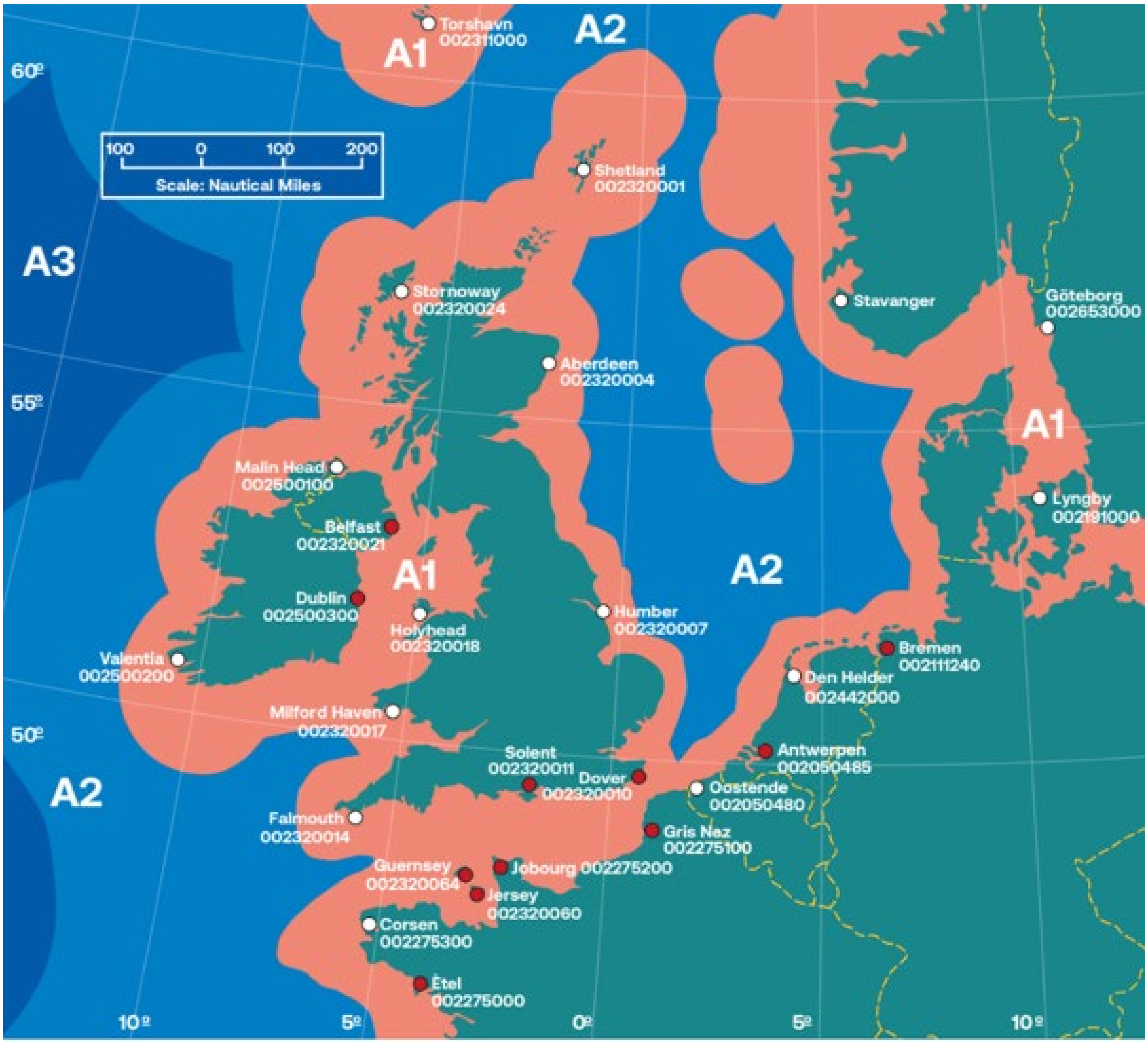

Figure 9-5 GMDSS Sea Areas (MCA, 2021)

141. In the event of an emergency involving a vessel located further offshore within sea area A2, vessels are able to contact coastal stations using High Frequency (HF) or Medium Frequency (MF) radio or otherwise contact other offshore resources.

9.5 Marine Accident Investigation Branch

142. All UK flagged vessels and non-UK flagged vessels in UK territorial waters (12nm), a UK port or carrying passengers to a UK port are required to report incidents to the MAIB. Data arising from these reports are assessed within this section, primarily covering the ten-year period between 2012 and 2021.

143. The incidents recorded within the MAIB data between 2012 and 2021 occurring within the study area are presented in **Figure 9-6**, colour-coded by incident type. Following this, **Figure 9-7** shows the same data colour-coded by the type of vessel(s) involved in each incident.

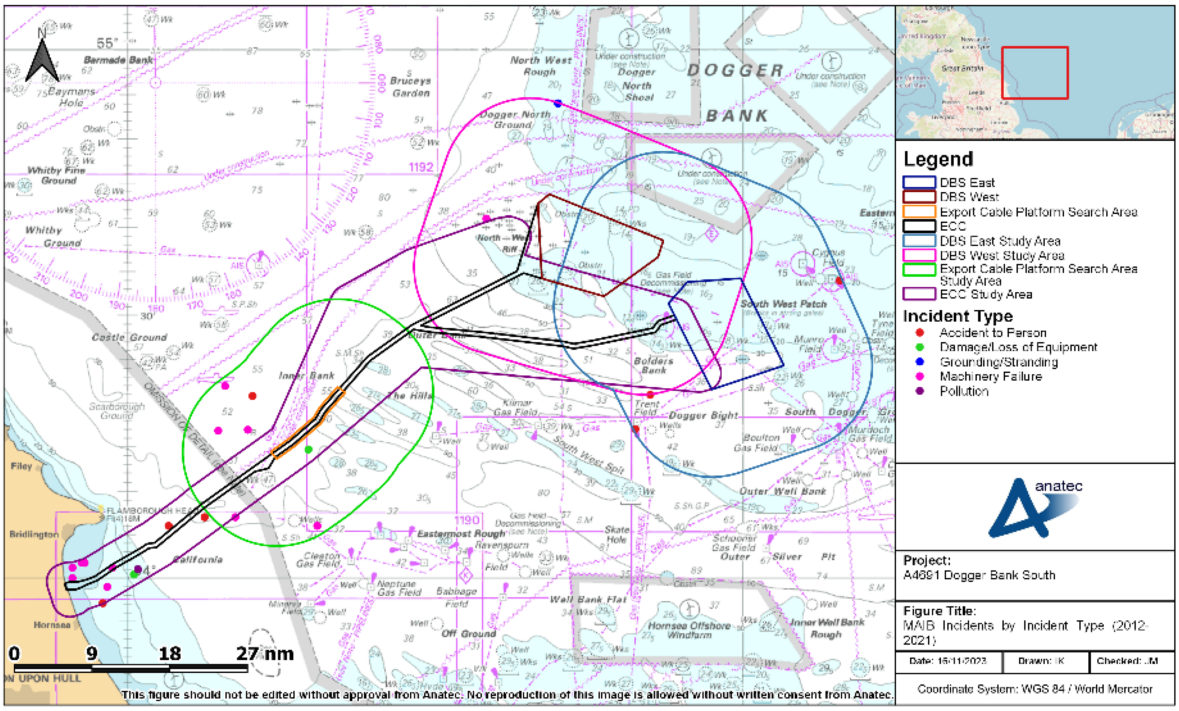

Figure 9-6 MAIB Incidents by Incident Type (2012 to 2021)

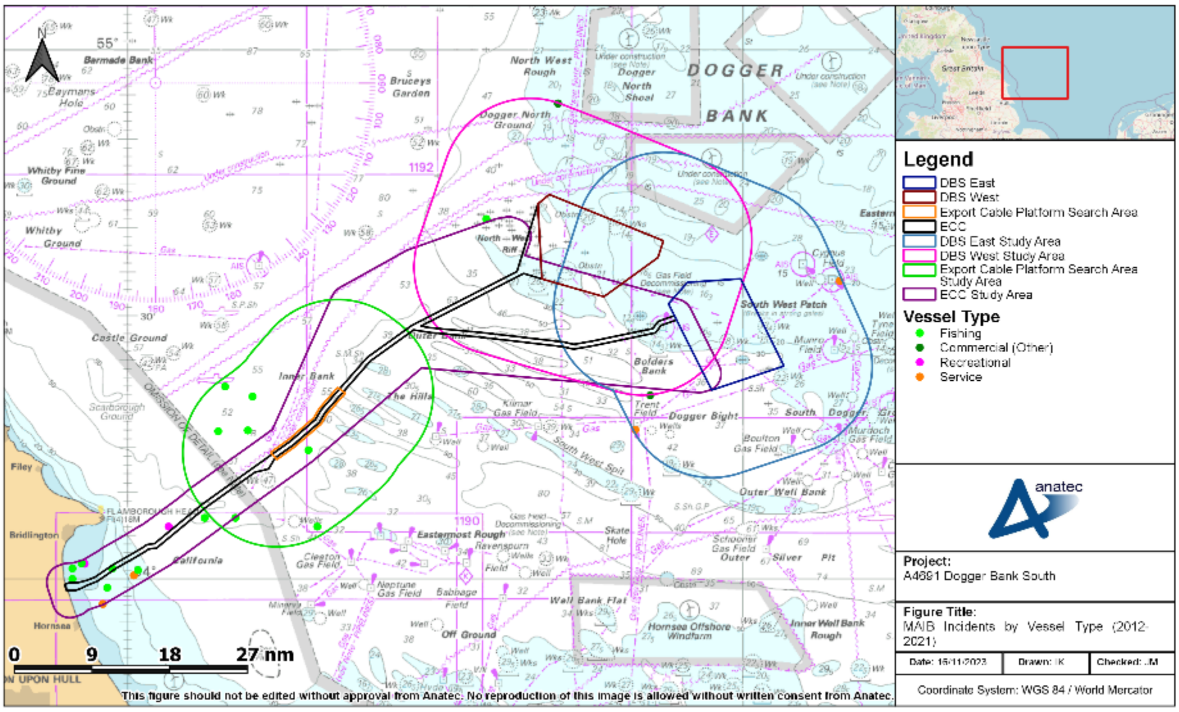

Figure 9-7 MAIB Incidents by Vessel Type (2012 to 2021)

144. A total of three unique incidents were recorded by the MAIB within the DBS East study area between 2012 and 2021 which corresponds to an average of one incident every three years. Two of the incidents involved support vessels while the other

involved a vessel of "*other commercial*" type. All three incidents involved an "*accident to person*". None of these incidents occurred within the DBS East Array Area itself.

145. There were two documented MAIB incidents during the ten year period within the DBS West study area, involving the grounding of a barge towing another vessel at the northern extent of the DBS West study area on the Dogger North Shoal, as well as the machinery failure of a fishing vessel.

146. A total of 12 incidents were recorded by the MAIB within the Offshore Export Cable Corridor study area between 2012 and 2021, which corresponds to an average of one incident per year. There was one incident within the Offshore Export Cable Corridor itself. The most common incident types recorded were "*machinery failure*" (50%), *"accident to person"* (25%) and "*damage/loss of equipment*" (17%). The vessel types involved in incidents were fishing vessels (67%), support vessels (17%), and pleasure craft (17%).

147. A total of seven incidents were recorded by the MAIB within the export cable platform search area study area between 2012 and 2021, corresponding to an average of one incident per year. The most common incident type was "*machinery failure"* with five counts, with one count each of "*accident to person"* and "*damage/loss of equipment"* noted. All vessels involved were fishing vessels. There were no incidents recorded within the export cable platform search area itself.

148. A review of older MAIB incident data within the study areas between 2002 and 2011 indicates that the number of incidents has generally remained steady in proximity to the DBS Array Areas while slightly decreasing closer to the UK east coast, with a total of four incidents within the DBS East study area, one incident within the DBS West study area, and 21 incidents within the Offshore Export Cable Corridor study area. No incidents occurred within the DBS Array Areas. The number of incidents has remained at seven within the export cable platform search area study area, with again no incidents recorded within the export cable platform search area itself.

9.6 Historical Offshore Wind Farm Incidents

9.6.1 Incidents Involving UK Offshore Wind Farm Developments

149. As of November 2023, there are 42 operational offshore wind farms in the UK, ranging from the North Hoyle offshore wind farm (fully commissioned in 2003) to Hornsea Project Two (fully commissioned in 2022). Between them these developments encompass approximately 22,040 fully operational wind turbine years.

150. MAIB incident data has been used to collate a list of reported historical collision and allision incidents involving UK offshore wind farm developments[1], which is summarised in **Table 9-1**. 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.

Table 9-1 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	7th August 2005	Wind turbine installation vessel allision with wind turbine base whilst manoeuvring alongside it. Minor damage sustained to a gangway on the vessel, the wind turbine tower and a wind turbine blade.	Minor damage to gangway on the vessel	None	MAIB
Project	Allision	29th September 2006	Offshore services vessel allision with rotating wind turbine blade.	None	None	MAIB
Project	Allision	8th February 2010	Work boat allision with disused pile following human error with throttle controls whilst in proximity. Passenger later diagnosed with injuries and no serious damage sustained by vessel.	Minor	Injury	MAIB
Project/third-party	Collision	23rd April 2011	Third-party catamaran collision with project guard vessel within harbour.	Moderate	None	MAIB
Project	Allision	18th November 2011	Cable-laying vessel allision with wind turbine foundation following watchkeeping failure. Two hull breaches to vessel.	Major	None	MAIB
Project/project	Collision	2nd June 2012	CTV allision with flotel. Nine persons safely evacuated and transferred to nearby vessel before being brought back into port.	Moderate	None	UK CHIRP

[1] Includes only those incidents reported explicitly as collisions or allisions to an accident investigation branch or anonymous reporting service. Unconfirmed incidents have not been considered.

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision	20th October 2012	Project vessel allision with wind turbine monopile following human error (misjudgement of distance). Minor damage sustained by vessel.	Minor	None	MAIB
Project	Allision	21st November 2012	Passenger transfer catamaran allision with buoy following navigational error. Vessel abandoned by crew of 12 having been holed, causing extensive flooding but no injuries sustained.	Major	None	MAIB
Project	Allision	21st November 2012	Work boat allision with unlit wind turbine transition piece at moderate speed following navigational error. Vessel able to proceed to port unassisted with no water ingress but some structural damage sustained.	Moderate	Injury	MAIB
Project	Allision	1st July 2013	Service vessel allision with wind turbine foundation following machinery failure. Minor damage sustained by vessel.	Minor	None	IMCA Safety Flash
Project	Allision	14th August 2014	Standby safety vessel allision with wind turbine pile. Oil leaked by vessel which moved away from environmentally sensitive areas until leak was stopped.	Minor with pollution	None	UK CHIRP
Third-party	Allision	26th May 2016	Third-party fishing vessel allision with wind turbine following human error (autopilot). Lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)
Project	Allision	14th February 2019	Survey vessel contacted with wind turbine jacket whilst autopilot was engaged.	Minor	None	MAIB
Project	Allision	16th January 2020	Project vessel allision with wind turbine. Injury sustained by crew member but vessel able to proceed to port unassisted.	None	Injury	Web search (Vessel Tracker, 2020)

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision	27th January 2020	Project vessel allision with wind turbine. Minor damage to vessel and wind turbine sustained, with no personal injuries.	Minor	None	Marine Safety Forum
Third-party	Allision	9th June 2022	Fishing vessel allision with wind turbine resulting in damage to vessel and two minor injuries for crew members. RNLI lifeboat escorted vessel under its own power to port.	Minor	Injury	Web search (RNLI, 2022)

(*) As per incident reports.

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

152. As of November 2023, there have been no third-party collisions directly 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.

153. As of November 2023, there have been 13 reported cases of an allision between a vessel and a wind turbine (under construction, operational or disused) in the UK, with all but two 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 1,695 wind turbine years per allision incident in the UK, noting that this is a conservative calculation given that only operational wind turbine hours have been included (whereas allision incidents counted include non-operational wind turbines).

9.6.2 Incidents Involving Non-UK Offshore Wind Farms

154. It is acknowledged that collision and allision incidents involving non-UK offshore wind farm developments have also occurred. However, it is not possible to maintain a comprehensive list of such incidents.

155. One high profile non-UK incident which is noted is that involving a bulk carrier in January 2022 which broke its anchor chain during a storm in Dutch waters and collided with a nearby anchored vessel. The vessel began to take on water, leading to all crew members being evacuated by helicopter. The vessel then continued to drift towards shore including through an under construction offshore wind farm where it allided with a wind turbine foundation and a platform foundation before being taken under tow.

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

156. 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 9-2**. The initial cause of these incidents is not related to the offshore wind farm in question.

157. **Table 9-2** comprises known incidents that were responded to by a wind farm vessel. Additional incidents associated with the construction or operation of offshore wind farms are also known to have occurred. These incidents typically involve an accident to person which requires medical attention (including emergency response).

Table 9-2 Historical Incidents Responded to By Vessels Associated with UK Offshore Wind Farm Developments

Incident Type	Date	Related Development	Description of Incident	Source
Capsize	21 June 2018	Walney	HMCG issued mayday relay broadcast following trimaran capsize. Support vessel for Walney arrived and recovered two persons from the water who were then winched onboard a Coastguard helicopter.	Web search (4C Offshore, 2018)
Capsize	5 November 2018	Race Bank	Fishing vessel capsized resulting in two persons in the water. Vessel operating at the nearby Race Bank reported to have assisted with the rescue which also involved a Belgian military helicopter and the RNLI.	Web search (British Broadcasting Corporation (BBC), 2018)
Vessel in distress	15 May 2019	London Array	Yacht in difficulty sought shelter by tying up to a wind turbine but suffered damage and a person in the water. Support vessel for London Array identified and secured the casualty vessel and recovered the person in the water. The support vessel raised the alarm to the Coastguard. The Coastguard later instructed the support vessel to return to port and seek medical assistance for the casualty vessel's occupant.	Web search (The Isle of Thanet News, 2019)
Drifting	7 July 2019	Gwynt y Môr	Speedboat suffered mechanical failure stranding four persons. Support vessel for Gwynt y Môr responded to an 'all-ships' broadcast from the Coastguard and prevented the casualty vessel drifting into the Gwynt y Môr array. The support vessel later towed the casualty vessel back towards port.	Web search (Renews, 2019)

Incident Type	Date	Related Development	Description of Incident	Source
Machinery failure	28 September 2019	Race Bank	Fishing vessel suffered mechanical failure and launched flares. Guard vessel and SOV for Race Bank both immediately offered assistance until the MCA's arrival on-scene.	Internal daily progress report received by Anatec
Vessel in distress	13 December 2019	Race Bank	Passing vessel got into difficulty and guard vessel for Race Bank was requested to assist. The Coastguard later requested that the guard vessel tow the casualty vessel into port.	Internal daily progress report received by Anatec
Search	21 May 2020	Walney	Coastguard contacted guard vessel for Walney reporting red flare sighting at the wind farm. Guard vessel proceeded to undertake search but did not find anything to report.	Internal daily progress report received by Anatec
Aircraft crash	15 June 2020	Hornsea Project One	United States (US) jet crashed into sea during routine flight. CTV and SOV for Hornsea Project One joined the search for the missing pilot.	Web search (4C Offshore, 2020)
Fire/explosion	15 December 2020	Dudgeon	Fishing vessel experienced explosions on board with crew injured. SOV for Dudgeon deployed its Fast Rescue Boat (FRB) and evacuated the casualty vessel.	Web search (Offshore WIND, 2020)
Vessel in distress	3 July 2021	Robin Rigg	Wind farm CTV fire alarm sounded, with the engine then shut down. A support vessel for Robin Rigg was able to assist in escorting the vessel to port.	Web search (Vessel Tracker, 2021)
Drifting	17 July 2021	Neart na Gaoithe	Small dinghy with two children aboard drifted offshore due to strong winds. A guard vessel associated with Neart na Gaoithe was able to retrieve the children.	Web search (Edinburgh Evening News, 2021)
Allision	9 June 2022	Westermost Rough	Fishing vessel allided with a wind turbine at Westermost Rough. A supply vessel was among the responders as an RNLI lifeboat escorted the vessel under its own power to port.	Web search (Vessel Tracker, 2022)

10 Vessel Traffic Movements

158. This section presents an overview of vessel traffic movements across the study areas (defined in section 3.4) for the DBS Array Areas (separated into the DBS East and DBS West Array Areas), Offshore Export Cable Corridor, and export cable platform search area, based upon the findings of the summer and winter vessel traffic surveys undertaken in July and October/November 2022 and excluding temporary traffic (see section 5.2).

10.1 Dogger Bank South Array Areas

159. This section provides a general overview of vessel traffic within the DBS East study area and DBS West study area, with more detailed analysis of each of the main vessel types presented in sections 10.1.3 to 10.1.6.

160. **Figure 10-1** presents the tracks of vessels recorded within the DBS East study area during the 28-day period, with **Figure 10-2** presenting a vessel density heat map[2] of the same data.

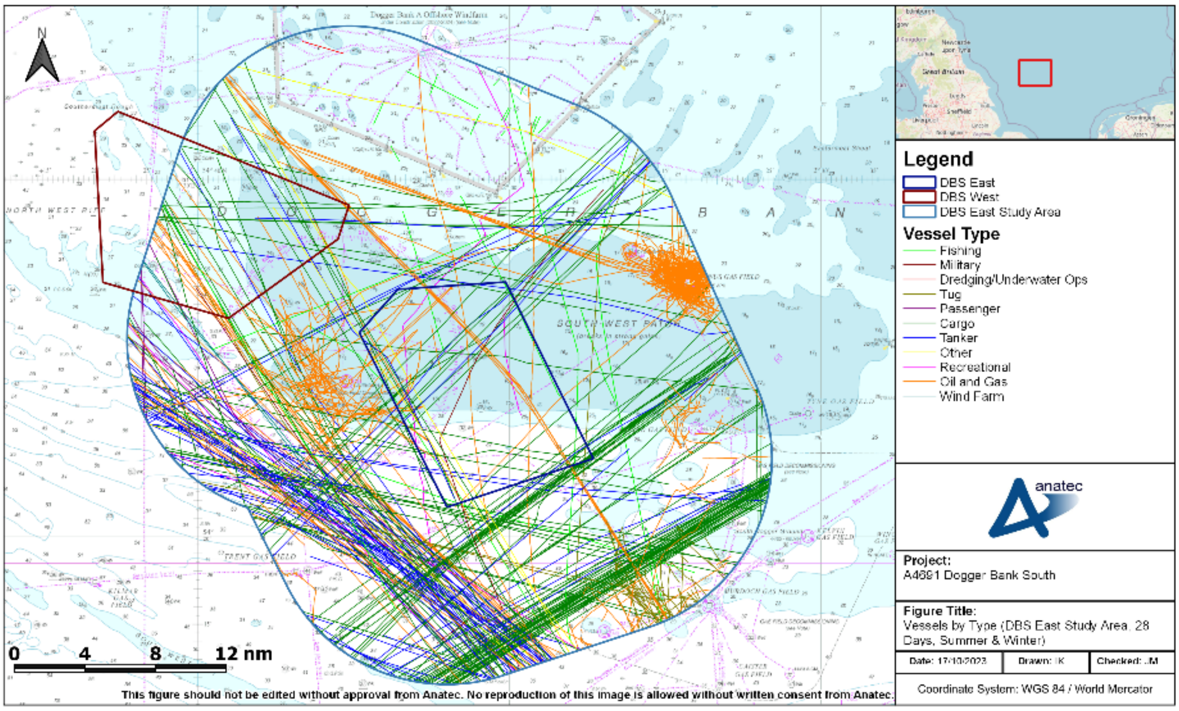

Figure 10-1 Vessels by Type (DBS East Study Area, 28 Days, Summer and Winter)

[2] To ensure contrasts in vessel density are suitably illustrated, the scale used for the vessel density heat map for DBS East and DBS West match but are independent of the scale used for the offshore export cable corridor and export cable platform search area in later subsections.

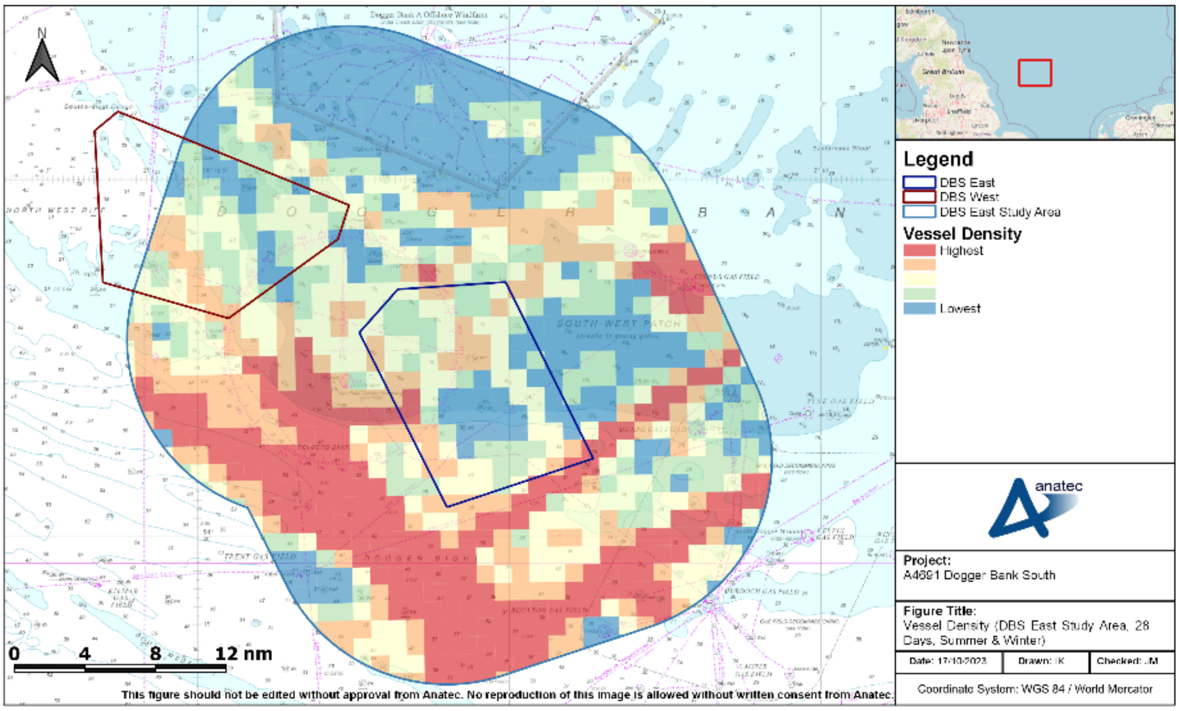

Figure 10-2 Vessel Density (DBS East Study Area, 28 Days, Summer and Winter)

161. High-density traffic is mainly located to the south-west of the DBS East Array Area, comprising commercial traffic undertaking north-west/south-east transits across the North Sea. There are also north-east/south-west cargo vessel routes of relatively high density to the south-east of the DBS East Array Area, one of which intersects the south-eastern extent of the DBS East Array Area.

162. High density traffic is also located in proximity to the Cygnus gas field to the north-east, due to oil and gas vessel activity. In contrast, the lowest density area is at Dogger Bank A, which had minimal traffic within its boundary (and was mostly recorded during early July).

163. **Figure 10-3** presents the tracks of vessels recorded within the DBS West study area during the 28-day period, with **Figure 10-4** presenting a vessel density heat map of the same data.

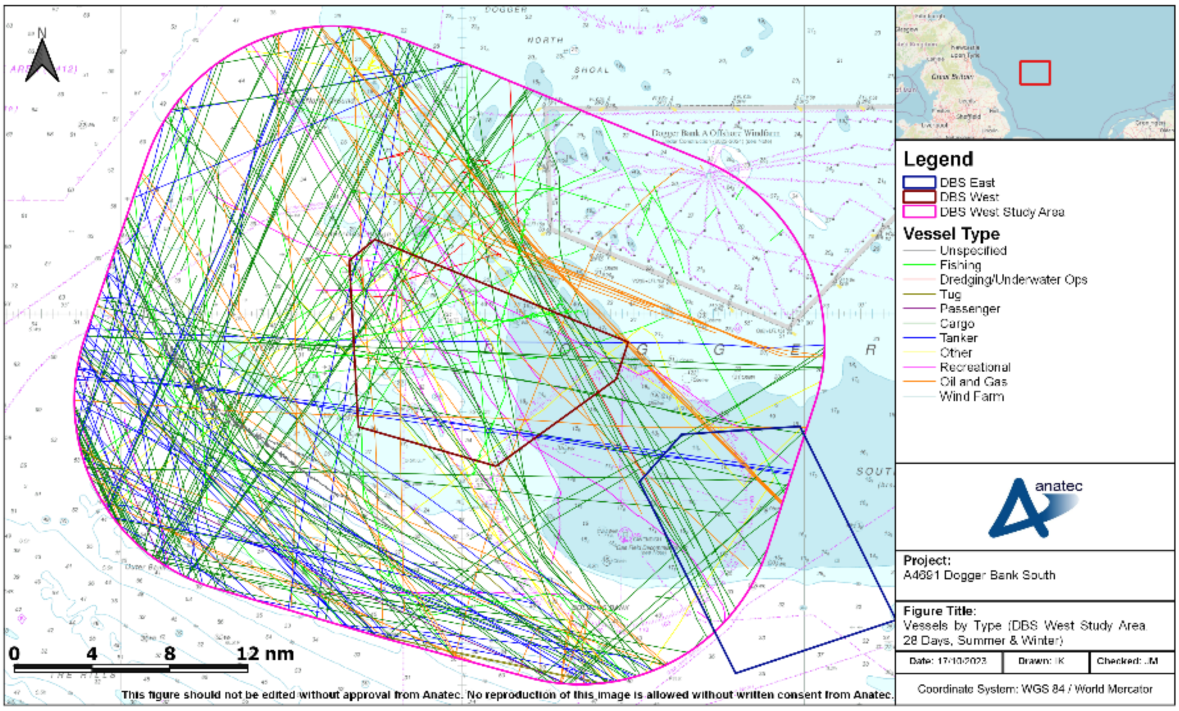

Figure 10-3 Vessels by Type (DBS West Study Area, 28 Days, Summer and Winter)

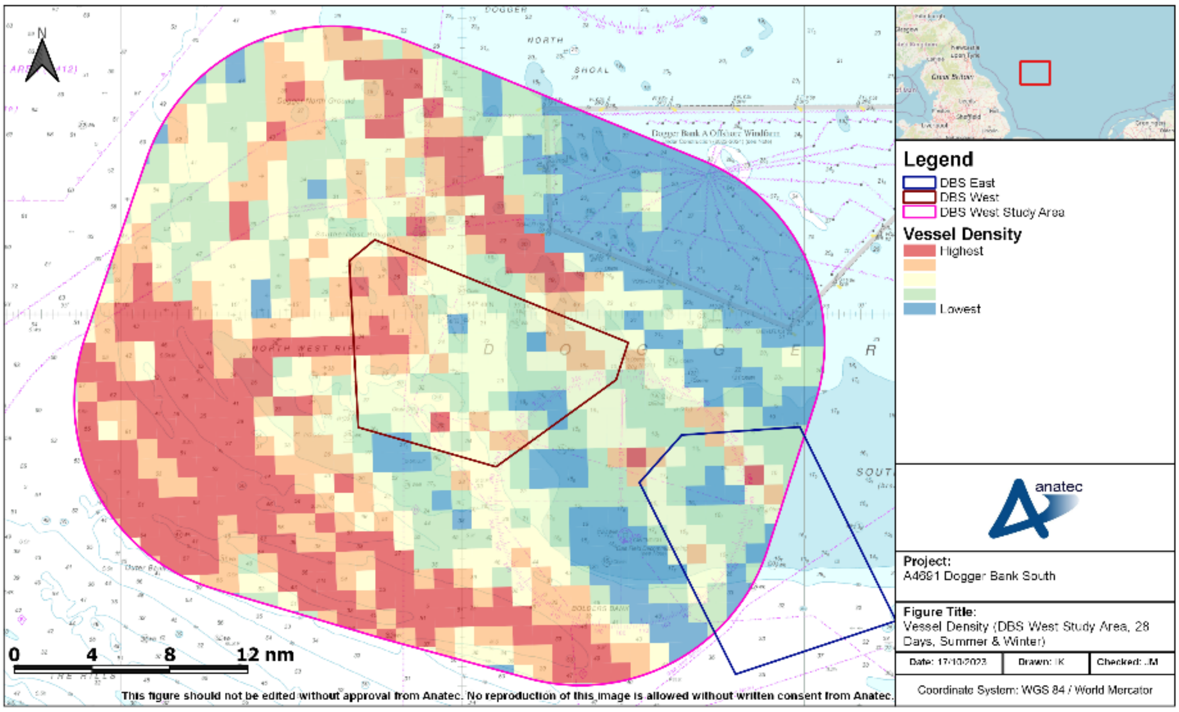

Figure 10-4 Vessel Density (DBS West Study Area, 28 Days, Summer and Winter)

164. High density traffic is mainly located to the south and west of the DBS West Array Area, mainly comprising commercial traffic undertaking north-west/south-east transits across the North Sea. Transits by cargo vessels and oil and gas vessels also

contribute to a region of relatively high density to the north of the DBS West Array Area between the boundary of the DBS West Array Area and the boundary of Dogger Bank A. Traffic within Dogger Bank A was minimal (and mostly recorded during July), with this region being the largest region of relatively low density within the DBS West study area.

10.1.1 Vessel Count

165. This section presents an overview of vessel counts within the DBS Array Area study areas during the survey periods. It is noted that throughout this section, only unique vessels are counted for each day to prevent overcounting in cases where a vessel may have been dropped and reacquired.

10.1.1.1 DBS East Array Area

166. For the 28-day period, an average of 14 unique vessels per day were recorded within the DBS East study area while an average of three unique vessels per day were recorded intersecting the DBS East Array Area itself.

167. **Figure 10-5** presents the daily counts of vessels recorded within the DBS East study area and the DBS East Array Area during the 28-day period. Approximately 20% of vessels recorded within the DBS East study area were also recorded within the DBS East Array Area itself.

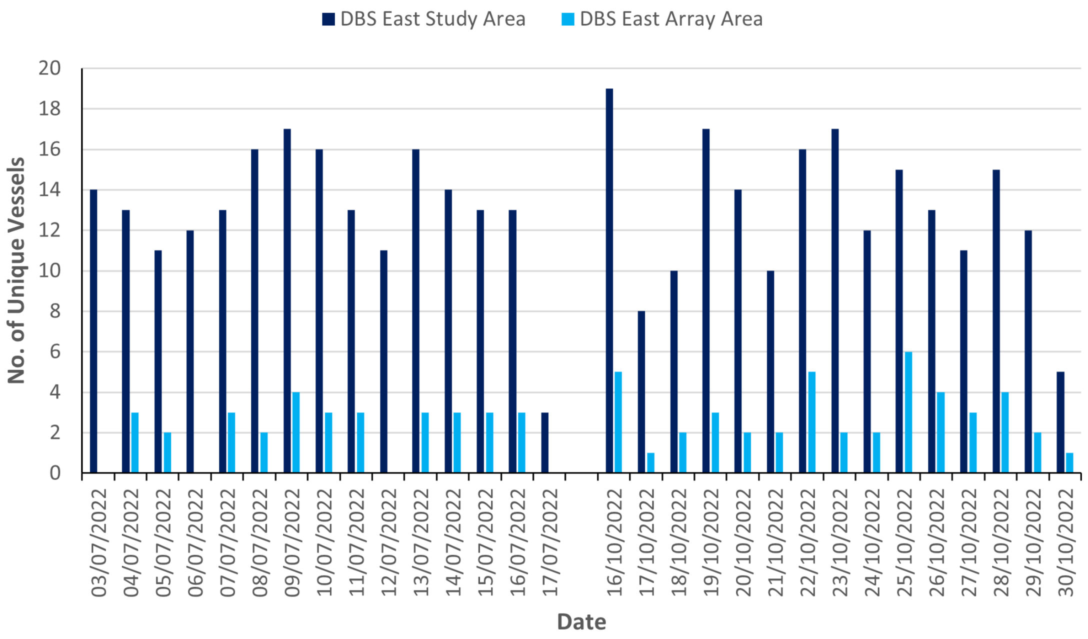

Figure 10-5 Vessel Counts per Day within DBS East Study Area and DBS East Array Area

168. The busiest day within the DBS East study area during the 28-day period was the 16th October, during which 19 unique vessels were recorded. The quietest full day was the 17th October, during which eight unique vessels were recorded.

10.1.1.2 DBS West Array Area

169. For the 28-day period, an average of ten unique vessels per day were recorded within the DBS West study area while an average of three unique vessels per day were recorded intersecting the DBS West Array Area itself.

170. **Figure 10-6** presents the daily counts of vessels recorded within the DBS West study area and the DBS West Array Area during the 28-day period. Approximately 29% of vessels recorded within the DBS West study area were also recorded within the DBS West Array Area itself.

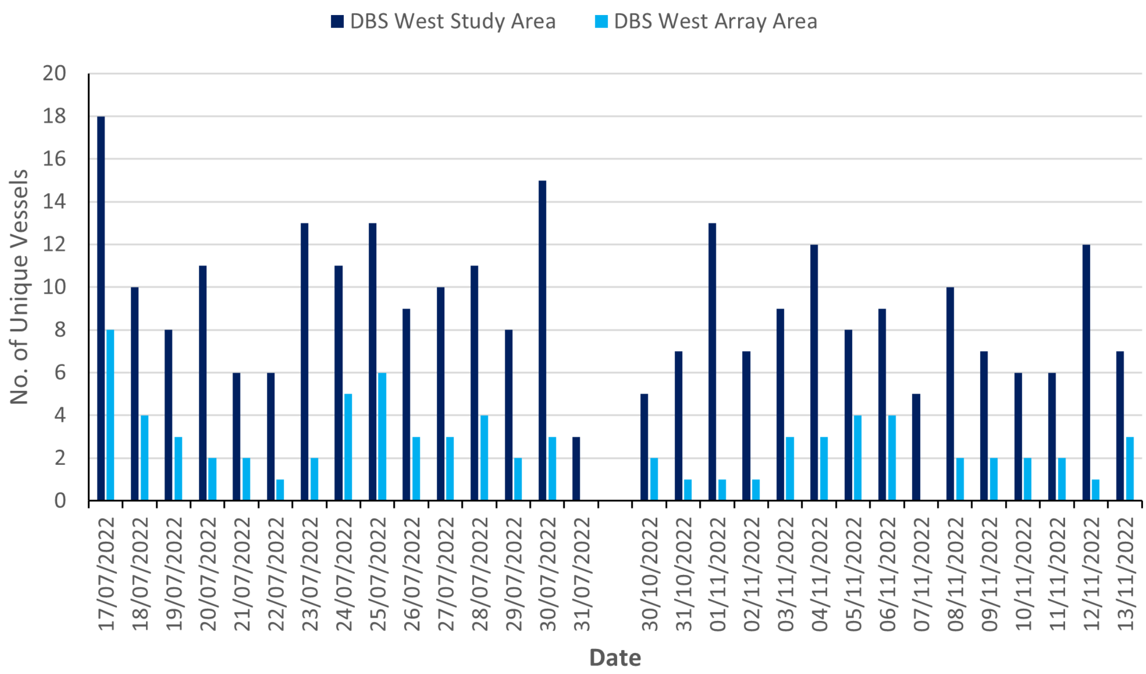

Figure 10-6 Vessel Counts per Day within DBS West Study Area and DBS West Array Area

171. The busiest day within the DBS West study area during the 28-day period was the 17th July, during which 17 unique vessels were recorded. The quietest full day was the 7th November, during which five unique vessels were recorded.

10.1.2 Vessel Type

172. This subsection presents analysis of the main vessel types recorded within and in proximity to the DBS Array Areas, with more detailed analysis on each individual vessel type being presented in sections 10.1.3 to 10.1.7.

10.1.2.1 DBS East Array Area

173. The distribution of the main vessel types recorded within the DBS East study area, as well as intersecting the DBS East Array Area itself, during the 28-day period is presented in **Figure 10-7**.

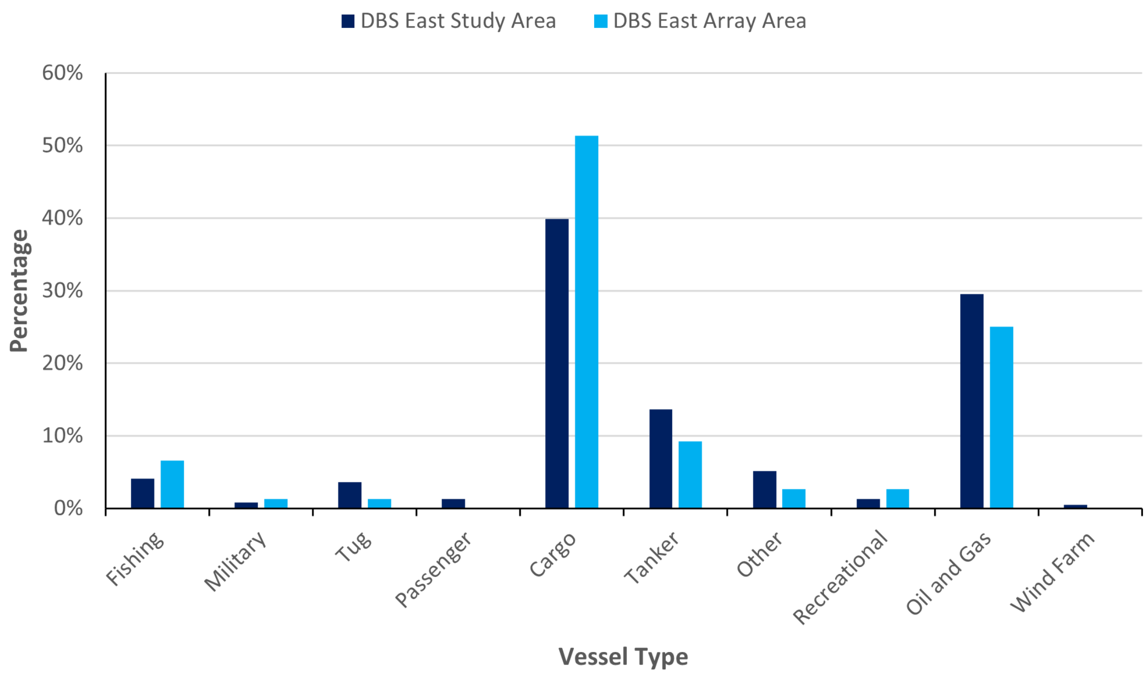

Figure 10-7 Distribution of Main Vessel Types (DBS East Array Area, 28 Days, Summer and Winter)

174. The main type of vessel recorded within both the DBS East study area and the DBS East Array Area itself was cargo vessels, accounting for 40% of the traffic within the DBS East study area and 51% of the traffic within the DBS East Array Area itself. The next most common vessel type within the DBS East study area was oil and gas vessels, accounting for 30%, followed by tankers (14%) and fishing vessels (4%). The most common vessel type within the DBS East Array Area itself after cargo vessels was oil and gas vessels, which accounted for 25%. This was followed by tankers (14%) and fishing vessels (4%).

10.1.2.2 DBS West Array Area

175. The distribution of the main vessel types recorded within the DBS West study area, as well as intersecting the DBS West Array Area itself, during the 28-day period is presented in **Figure 10-8**.

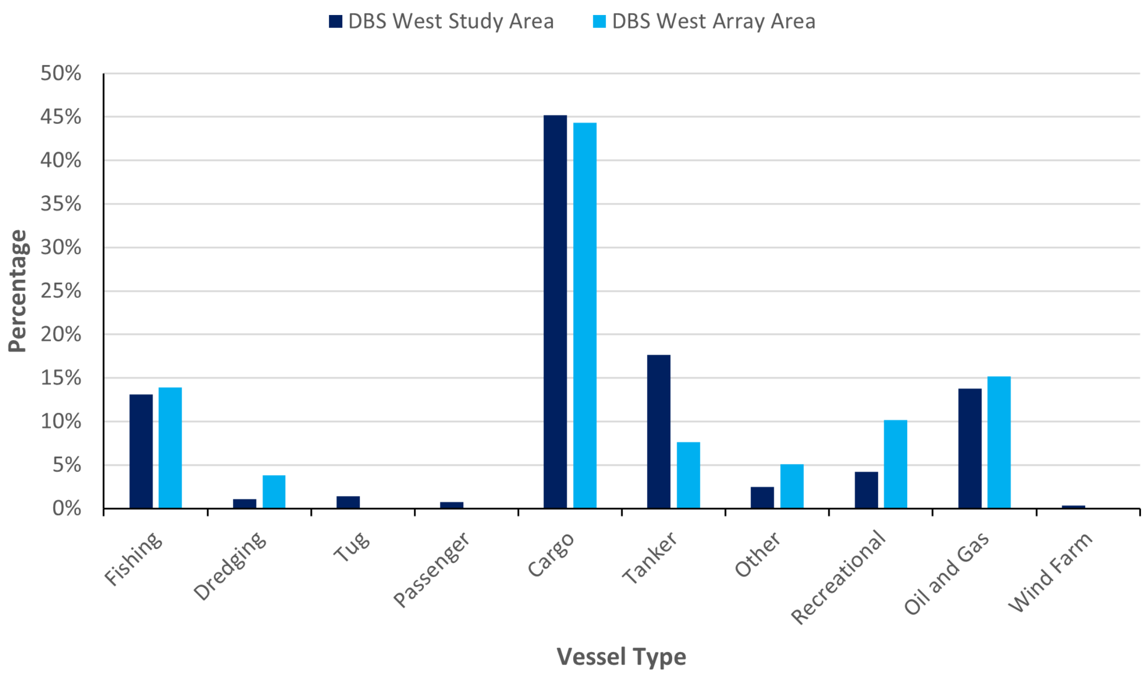

Figure 10-8 Distribution of Main Vessel Types (DBS West Array Area, 28 Days, Summer and Winter)

176. The main type of vessel recorded within both the DBS West study area and the DBS West Array Area was cargo vessels, accounting for 46% of the traffic within the DBS West study area and 44% of the traffic within the DBS West Array Area. The next most common vessel type within the DBS West study area was tankers, accounting for 18%, followed by oil and gas vessels (14%) and fishing vessels (10%). The most common vessel type within the DBS West Array Area after cargo vessels was oil and gas vessels, which accounted for 15%. This was followed by fishing vessels (14%) and recreational vessels (10%).

10.1.3 Cargo Vessels

10.1.3.1 DBS East Array Area

177. **Figure 10-9** presents the cargo vessels recorded within the DBS East study area during the 28-day period.

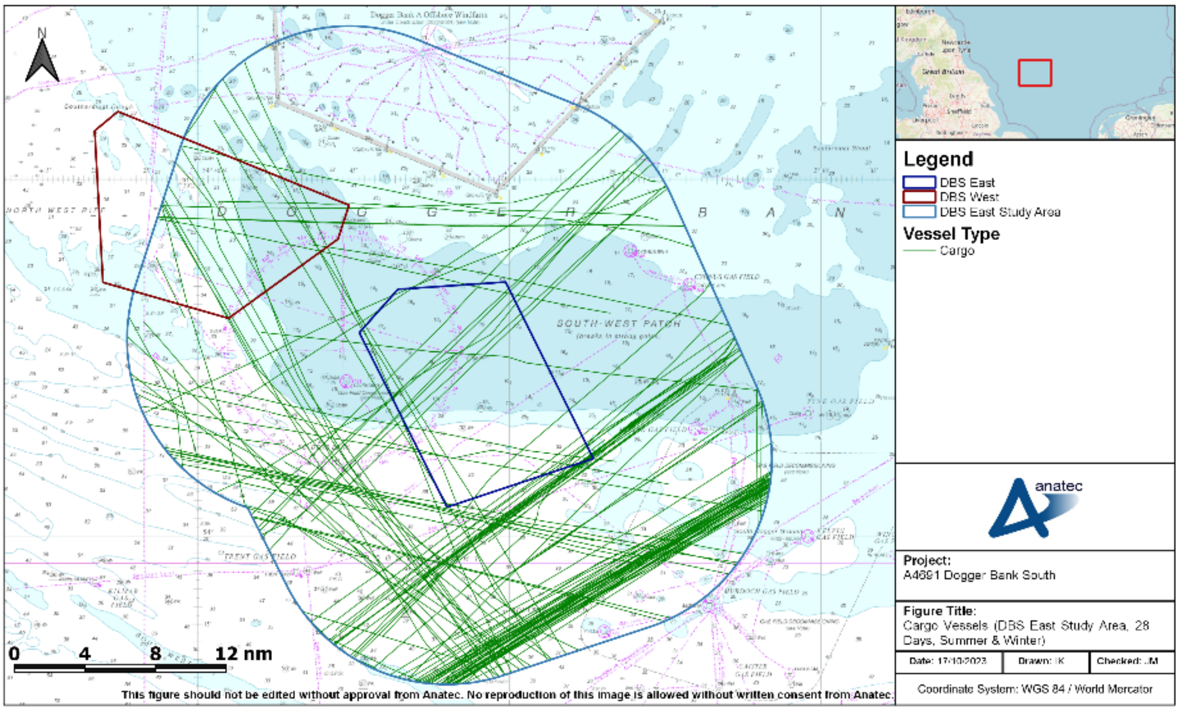

Figure 10-9 Cargo Vessels (DBS East Study Area, 28 Days, Summer and Winter)

178. An average of between five and six cargo vessels per day were recorded within the DBS East study area during the 28-day period, and an average of between one and two cargo vessels per day was recorded within the DBS East Array Area itself.

179. Cargo vessels were recorded transiting in a variety of directions but avoided Dogger Bank A. Cargo vessels were commonly observed undertaking north-east/south-west routes, either passing south-east of, passing at the south-eastern corner of, or passing through the DBS East Array Area. The most frequented of these routes was mainly undertaken by two Roll-on/Roll-off (RoRo) cargo vessels operated by DFDS Seaways; **Figure 10-10** presents the RoRo cargo vessels recorded within the DBS East study area during the 28-day period.

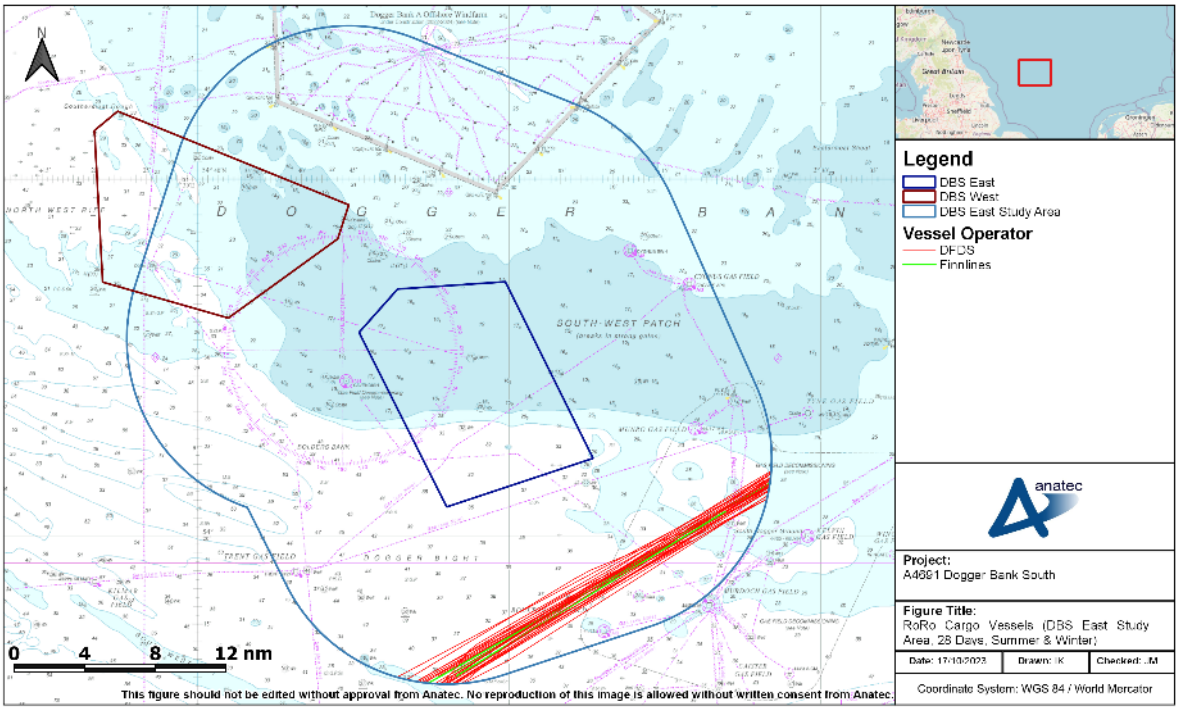

Figure 10-10 RoRo Cargo Vessels (DBS East Study Area, 28 Days, Summer and Winter)

180. The DFDS Seaways route is between Immingham (UK) and Gothenburg (Sweden) or Immingham and Brevik (Norway), generally featuring one to two transits per day. The route is also operated by Finnlines between Hull (UK) and Helsinki (Finland), generally featuring two transits per week.

10.1.3.2 DBS West Array Area

181. **Figure 10-11** presents the cargo vessels recorded within the DBS West study area during the 28-day period.

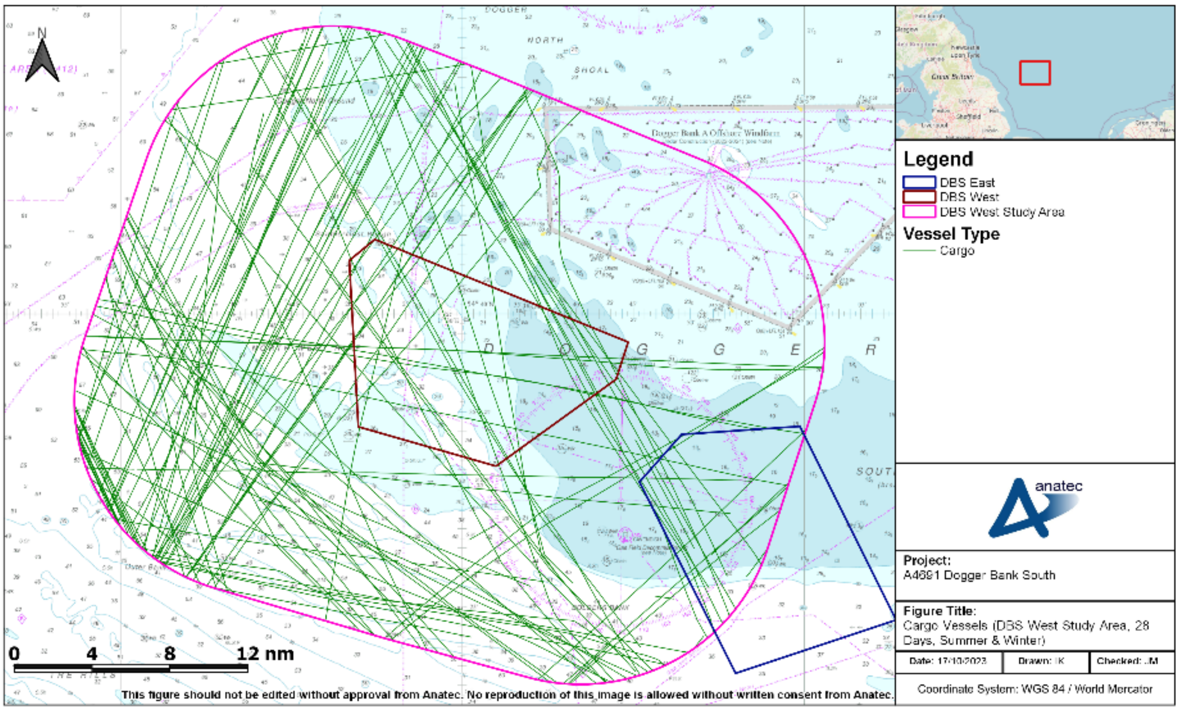

Figure 10-11 Cargo Vessels (DBS West Study Area, 28 Days, Summer and Winter)

182. An average of between four and five cargo vessels per day was recorded within the DBS West study area during the 28-day period, and an average of between one and two cargo vessels per day was recorded within the DBS West Array Area itself.

183. Cargo vessels generally avoided the boundary of Dogger Bank A and were seen transiting to/from a variety of destinations including UK and Norwegian ports. No regular RoRo cargo vessels were observed.

10.1.4 Tankers

10.1.4.1 DBS East Array Area

184. **Figure 10-12** presents the tankers recorded within the DBS East study area during the 28-day period.

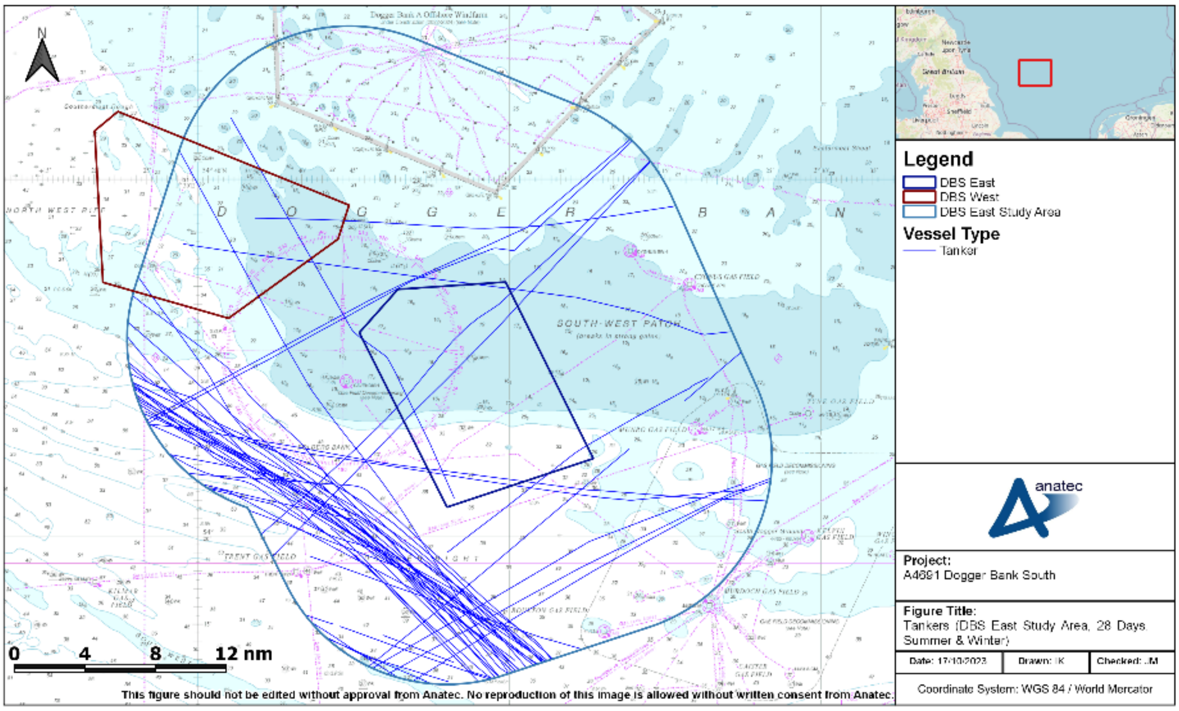

Figure 10-12 Tankers (DBS East Study Area, 28 Days, Summer and Winter)

185. An average of two tankers per day was recorded within the DBS East study area during the 28-day period, with an average of one tanker every three days recorded within the DBS East Array Area itself.

186. Tankers were generally concentrated along a south-east/north-west route to the south-west of the DBS East Array Area. This route passes between the platforms associated with the Cavendish and Trent gas fields. Destinations of the tankers undertaking this route were mainly UK and Dutch ports.

10.1.4.2 DBS West Array Area

187. **Figure 10-13** presents the tankers recorded within the DBS West study area during the 28-day period.

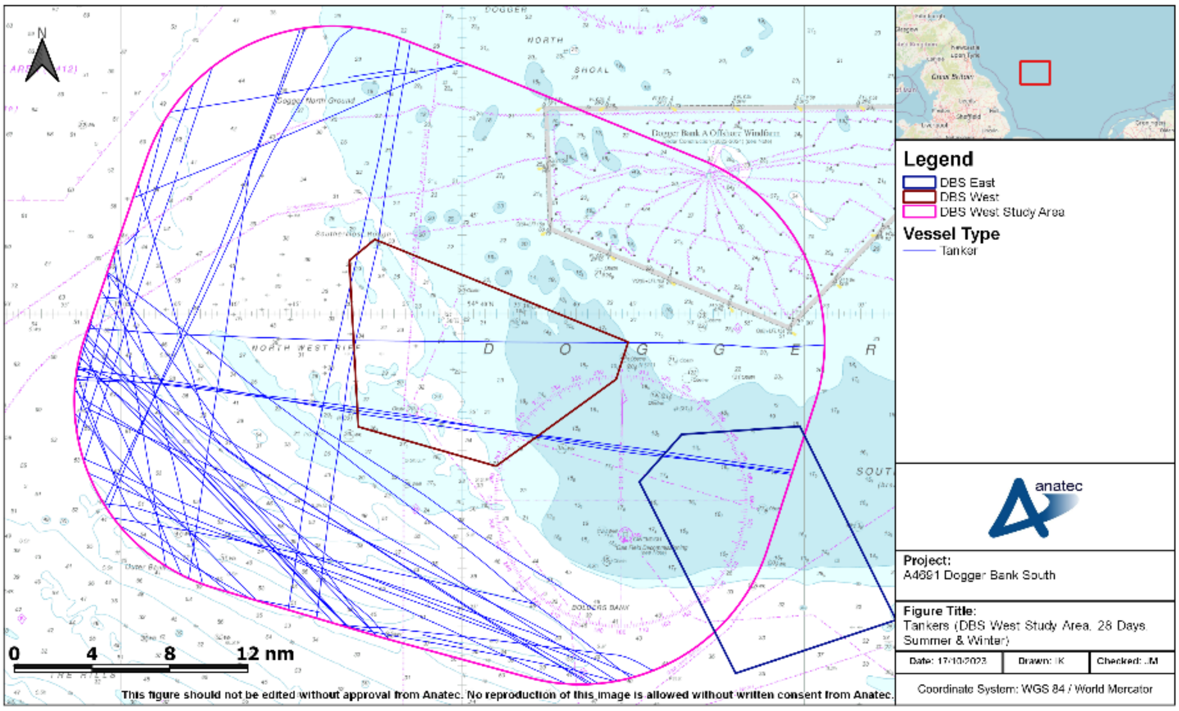

Figure 10-13 Tankers (DBS West Study Area, 28 Days, Summer and Winter)

188. An average of between one and two tankers per day was recorded within the DBS West study area during the 28-day period, and an average of one tanker every four days recorded within the DBS West Array Area itself.

189. Tankers were generally recorded to the west and south of the DBS West Array Area, with destinations mainly being UK and Dutch ports.

10.1.5 Oil and Gas Vessels

10.1.5.1 DBS East Array Area

190. **Figure 10-14** presents the oil and gas vessels recorded within the DBS East study area during the 28-day period. The platforms associated with activities are also shown for context.

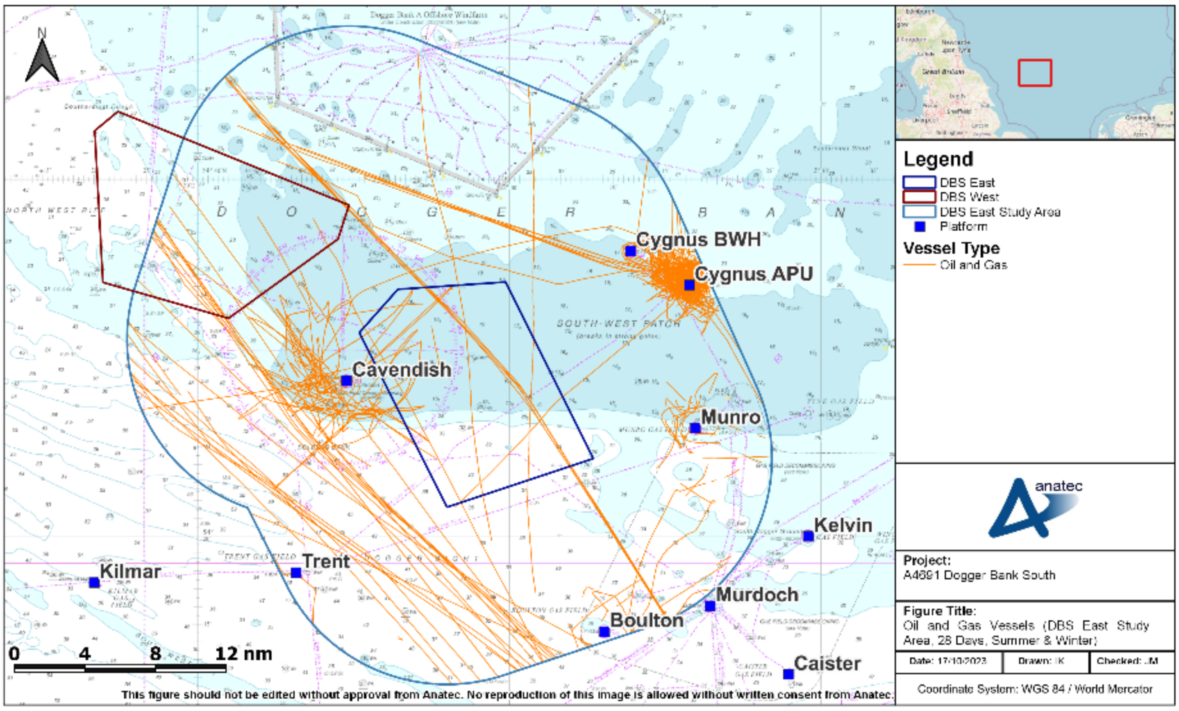

Figure 10-14 Oil and Gas Vessels (DBS East Study Area, 28 Days, Summer and Winter)

191. An average of between three and four oil and gas vessels per day were recorded within the DBS East study area during the 28-day period, and an average of one oil and gas vessel every day was recorded within the DBS East Array Area itself.

192. Oil and gas vessel activity was largely concentrated in proximity to the Cygnus gas field to the east of the DBS East Array Area, with transits to the Cygnus gas field passing north of the DBS Array Areas and south of Dogger Bank A. An oil and gas vessel was also seen in proximity to Cavendish, located south of the DBS East Array Area, for a duration of ten days.

193. The remainder of the traffic was largely observed undertaking south-east/north-west transits, with Aberdeen (UK) being one of the most common destinations for these vessels.

10.1.5.2 DBS West Array Area

194. **Figure 10-15** presents the oil and gas vessels recorded within the DBS West study area during the 28-day period.

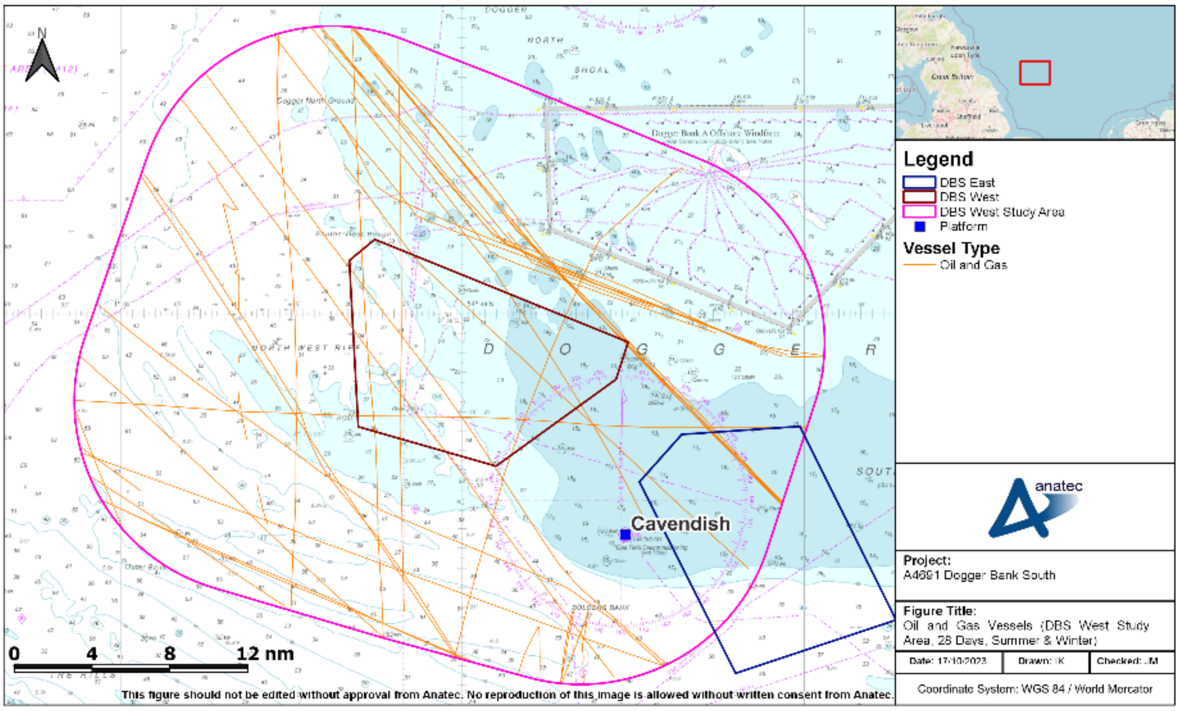

Figure 10-15 Oil and Gas Vessels (DBS West Study Area, 28 Days, Summer and Winter)

195. An average of between one and two oil and gas vessels per day was recorded within the DBS West study area during the 28-day period, and an average of one oil and gas vessel every two days was recorded within the DBS West Array Area. Destinations included Aberdeen, the Cygnus gas field (located within the DBS East study area) and the Southwark oil field. Again, transits to/from the Cygnus gas field were generally made north of the DBS Array Areas and south of Dogger Bank A.

10.1.6 Fishing Vessels

10.1.6.1 DBS East Array Area

196. **Figure 10-16** presents the fishing vessels recorded within the DBS East study area during the 28-day period, colour-coded by average vessel speed.

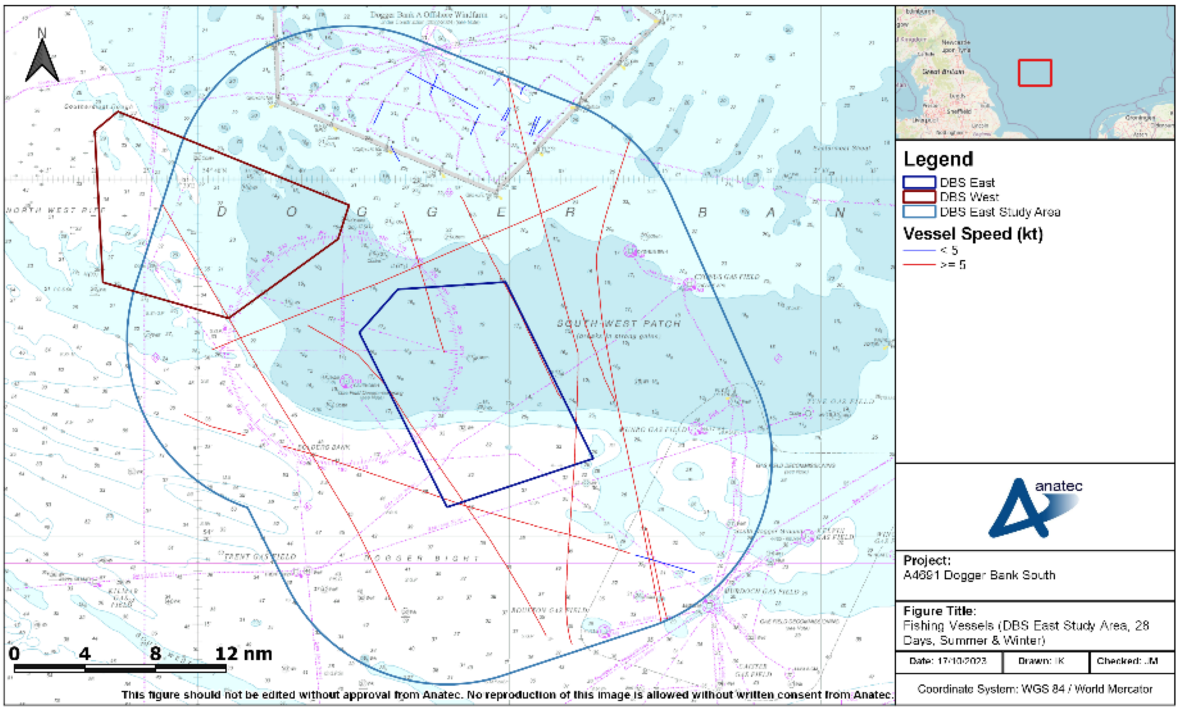

Figure 10-16 Fishing Vessels by Speed (DBS East Study Area, 28 Days, Summer and Winter)

197. An average of one fishing vessel per day was recorded within the DBS East study area during the 28-day period, and a fishing vessel was recorded intersecting the DBS East Array Area every four days.

198. Although some fishing vessels were clearly in transit (based on track behaviour and average speed), there were various sparse tracks recorded within Dogger Bank A from a vessel likely actively fishing during early July.

199. It is noted that the DBS East Array Area overlaps with a Special Area of Conservation (SAC) which prohibits bottom-trawling fishing gear and has been in operation since June 2022[3].

10.1.6.2 DBS West Array Area

200. **Figure 10-17** presents the fishing vessels recorded within the DBS West study area during the 28-day period, colour-coded according to average vessel speed.

[3] The Dogger Bank SAC will be assessed every five years to identify if it remains fit for purpose.

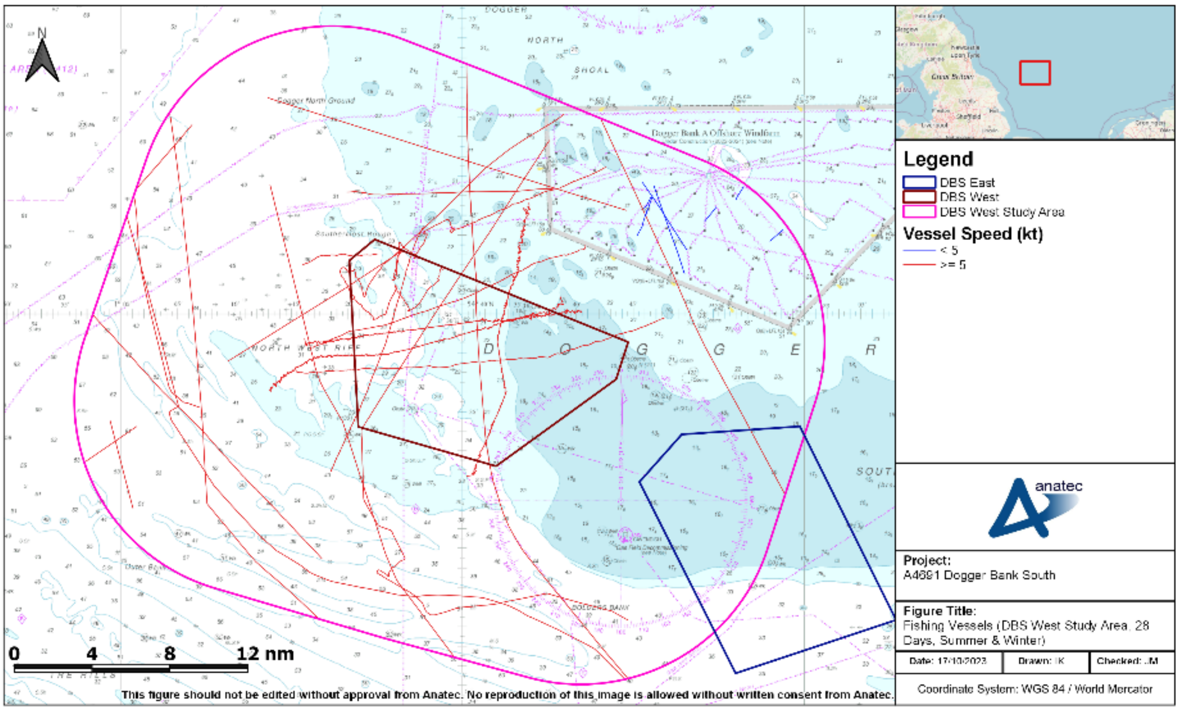

Figure 10-17 Fishing Vessels by Speed (DBS West Study Area, 28 Days, Summer and Winter)

201. An average of one fishing vessel per day was recorded within the DBS West study area during the 28-day period, and an average of one fishing vessel every two to three fishing vessels was recorded within the DBS West Array Area itself.

202. Fishing vessels were generally recorded transiting in a variety of directions. One fishing vessel was recorded at speeds suggestive of active fishing within the DBS West Array Area; this vessel was recorded on Radar. A fishing vessel was also recorded at speeds suggestive of active fishing within Dogger Bank A during early July.

203. The relatively low level of fishing vessel activity (across both DBS Array Areas) may be attributed to the distance offshore.

10.1.7 Recreational Vessels

10.1.7.1 DBS East Array Area

204. **Figure 10-18** presents the recreational vessels recorded within the DBS East study area during the 28-day period.

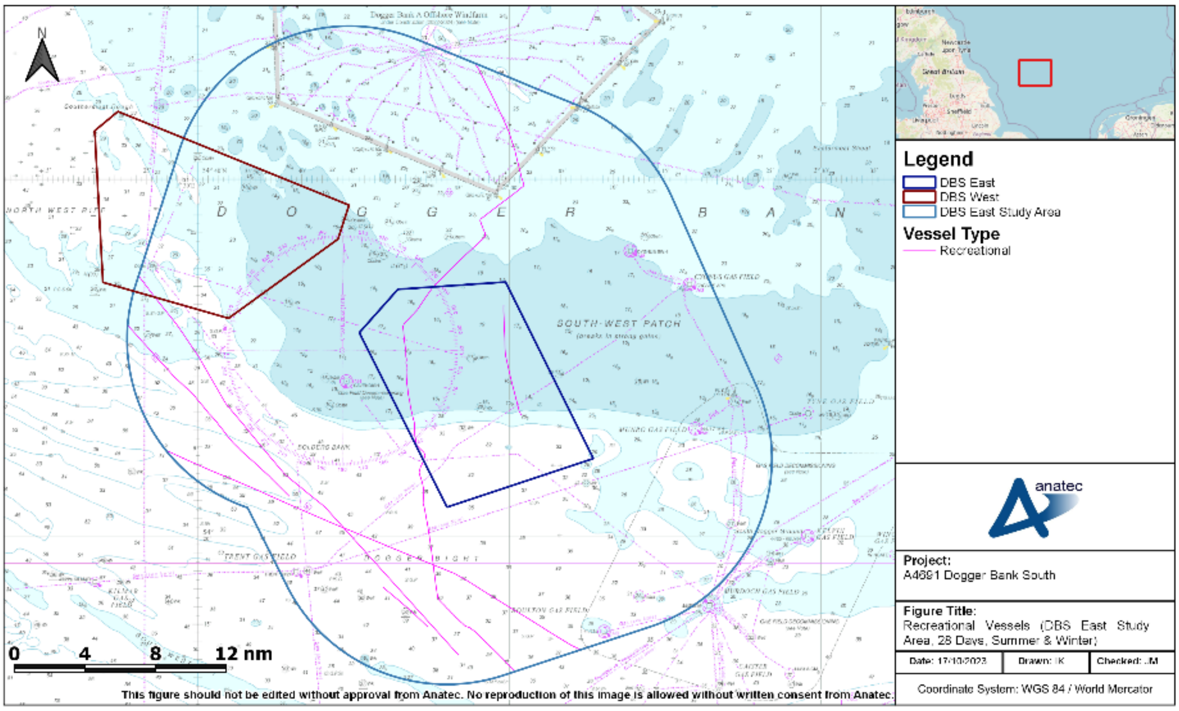

Figure 10-18 Recreational Vessels (DBS East Study Area, 28 Days, Summer and Winter)

205. A recreational vessel was recorded within the DBS East study area every five to six days. Two of these vessels were recorded intersecting the DBS East Array Area itself.

10.1.7.2 DBS West Array Area

206. **Figure 10-19** presents the recreational vessels recorded within the DBS West study area during the 28-day period.

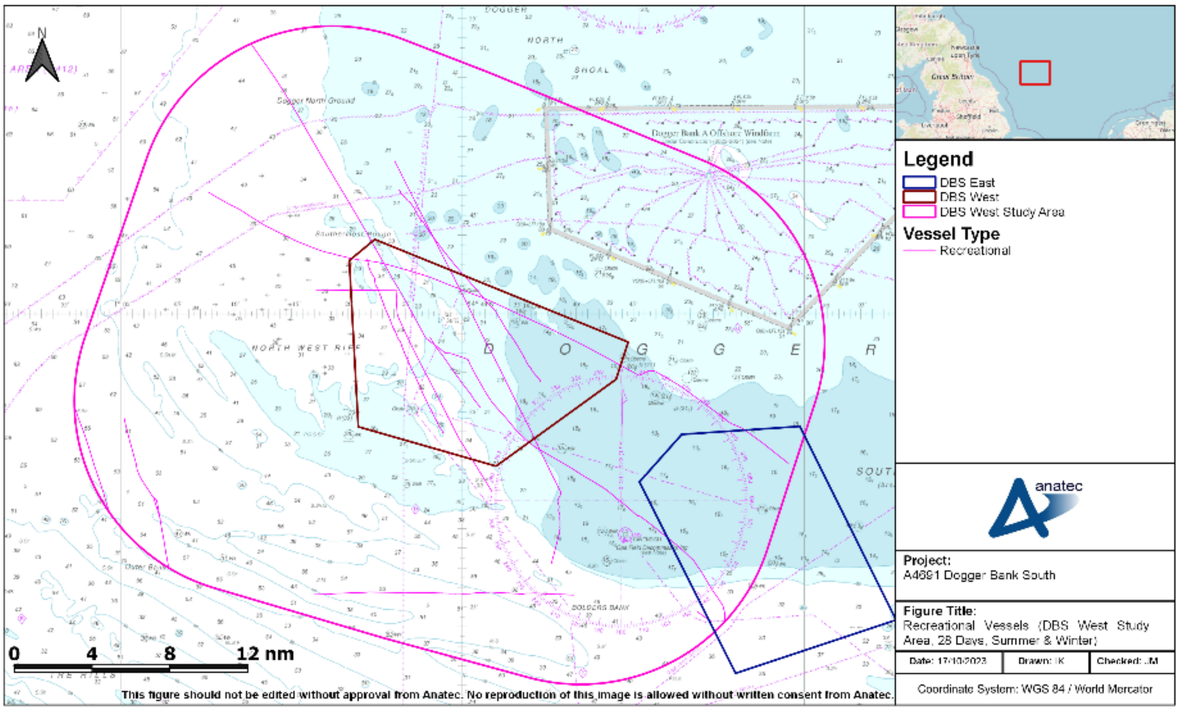

Figure 10-19 Recreational Vessels (DBS West Study Area, 28 Days, Summer and Winter)

207. A recreational vessel was recorded within the DBS West study area every two to three days. The DBS West Array Area itself was intersected eight times, with three of these intersections being recorded on Radar.

208. The relatively low level of recreational vessel activity (across both DBS Array Areas) may be attributed to the distance offshore.

10.1.8 Vessel Size

10.1.8.1 Vessel Length – DBS East Array Area

209. Vessel length was available for approximately 99% of vessels recorded throughout the two 14-day survey periods for the DBS East study area and ranged from 9m for a sailing vessel to 336m for a crude oil tanker. The distribution of vessel lengths recorded within the DBS East study area throughout each survey period is presented in **Figure 10-20**.

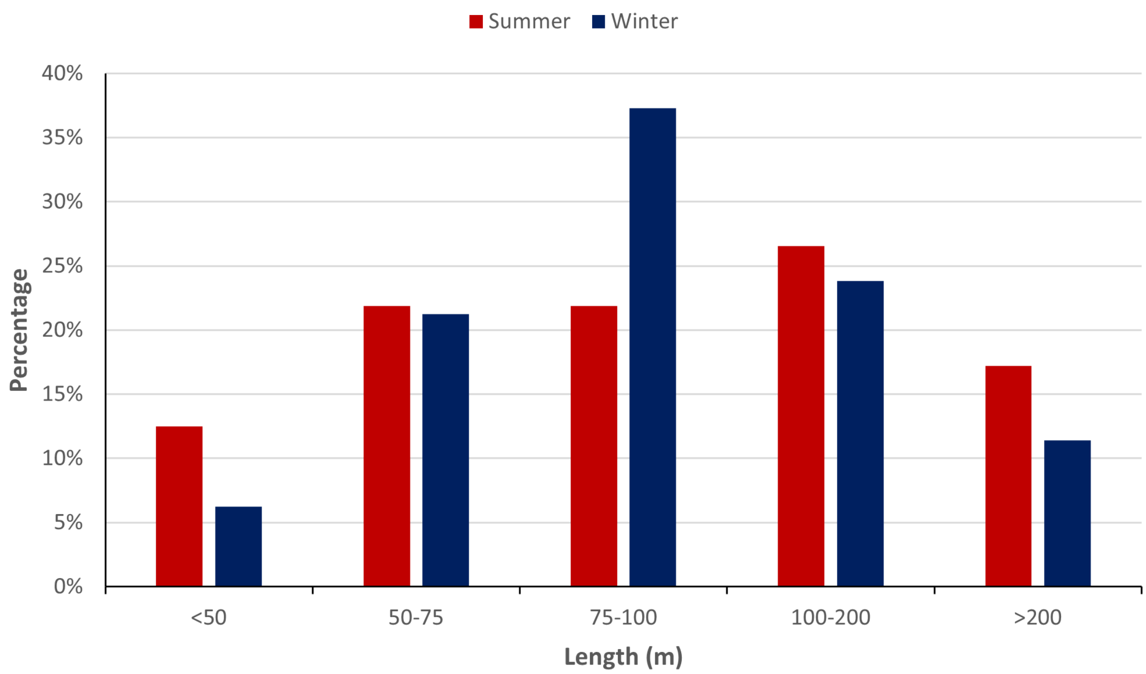

Figure 10-20 Distribution of Vessel Lengths (DBS East Array Area)

210. Excluding the proportion of vessels for which length was not available, the average length of vessels within the DBS East study area throughout the summer and winter survey periods was 119m and 110m respectively.

211. **Figure 10-21** presents a plot of the vessel tracks recorded in the DBS East study area throughout the survey periods, colour-coded by vessel length.

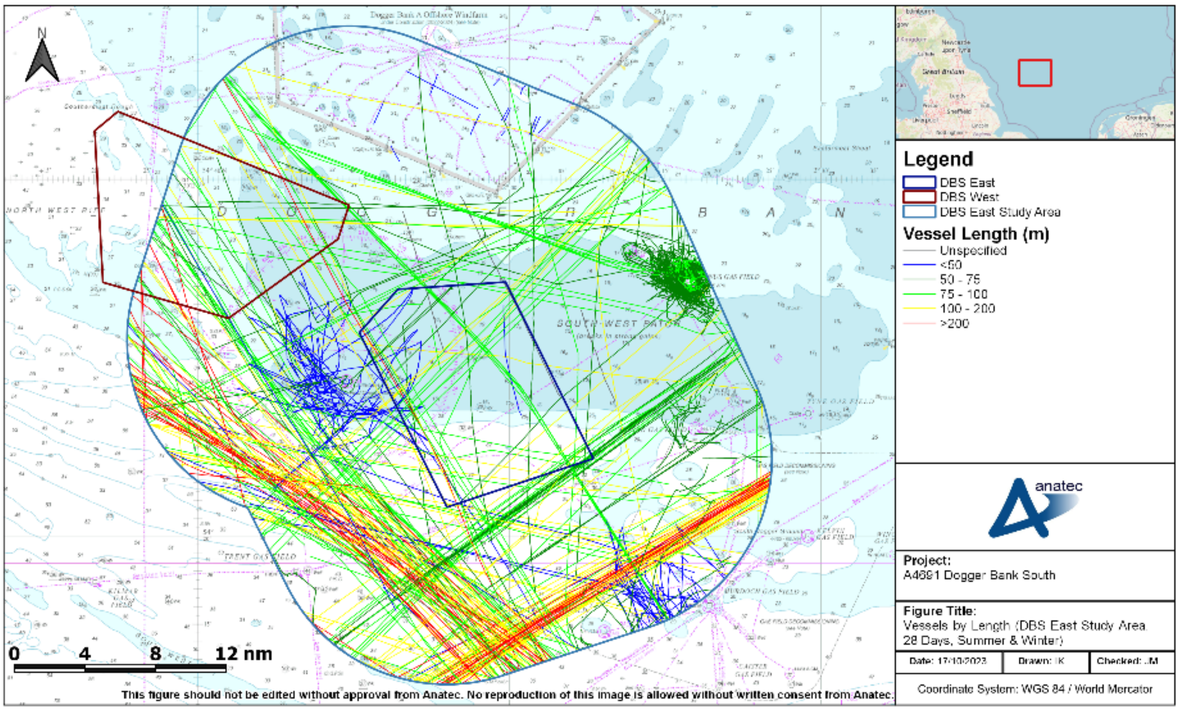

Figure 10-21 Vessels by Length (DBS East Study Area, 28 Days, Summer and Winter)

212. The vessels of smaller length were associated with oil and gas activities clustered around the platforms in the area, as well as the less frequently recorded fishing and recreational vessels. Vessels of larger length were typically tankers and the DFDS Seaways-operated RoRo cargo vessels transiting between Immingham and Gothenburg.

10.1.8.2 Vessel Length – DBS West Array Area

213. Vessel length was available for approximately 94% of vessels recorded throughout the two 14-day survey periods for the DBS West study area and ranged from 11m for a sailing vessel to 300m for two container vessels. The distribution of vessel lengths recorded within the DBS West study area throughout each survey period is presented in **Figure 10-22**.

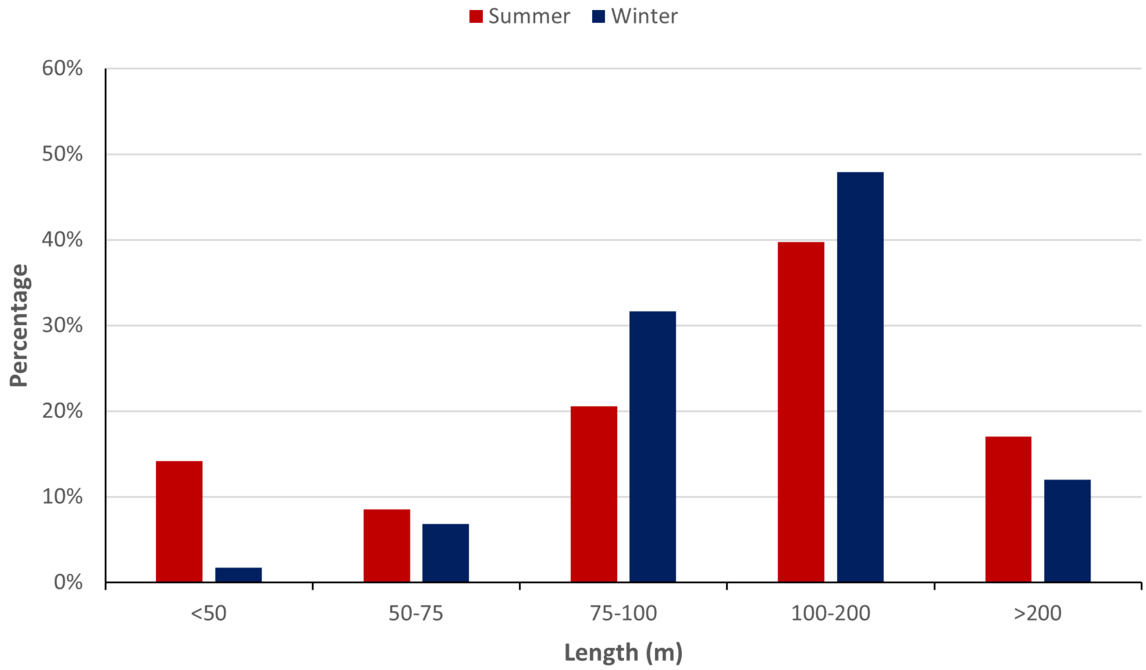

Figure 10-22 Distribution of Vessel Lengths (DBS West Array Area)

214. Excluding the proportion of vessels for which length was not available, the average length of vessels within the DBS West study area throughout the summer and winter survey periods was 124m and 128m respectively.

215. **Figure 10-23** presents a plot of the vessel tracks recorded in the DBS West study area throughout the survey periods, colour-coded by vessel length.

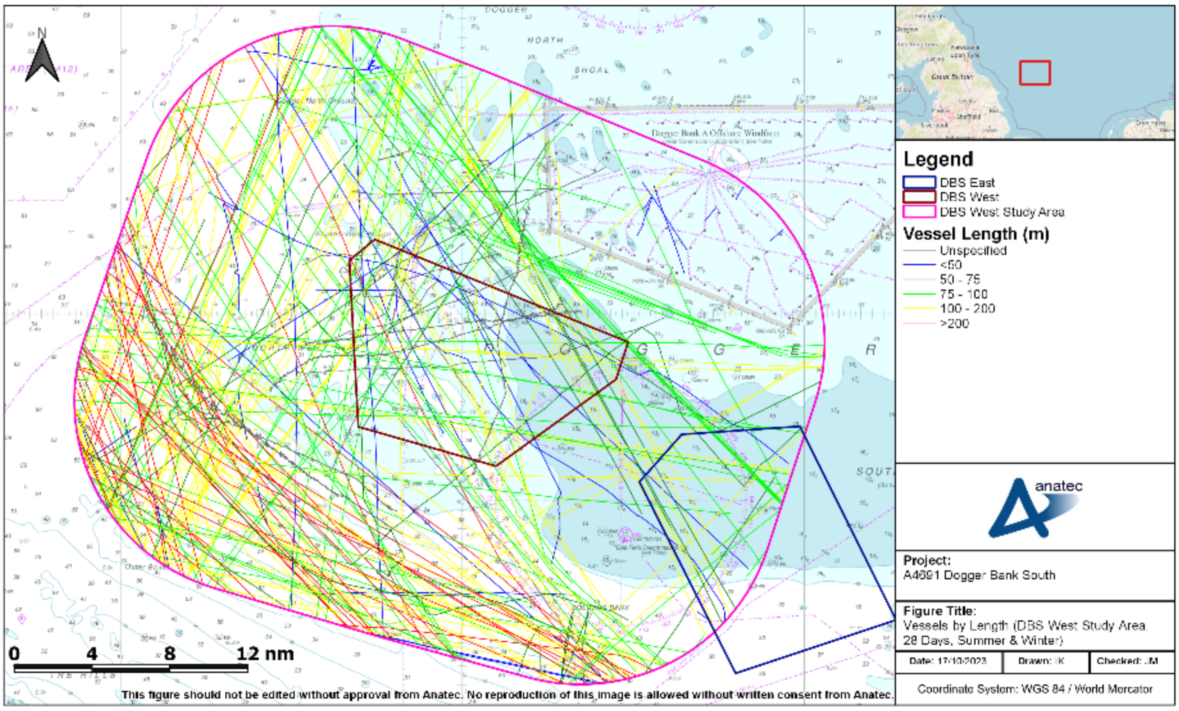

Figure 10-23 Vessels by Length (DBS West Study Area, 28 Days, Summer and Winter)

216. Vessels of smaller length were recorded as being the oil and gas vessels and fishing vessels transiting within the DBS study area, whilst the vessels of greater length were cargo vessels and tankers.

10.1.8.3 Vessel Draught – DBS East Array Area

217. Vessel draught was available for approximately 84% of vessels recorded throughout the two 14-day survey periods for DBS East study area and ranged from 2.4m for two wind farm vessels and 13.8m for a bulk carrier. The distribution of vessel draughts recorded within the DBS East study area throughout each survey period is presented in **Figure 10-24**.

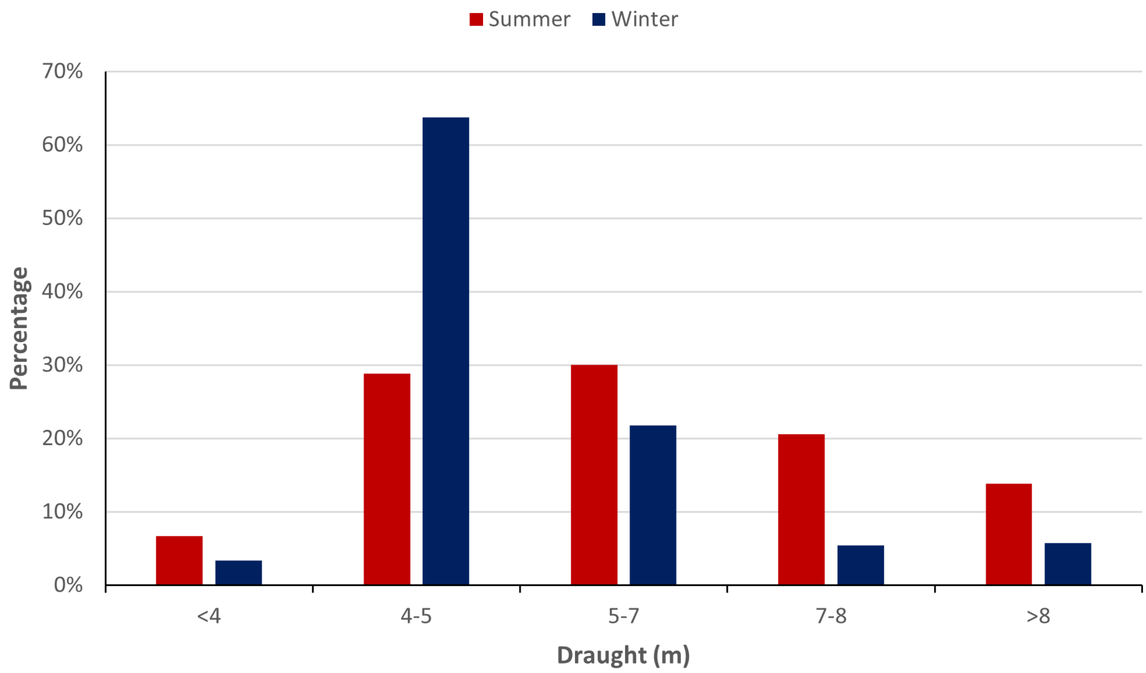

Figure 10-24 Distribution of Vessel Draughts (DBS East Array Area)

218. Excluding the proportion of vessels for which draught data were not available, the average draught of vessels within the DBS East study area throughout the summer and winter survey periods was 6.1m and 5.3m respectively.

219. **Figure 10-25** presents a plot of the vessel tracks recorded in the DBS East study area throughout the survey periods, colour-coded by vessel draught.

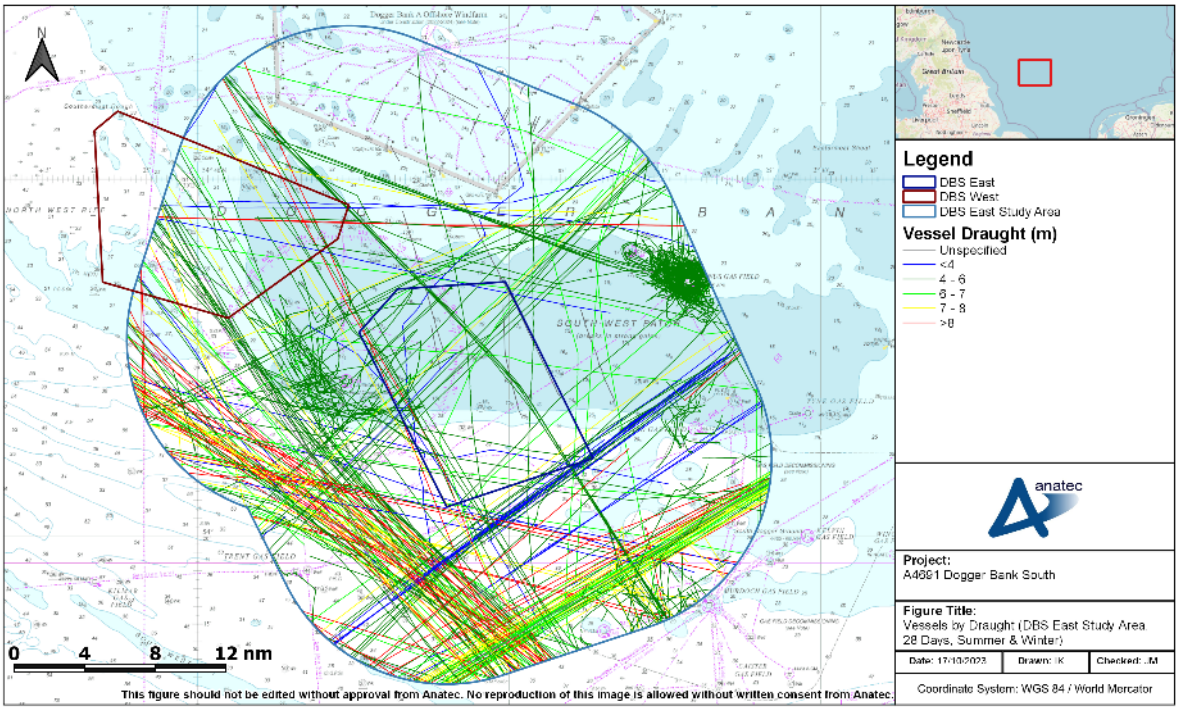

Figure 10-25 Vessels by Draught (DBS East Study Area, 28 Days, Summer and Winter)

220. Similarly to vessel length, the vessels of shallower draught were associated with oil and gas, fishing, and recreational vessels, with one smaller cargo vessel regularly routeing directly to the south of the DBS Array Area. Vessels of larger draught were typically tankers.

10.1.8.4 Vessel Draught – DBS West Array Area

221. Vessel draught was available for approximately 86% of vessels recorded throughout the two 14-day survey periods for DBS West study area and ranged from 2.5m for a wind farm to 14.6m for a shuttle tanker. The distribution of vessel draughts recorded within the DBS West study area throughout each survey period is presented in **Figure 10-26.**

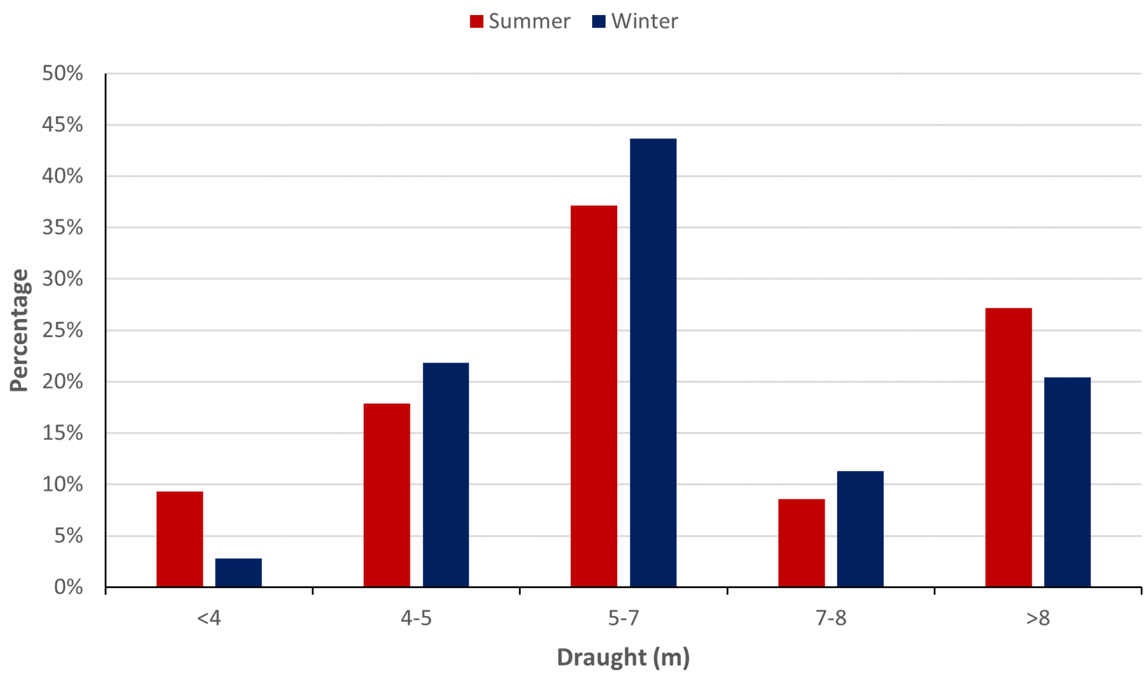

Figure 10-26 Distribution of Vessel Draughts (DBS West Array Area)

222. Excluding the proportion of vessels for which draught data were not available, the average draught of vessels within the DBS West study area throughout the summer and winter survey periods was 6.7m for both.

223. **Figure 10-27** presents a plot of the vessel tracks recorded in the DBS West study area throughout the survey periods, colour-coded by vessel draught.

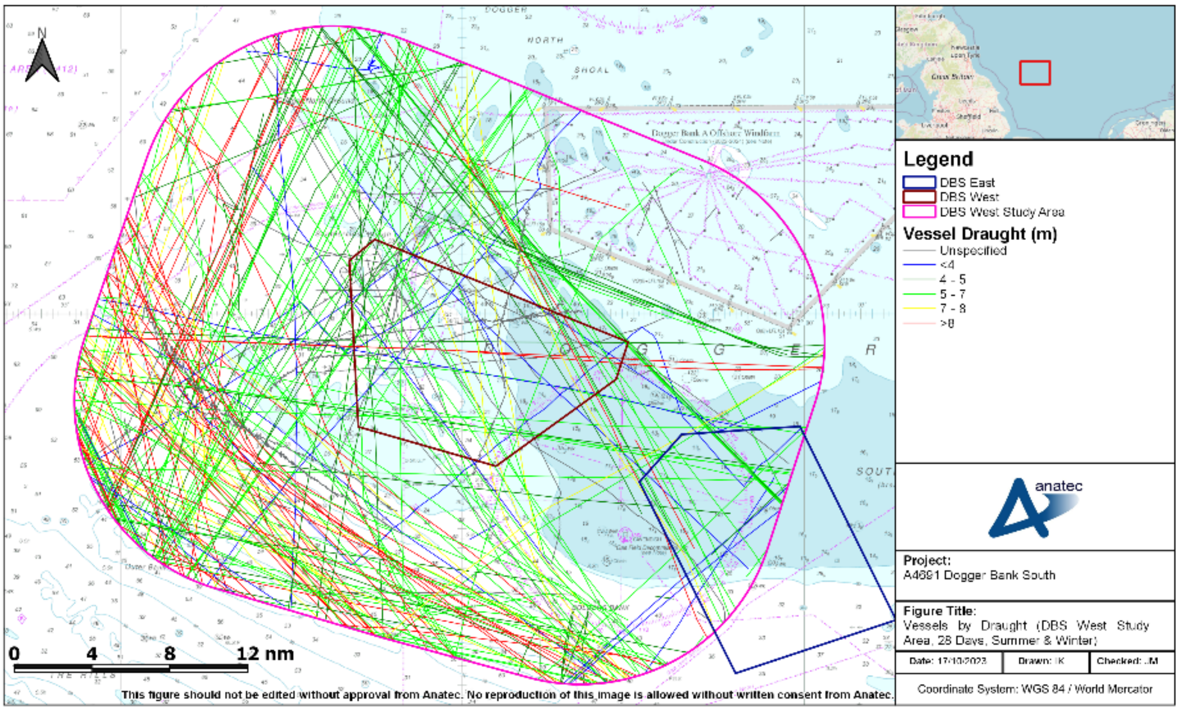

Figure 10-27 Vessels by Draught (DBS West Study Area, 28 Days, Summer and Winter)

224. As with vessel length, vessels of shallower draught were recorded as being the oil and gas vessels and fishing vessels transiting within the DBS study area, whilst the vessels of greater draught were cargo vessels and tankers.

10.1.9 Anchored Vessels

225. Vessels broadcast their navigation status via AIS, including whether they are at anchor. Any vessels broadcasting their status as "*at anchor*" were identified. However, navigation status is not always up to date since it relies on the officer of the watch. Therefore, the AIS tracks from vessels broadcasting their status as "*at anchor*" were manually inspected to confirm or deny anchoring activity. Additionally, AIS tracks from vessels which transmitted a navigation status other than "*at anchor*" were used as input to Anatec's Speed Analysis model. This program detects any tracks of vessels that were travelling with speeds less than one knot (kt) for a minimum of 30 minutes. The output is then manually reviewed to check for any additional anchored vessels.

226. One vessel recorded on AIS was deemed as being at anchor across the 28-day periods for the DBS array study areas, based on track behaviour and navigation status. This was an oil and gas vessel and was recorded within the DBS East Array Area. The tracks of this vessel are shown in **Figure 10-28**.

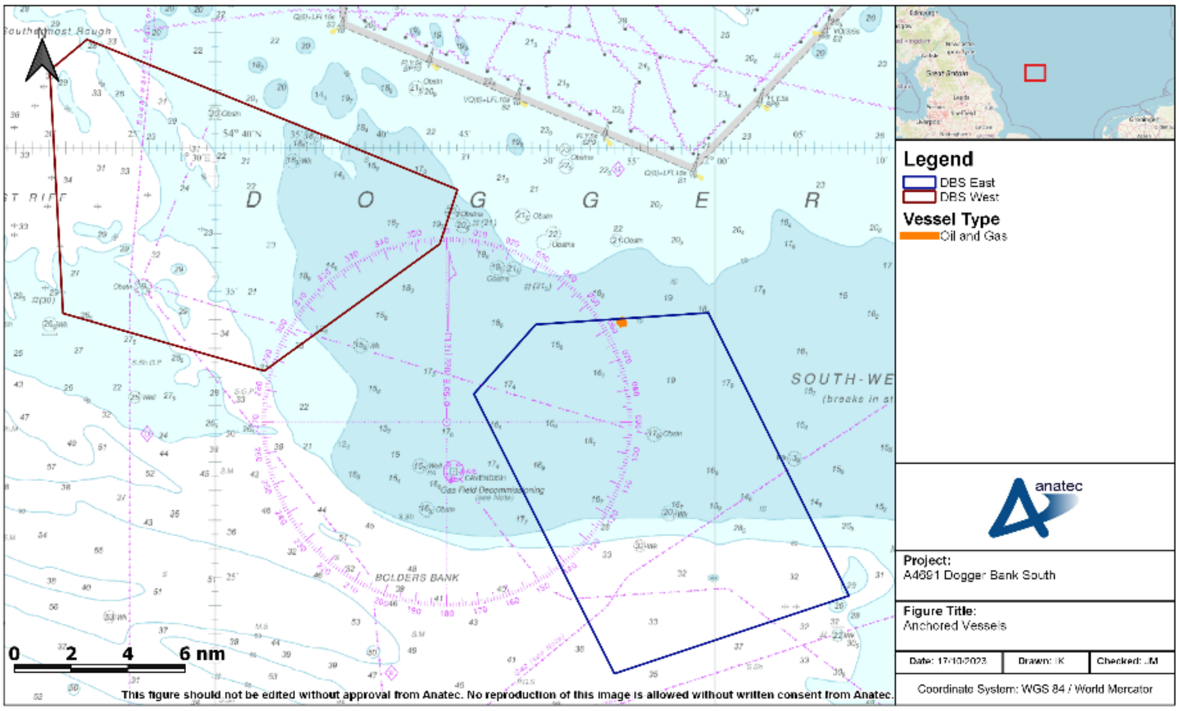

Figure 10-28 Anchored Vessel

227. The vessel was recorded during the winter period and with the behaviour characteristic of anchoring activity occurring over a 12-hour period.

10.2 Offshore Export Cable Corridor

228. This section provides a general overview of vessel traffic within the Offshore Export Cable Corridor study area, with more detailed analysis of each of the main vessel types presented in sections 10.2.3 to 10.2.8.

229. **Figure 10-29** presents the tracks of vessels recorded within the Offshore Export Cable Corridor study area during the 28-day period, colour-coded by vessel type, with **Figure 10-30** presenting a vessel density heat map[4] of the same data.

[4] To ensure contrasts in vessel density are suitably illustrated, the scale used for the vessel density heat map of the offshore export cable corridor study area is specific to the vessel traffic data and does not match that used for the vessel density heat maps associated with the DBS Array Areas.

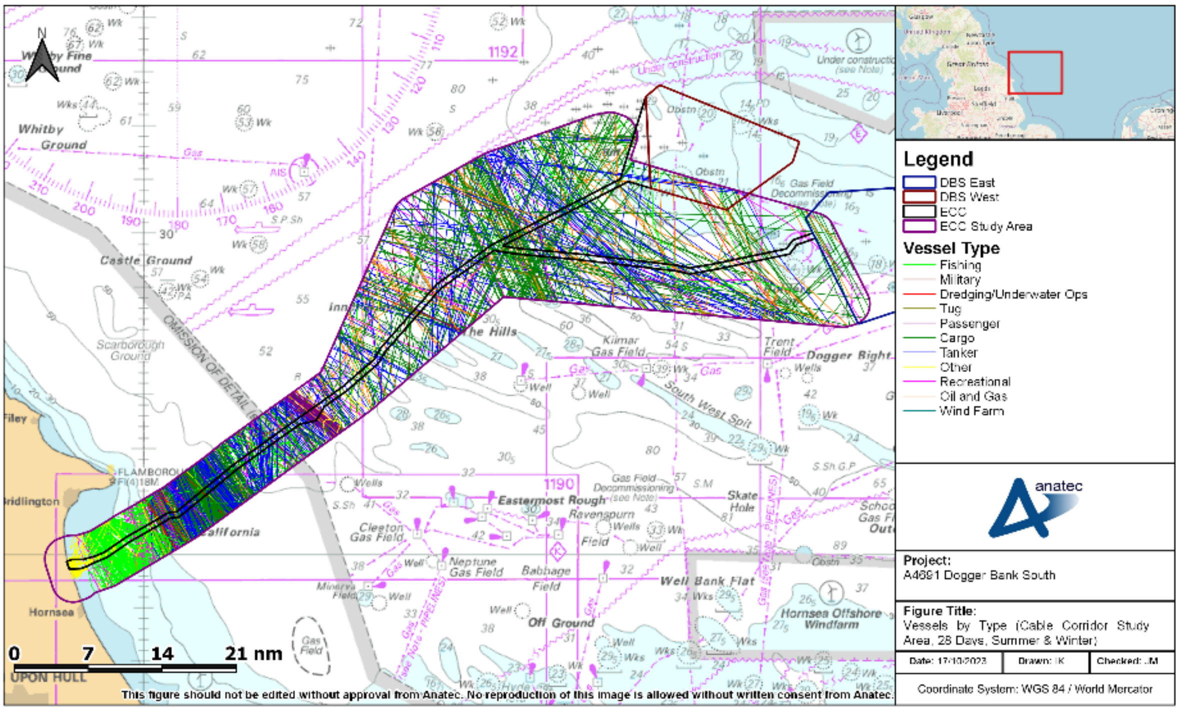

Figure 10-29 Vessels by Type (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

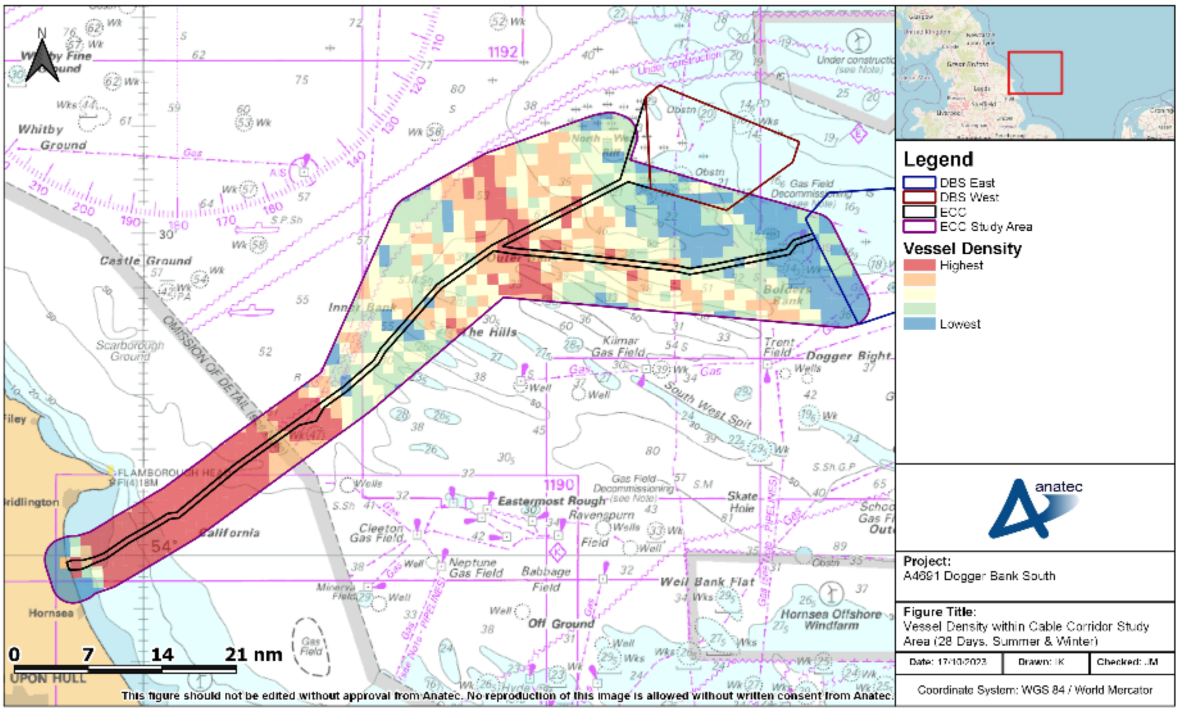

Figure 10-30 Vessel Density (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

230. Traffic of relatively high density is mainly located within 30nm of the coast; this traffic mainly consisted of fishing vessels within 9nm of the coast, with the high density traffic further offshore mainly being composed of commercial vessels routeing along the UK east coast. Two particularly high density areas for commercial vessels are noted – a route featuring passenger vessels crossing the Offshore Export Cable Corridor approximately 27nm from the landfall and a route featuring mainly cargo vessels passing in a north-west/south-east direction.

10.2.1 Vessel Count

231. This section presents an overview of vessel counts within the Offshore Export Cable Corridor study area during the survey periods. It is noted that throughout this subsection, only unique vessels are counted for each day to prevent overcounting in cases where a vessel may have been dropped and reacquired.

232. For the 28-day period, an average of 50 unique vessels per day was recorded within the Offshore Export Cable Corridor study area while an average of 47 unique vessels per day was recorded intersecting the Offshore Export Cable Corridor itself.

233. **Figure 10-31** presents the daily counts of vessels recorded within the Offshore Export Cable Corridor study area and the Offshore Export Cable Corridor itself during the 28-day period. Approximately 95% of vessels recorded within the Offshore Export Cable Corridor study area were also recorded within the Offshore Export Cable Corridor itself.

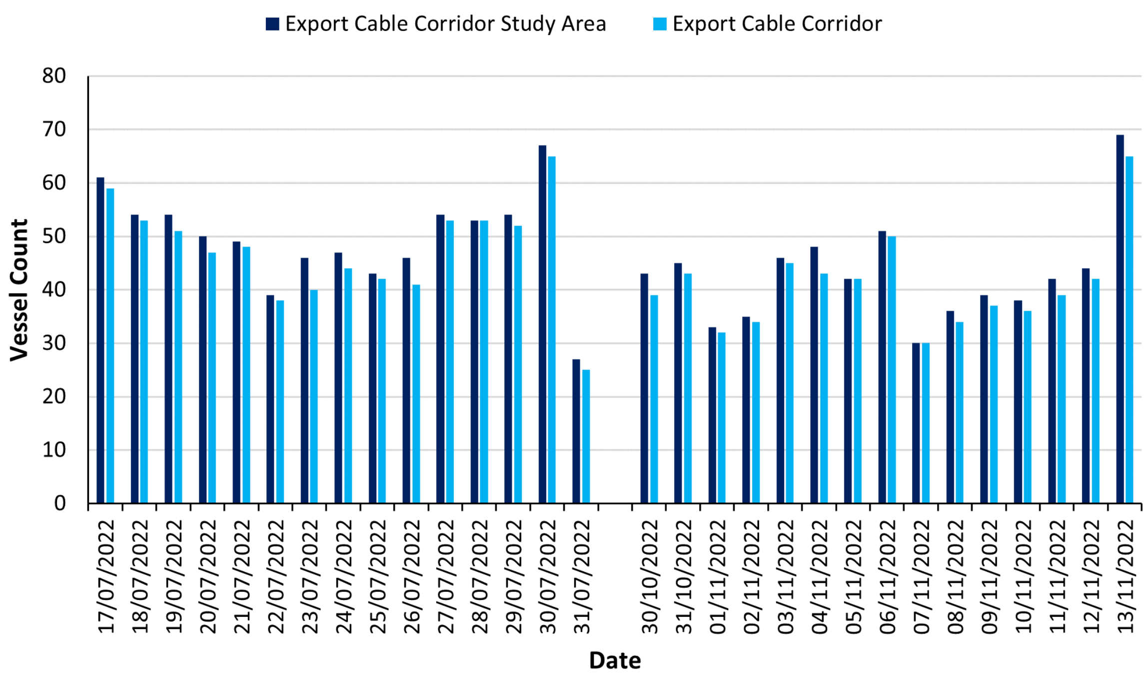

Figure 10-31 Vessel Counts per Day within Offshore Export Cable Corridor Study Area

234. The busiest day within the Offshore Export Cable Corridor study area during the 28-day period was the 30th July, during which 67 unique vessels were recorded. The quietest full day was the 7th November, during which 30 unique vessels were recorded.

10.2.2 Vessel Type

235. This section presents analysis of the main vessel types recorded within and in proximity to the Offshore Export Cable Corridor, with more detailed analysis on each individual vessel type being presented in sections 10.2.3 to 10.2.8.

236. The distribution of the main vessel types recorded within the Offshore Export Cable Corridor study area, as well as intersecting the Offshore Export Cable Corridor itself during the 28-day period is presented in **Figure 10-32**.

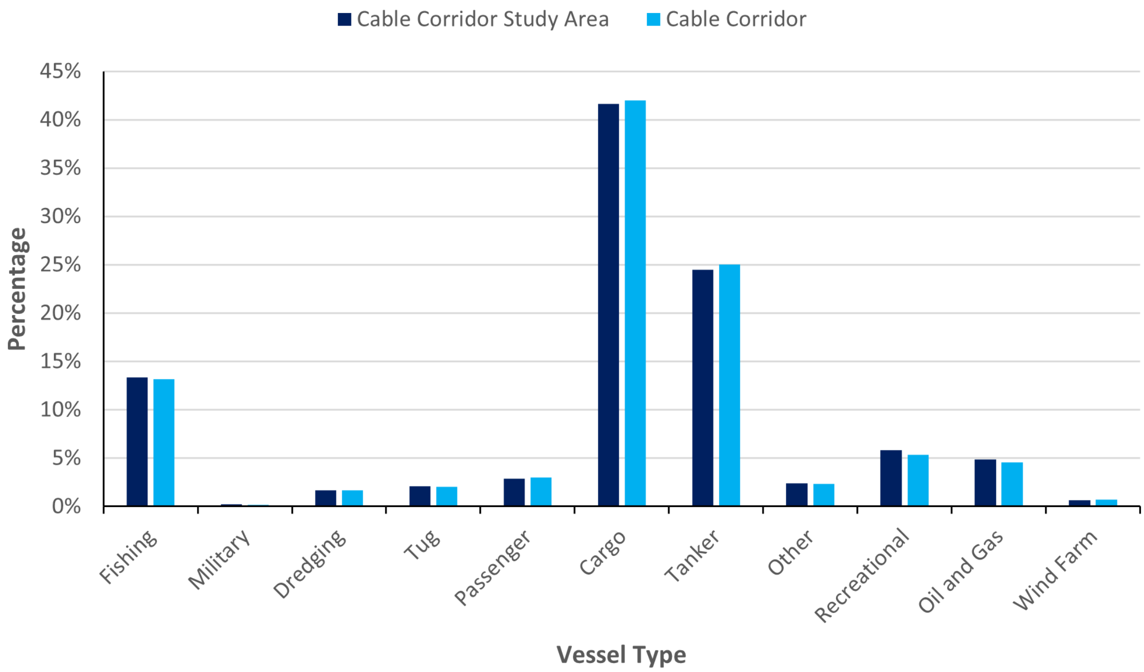

Figure 10-32 Distribution of Vessel Types (Offshore Export Cable Corridor, 28 Days, Summer and Winter)

237. The main type of vessel recorded within the Offshore Export Cable Corridor study area was cargo, accounting for 42% of the traffic. The next most common vessel type within the Offshore Export Cable Corridor study area was tankers, accounting for 24% of the traffic. This was then followed by fishing vessels (13%), recreational vessels (6%), oil and gas vessels (5%) and passenger vessels (3%). These proportions were generally the same for the traffic within the Offshore Export Cable Corridor itself given that the majority of traffic crosses the Offshore Export Cable Corridor.

10.2.3 Cargo Vessels

238. **Figure 10-33** presents the cargo vessels recorded within the Offshore Export Cable Corridor study area during the 28-day period.

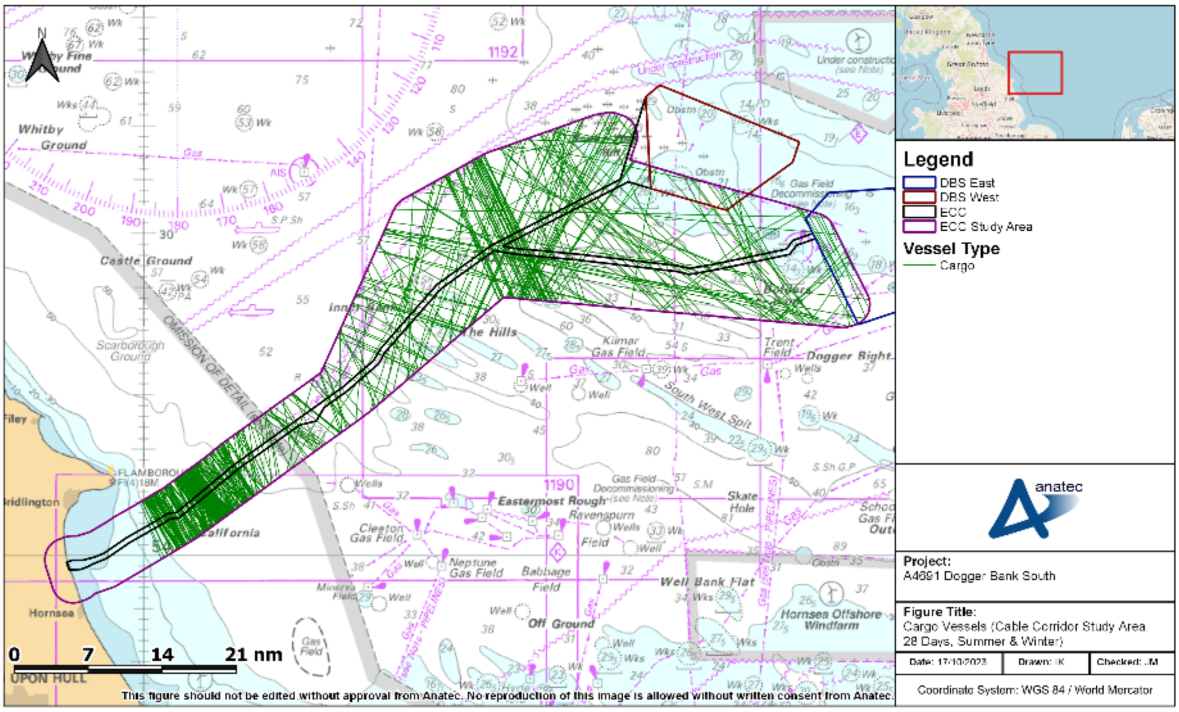

Figure 10-33 Cargo Vessels (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

239. An average of between 20 and 21 cargo vessels per day were recorded within the Offshore Export Cable Corridor study area during the 28-day period, with an average of 20 per day within the Offshore Export Cable Corridor itself.

240. A large proportion of cargo vessel traffic was concentrated within 21nm of the landfall, engaged in south-east/north-west transit between UK ports and Belgian or Dutch ports. A prominent south-east/north-west cargo vessel route further offshore was also recorded, with destinations including UK ports, Dutch ports and Icelandic ports.

10.2.4 Tankers

241. **Figure 10-34** presents the tankers recorded within the Offshore Export Cable Corridor study area during the 28-day period.

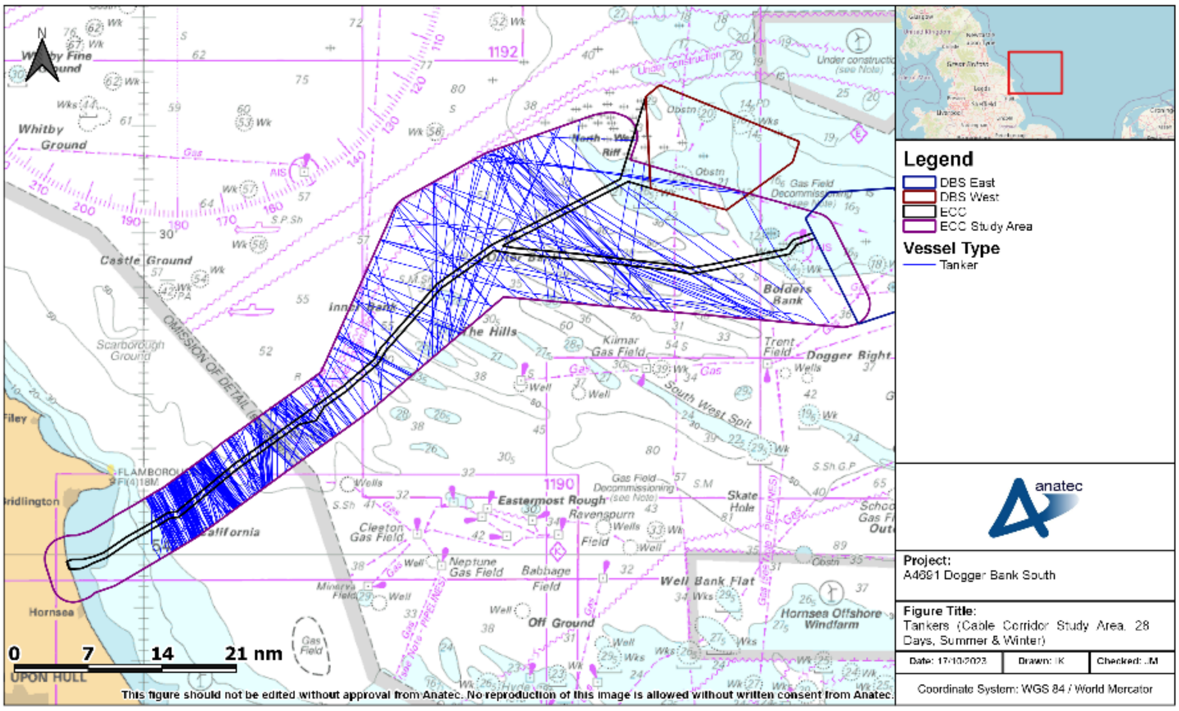

Figure 10-34 Tankers (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

242. An average of 12 unique tankers per day were recorded within the Offshore Export Cable Corridor study area during the 28-day period, with almost all of these tankers also intersecting the Offshore Export Cable Corridor itself.

243. The majority of tanker traffic was recorded within 30nm of the landfall; these tankers were engaged in north-west/south-east transit with destinations mainly including UK ports and Dutch ports.

10.2.5 Passenger Vessels

244. **Figure 10-35** presents the passenger vessels recorded within the Offshore Export Cable Corridor study area during the 28-day period.

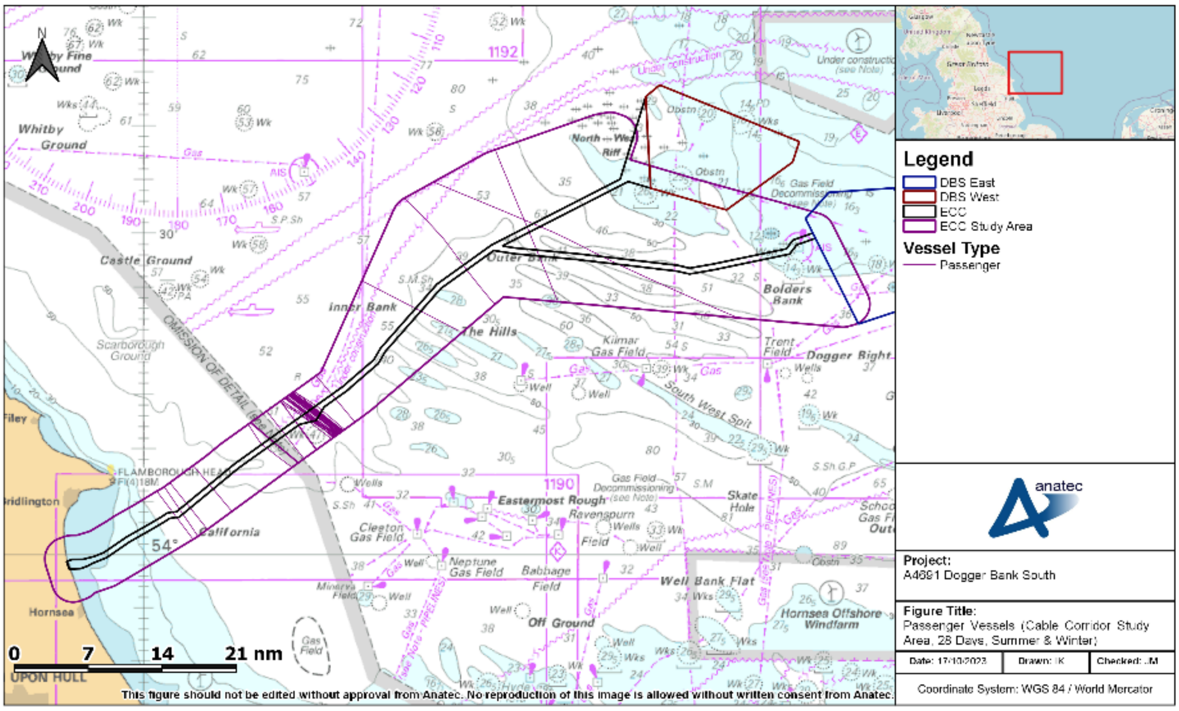

Figure 10-35 Passenger Vessels (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

245. An average of between one and two passenger vessels per day were recorded within the Offshore Export Cable Corridor study area, with each of these vessels also being recorded within the Offshore Export Cable Corridor itself.

246. The majority of these vessels were recorded in north-west/south-east transit 27nm from the landfall. This traffic was composed of two Roll-on/Roll-off Passenger (RoPax) vessels operated by DFDS Seaways, navigating a twice daily route between North Shields (UK) and Ijmuiden (the Netherlands).

10.2.6 Fishing Vessels

247. **Figure 10-36** presents the fishing vessels recorded within the Offshore Export Cable Corridor study area during the 28-day period, colour-coded by average vessel speed.

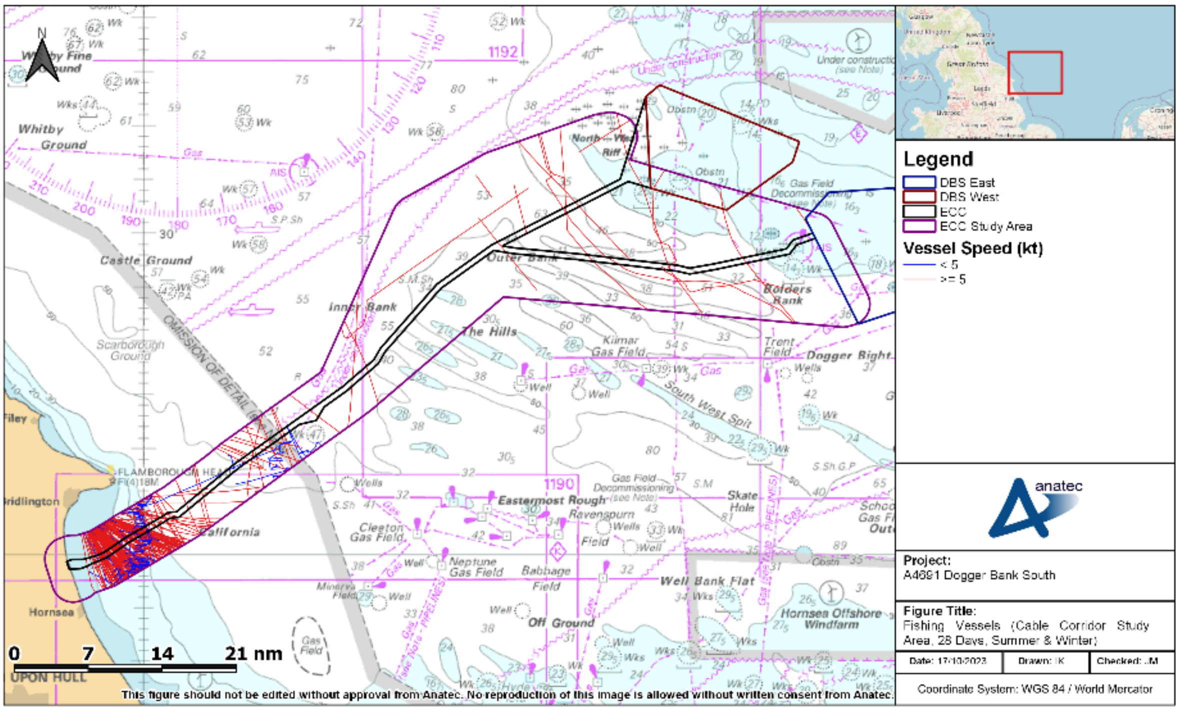

Figure 10-36 Fishing Vessels by Speed (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

248. An average of between six and seven fishing vessels per day were recorded within the Offshore Export Cable Corridor study area, with a similar level of traffic being recorded within the Offshore Export Cable Corridor itself.

249. The large majority of fishing vessel traffic was recorded within 9nm of the landfall, engaged in north-west/south-east transit. Behaviour suggestive of active fishing was also recorded within this region, displayed by three fishing vessels, including within the Offshore Export Cable Corridor itself.

10.2.7 Oil and Gas Vessels

250. **Figure 10-37** presents the oil and gas vessels recorded within the Offshore Export Cable Corridor study area during the 28-day period.

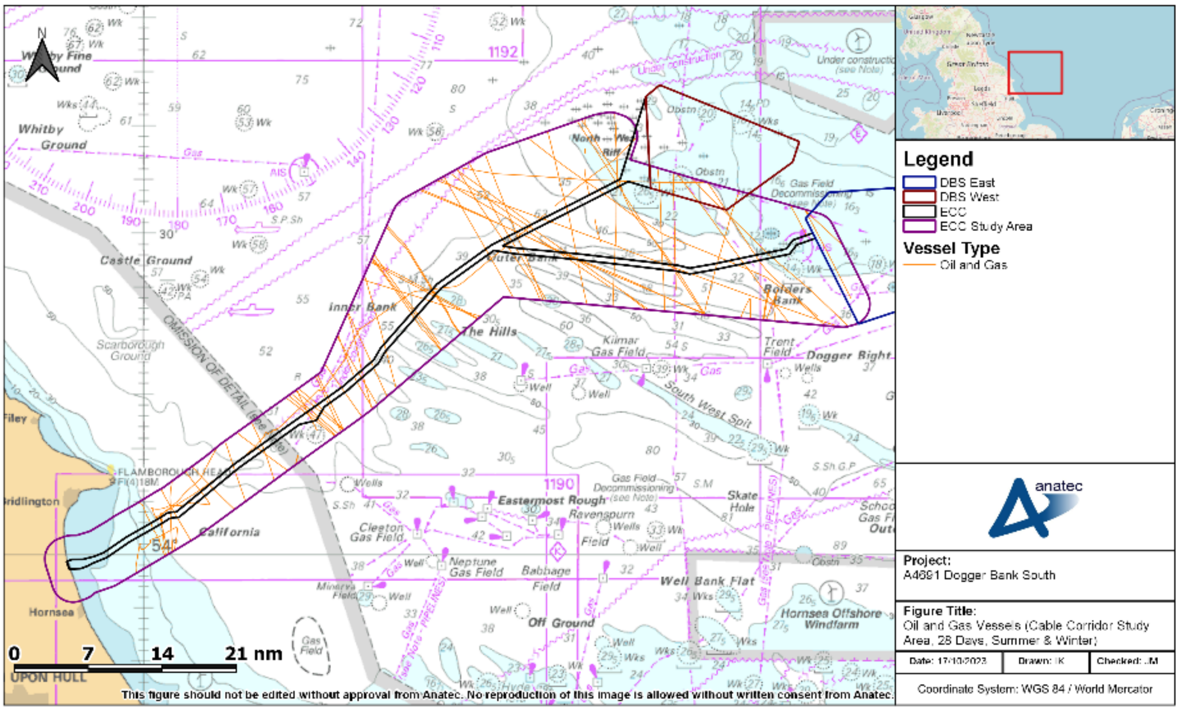

Figure 10-37 Oil and Gas Vessels (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

251. An average of between two and three oil and gas vessels per day were recorded within the Offshore Export Cable Corridor study area during the 28-day period, with a similar level of traffic being recorded within the Offshore Export Cable Corridor itself.

252. The traffic was distributed throughout the Offshore Export Cable Corridor study area and was mostly in north-west/south-east transit.

10.2.8 Recreational Vessels

253. **Figure 10-38** presents the recreational vessels recorded within the Offshore Export Cable Corridor study area during the 28-day period.

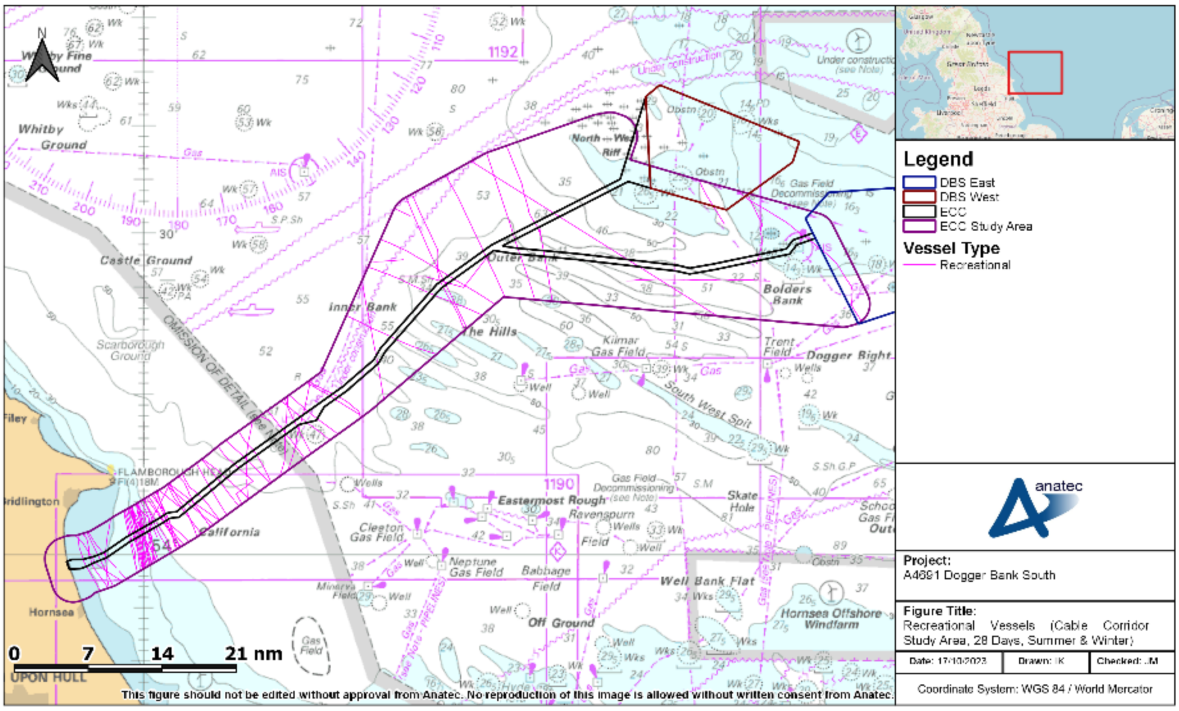

Figure 10-38 Recreational Vessels (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

254. An average of three recreational vessels per day was recorded within the Offshore Export Cable Corridor study area during the 28-day period, with two to three vessels being recorded within the Offshore Export Cable Corridor itself.

255. The majority of traffic was recorded within 12nm of landfall, undertaking north-west/south-east transits.

10.2.9 Vessel Size

10.2.9.1 Vessel Length

256. Vessel length was available for over 99% of vessels recorded throughout the two 14-day survey periods and ranged from 8m for an RNLI lifeboat to 333m for a crude oil tanker. The distribution of vessel lengths recorded within the DBS East study area throughout each survey period is presented in **Figure 10-39.**

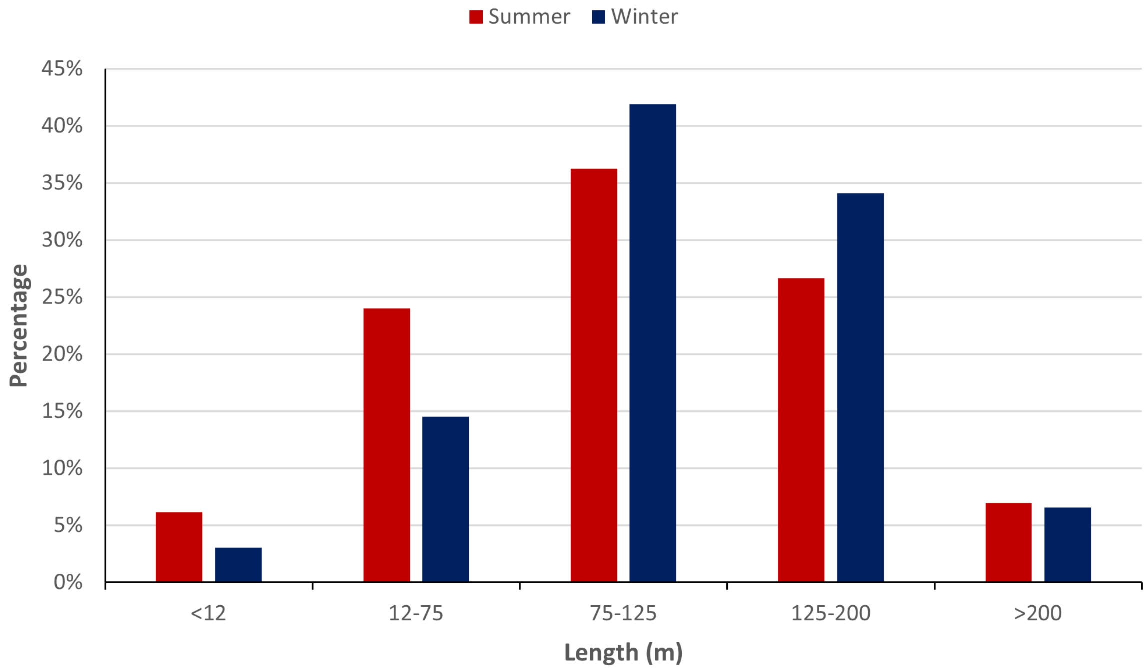

Figure 10-39 Distribution of Vessel Lengths (Offshore Export Cable Corridor)

257. Excluding the proportion of vessels for which length was not available, the average length of vessels within the Offshore Export Cable Corridor study area throughout the summer and winter survey periods was 100m and 113m respectively.

258. **Figure 10-40** presents a plot of the vessel tracks recorded in the Offshore Export Cable Corridor study area throughout the survey periods, colour-coded by vessel length.

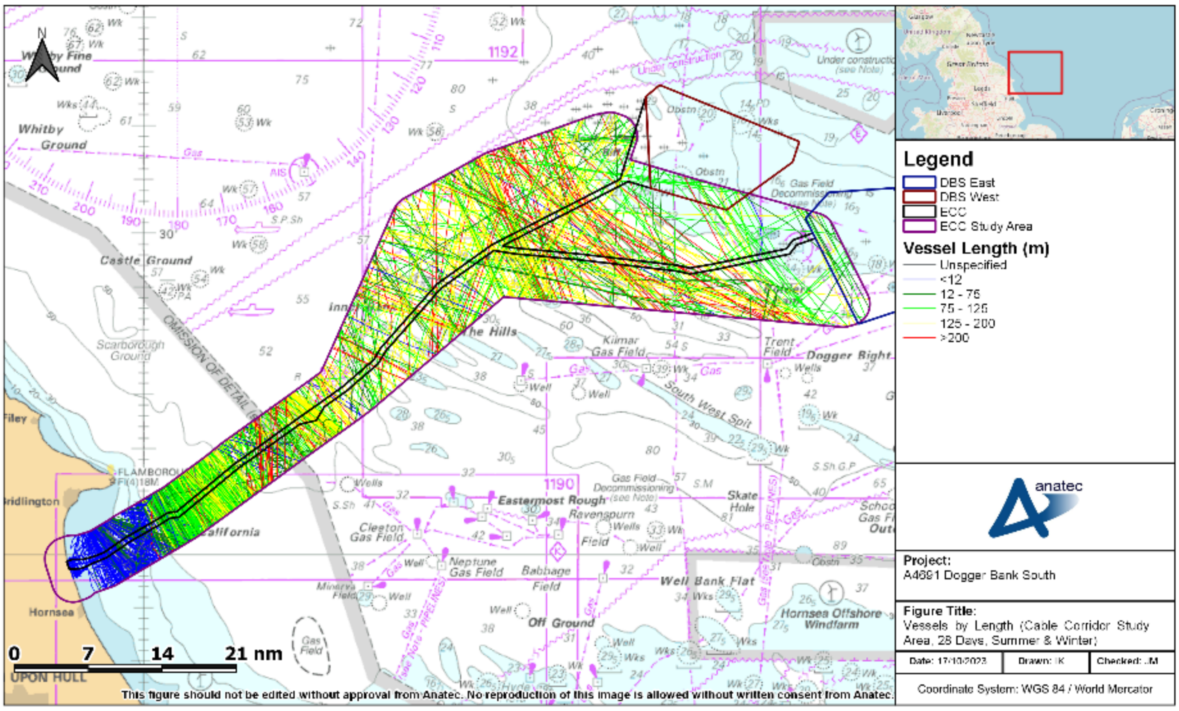

Figure 10-40 Vessels by Length (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

259. Vessels of smaller length were recorded close to shore and were primarily composed of fishing and recreational vessels. Larger commercial vessels were recorded further offshore.

10.2.9.2 Vessel Draught

260. Vessel draught was available for approximately 78% of vessels recorded throughout the two 14-day survey periods and ranged from 1.0m for charter vessel and 19.5m for a crude oil carrier. The distribution of vessel draughts recorded within the DBS East study area throughout each survey period is presented in **Figure 10-41**.

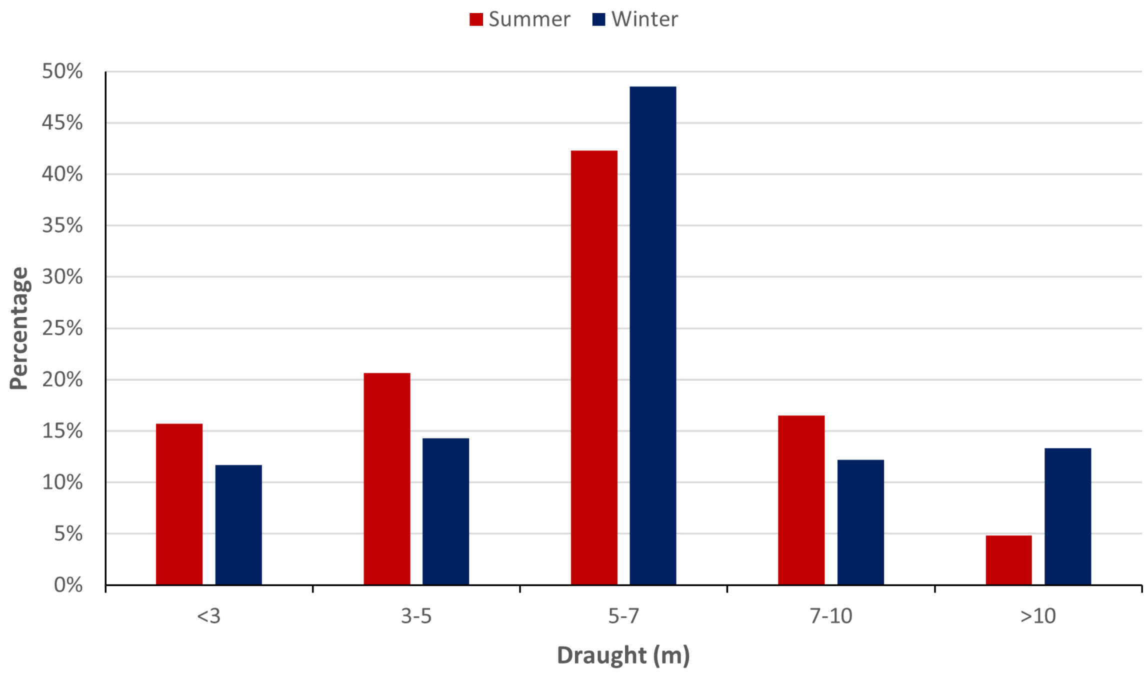

Figure 10-41 Distribution of Vessel Draughts (Offshore Export Cable Corridor)

261. Excluding the proportion of vessels for which draught was not available, the average draught of vessels within the Offshore Export Cable Corridor study area throughout the summer and winter survey periods was 5.6m and 6.2m respectively.

262. **Figure 10-42** presents a plot of the vessel tracks recorded in the Offshore Export Cable Corridor study area throughout the survey periods, colour-coded by vessel draught.

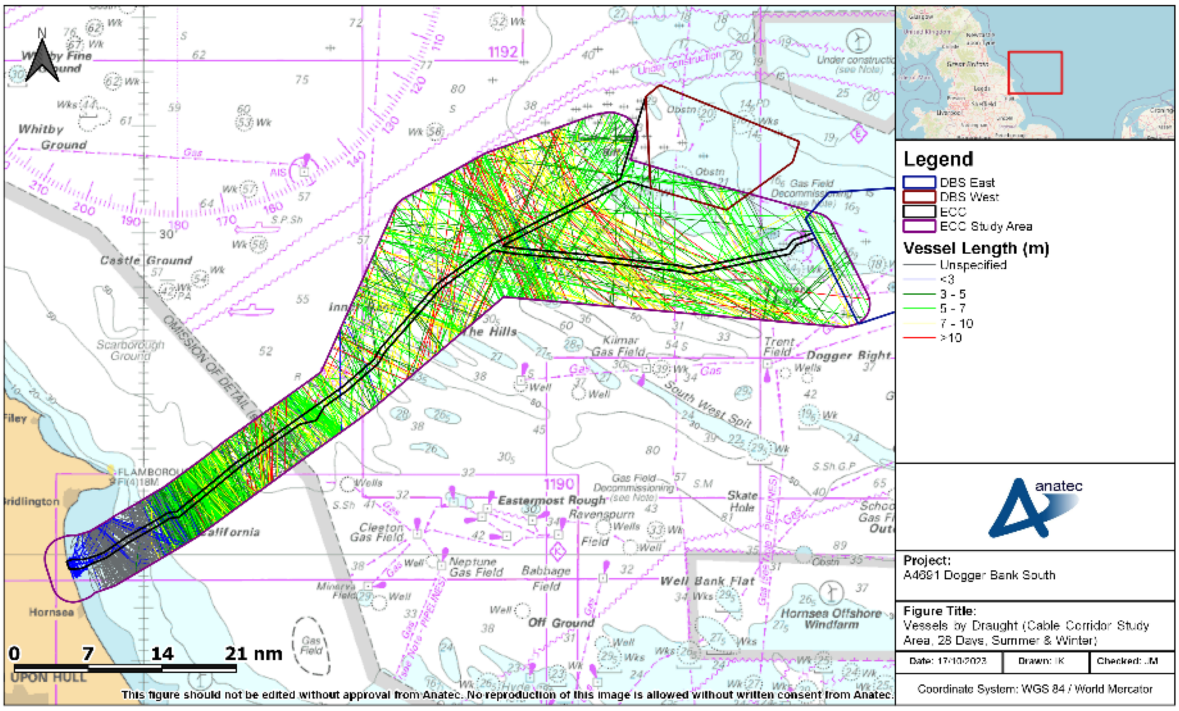

Figure 10-42 Vessels by Draught (Offshore Export Cable Corridor Study Area, 28 Days, Summer and Winter)

263. Similarly to vessel length, vessels of shallower draught were recorded close to shore and were primarily composed of fishing and recreational vessels, with larger commercial vessels recorded further offshore.

10.2.10 Anchored Vessels

264. The same criteria as outlined for the DBS Array Areas has been used to identify anchored vessels within the Offshore Export Cable Corridor study area.

265. One vessel recorded on AIS was deemed as being at anchor during the 28-day period, based on its track behaviour and navigation status. This was a cargo vessel recorded 3.2nm south of the Offshore Export Cable Corridor in The Hills (a series of banks) with the behaviour characteristic of anchoring activity occurring over the course of six days.

10.3 Export Cable Platform Search Area

266. This section provides an overview of the vessel traffic movements across the export cable platform search area study area, with more detailed analysis of the main vessel types presented in sections 10.3.3 to 10.3.8.

267. The tracks of vessels recorded within the export cable platform search area study area during the 28-day survey period are presented in **Figure 10-43**. A density heat map of the same data is presented in **Figure 10-44.**

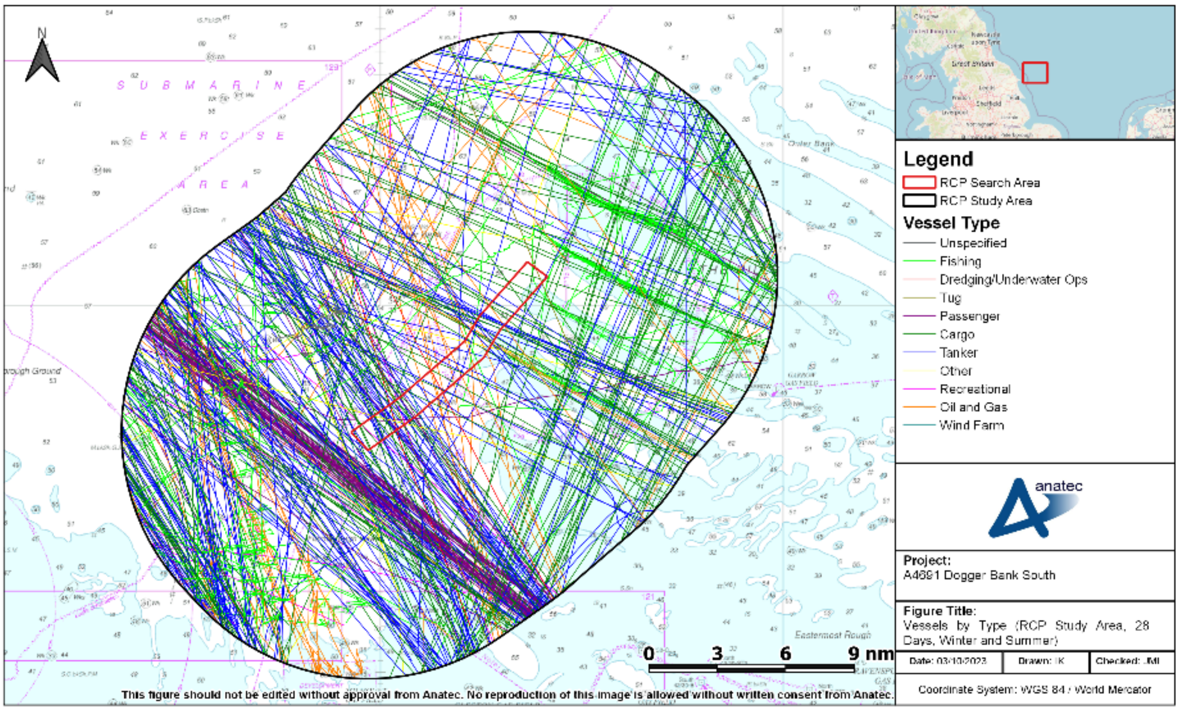

Figure 10-43 Vessels by Type (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

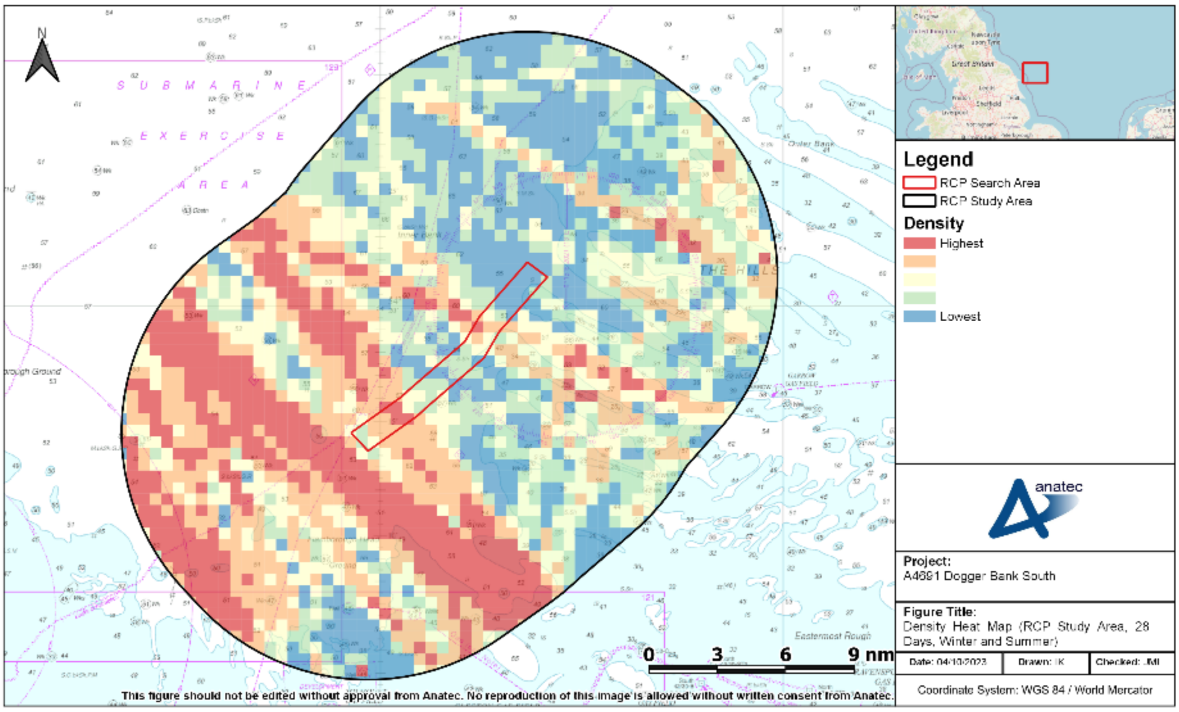

Figure 10-44 Density Heat Map (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

268. Bands of high density were predominant in a north-west to south orientation featuring vessel traffic following the UK east coast.

10.3.1 Vessel Count

269. This section presents an overview of vessel counts within the export cable platform search area study area during the survey periods. It is noted that throughout this section, only unique vessels are counted for each day to prevent overcounting in cases where a vessel may have been dropped and reacquired.

270. For the 14 days analysed during the winter survey period, an average of 15 to 16 unique vessels per day were recorded within the export cable platform search area study area. In terms of vessels intersecting the export cable platform search area, there was an average of four unique vessels per day during the winter survey period. It is noted that the first and last day of the winter survey were partial survey days (as described in section 5.2.1). The vessel counts per day within the export cable platform search area study area and export cable platform search area are presented in **Figure 10-45**.

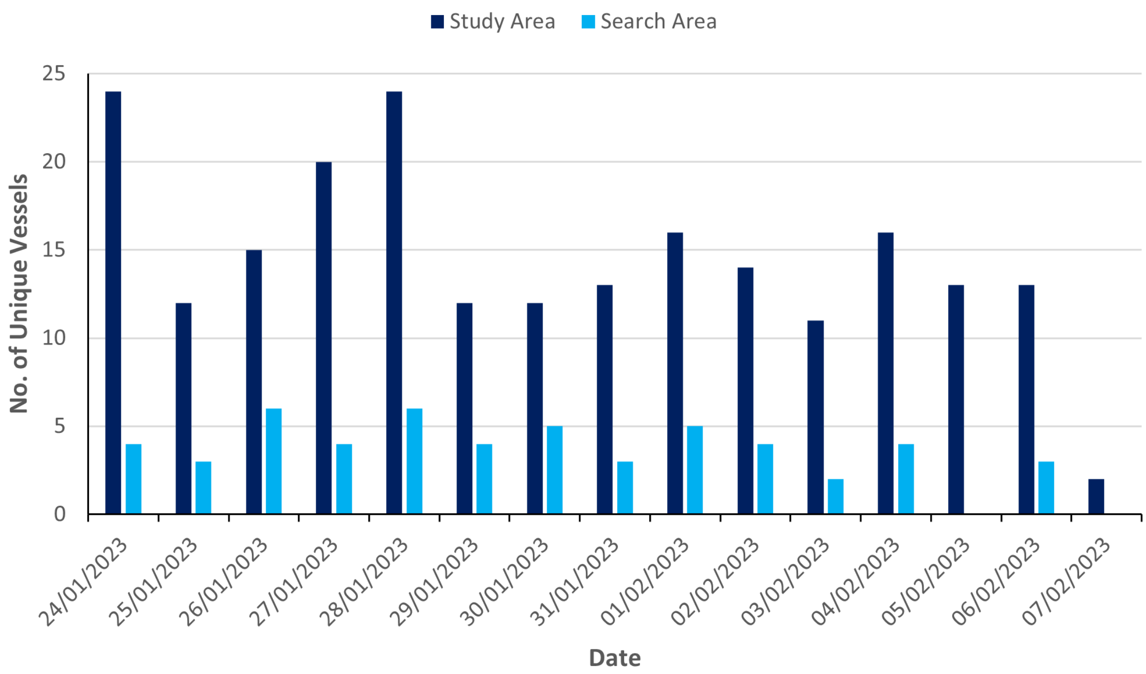

Figure 10-45 Export Cable Platform Search Area Study Area Winter Vessel Counts

271. Throughout the winter survey period, approximately 24% of unique vessel tracks recorded within the export cable platform search area study area intersected the export cable platform search area.

272. The busiest days recorded within the export cable platform search area study area during the winter survey period were the 24th and 28th January 2023, during which 24 unique vessels were recorded. The quietest full day recorded within the export cable platform search area study area during the winter survey period was the 3rd February 2023, during which 11 unique vessels were recorded.

273. For the 14 days analysed during the summer survey period, an average of 19 unique vessels per day were recorded within the export cable platform search area study area. In terms of vessels intersecting the export cable platform search area, there was an average of four unique vessels per day during the summer survey period. It is noted that the first and last day of the summer survey were partial survey days (as described in section 5.2.1). The vessel counts per day within the export cable platform search area study area and export cable platform search area are presented in **Figure 10-46**.

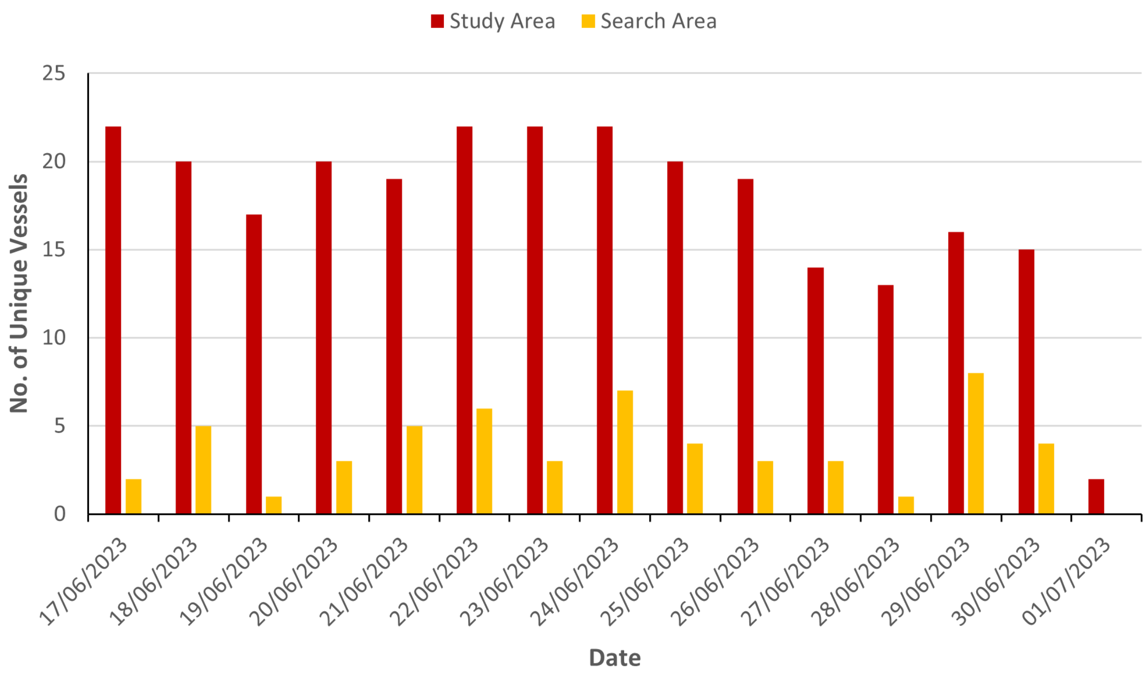

Figure 10-46 Export Cable Platform Search Area Study Area Summer Vessel Counts

274. Throughout the summer survey period, approximately 21% of unique vessel tracks recorded within the export cable platform search area study area intersected the export cable platform search area.

275. The busiest days recorded within the export cable platform search area study area during the winter survey period were the 22nd, 23rd, and 24th January 2023, during which 22 unique vessels were recorded. The quietest full day recorded within the export cable platform search area study area during the winter survey period was the 28th February 2023, during which 13 unique vessels were recorded.

10.3.2 Vessel Type

276. The percentage distribution of the main vessel types recorded passing within the export cable platform search area study area, as well as intersecting the export cable platform search area, during the winter and summer survey periods is presented in **Figure 10-47**.

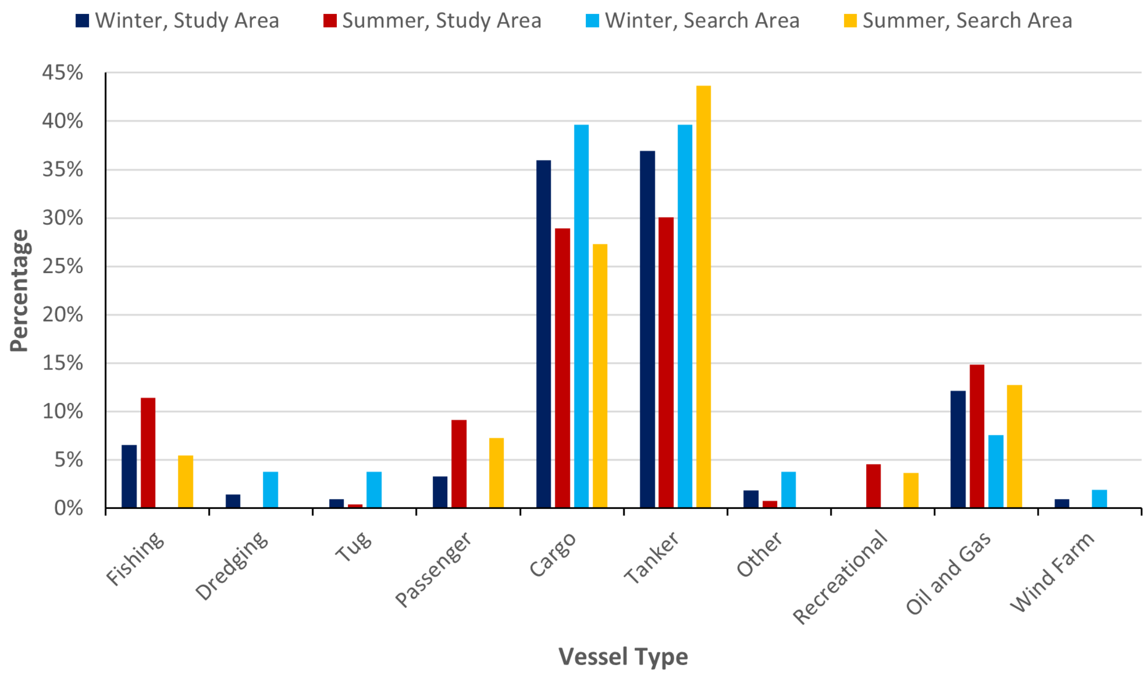

Figure 10-47 Export Cable Platform Search Area Study Area Distribution of Vessel Types

277. Throughout the winter survey period, the most common vessel types within the export cable platform study area were tankers (37%) and cargo vessels (36%). Throughout the summer survey period, the most common vessel types within the export cable platform study area were again tankers (30%) and cargo vessels (29%).

278. The following subsections consider each of the main vessel types individually.

10.3.3 Tankers

279. **Figure 10-48** presents the tankers recorded within the export cable platform search area study area during the 28-day survey period.

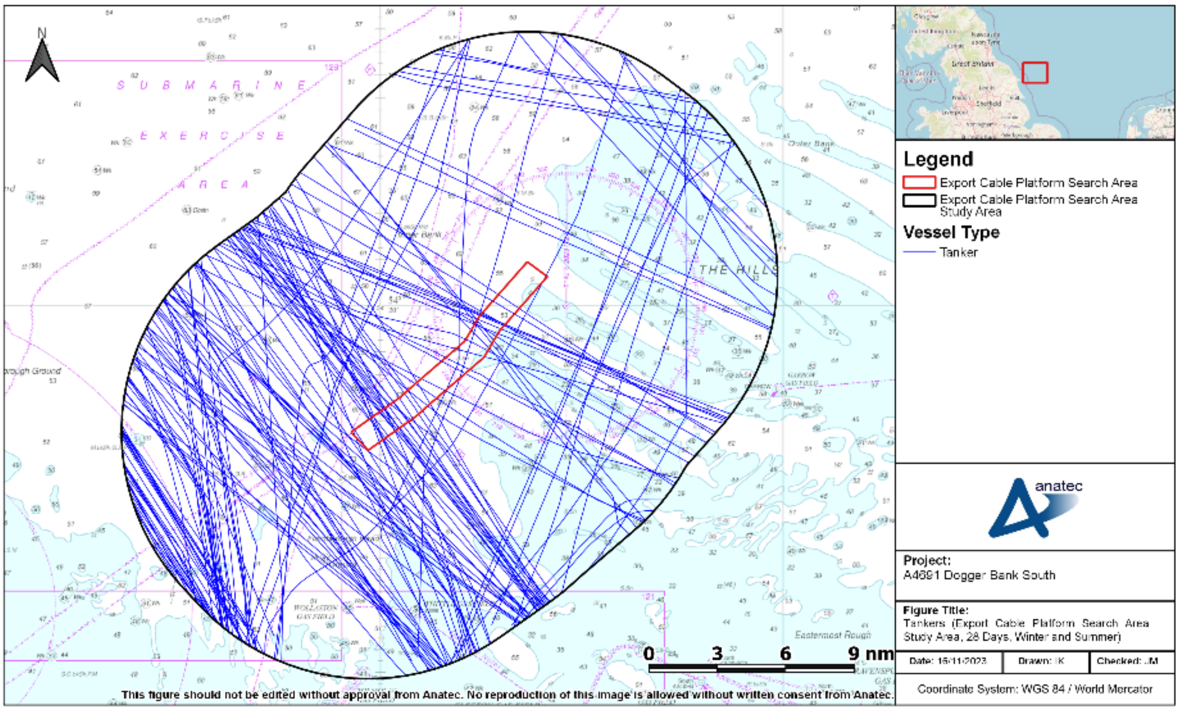

Figure 10-48 Tankers (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

280. Tankers were mainly seen in north-west to south-east transit. An average of five to six unique tankers per day were recorded within the export cable platform search area study area during the 28-day survey period, with an average of one to two intersections through the export cable platform search area per day recorded.

10.3.4 Cargo Vessels

281. **Figure 10-49** presents the cargo vessels recorded within the export cable platform search area study area during the 28-day survey period.

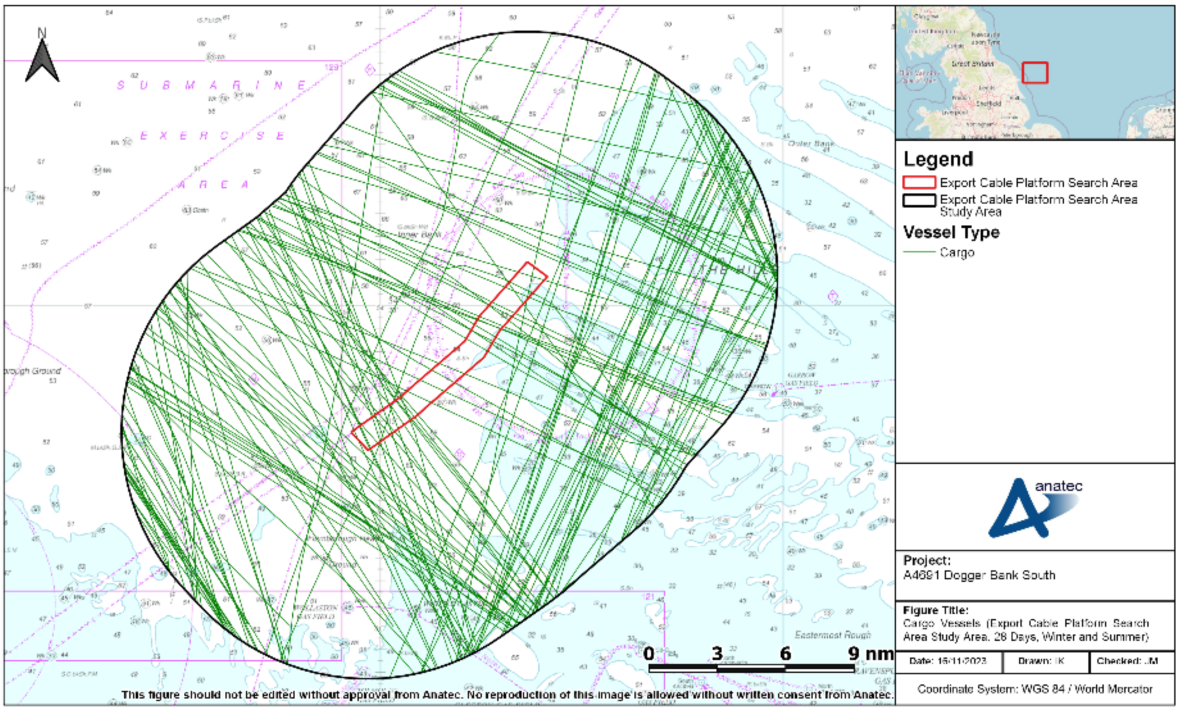

Figure 10-49 Cargo Vessels (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

282. Cargo vessels were mainly seen in north-west to south-east transit. An average of five to six unique cargo vessels per day were recorded within the export cable platform search area study area during the 28-day survey period, with an average of one intersection through the export cable platform search area per day recorded.

283. No regular Roll-on/Roll-off cargo (RoRo) routeing was recorded within the dataset.

10.3.5 Passenger Vessels

284. **Figure 10-50** presents the passenger vessels recorded within the export cable platform search area study area during the 28-day survey period.

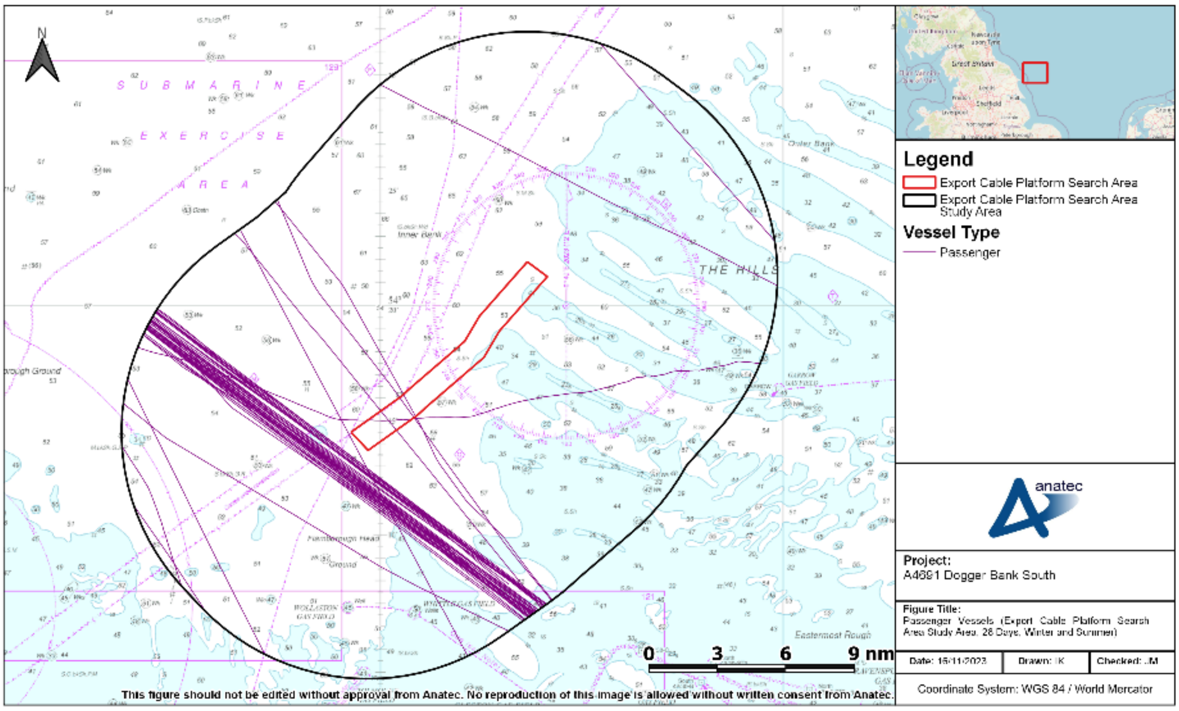

Figure 10-50 Passenger Vessels (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

285. Passenger vessels were mainly seen in north-west to south-east transit. An average of one unique passenger vessel per day was recorded within the export cable platform search area study area during the 28-day survey period, with an average of one intersection through the export cable platform search area per week recorded.

10.3.6 Fishing Vessels

286. **Figure 10-51** presents the fishing vessels recorded within the export cable platform search area study area during the 28-day survey period.

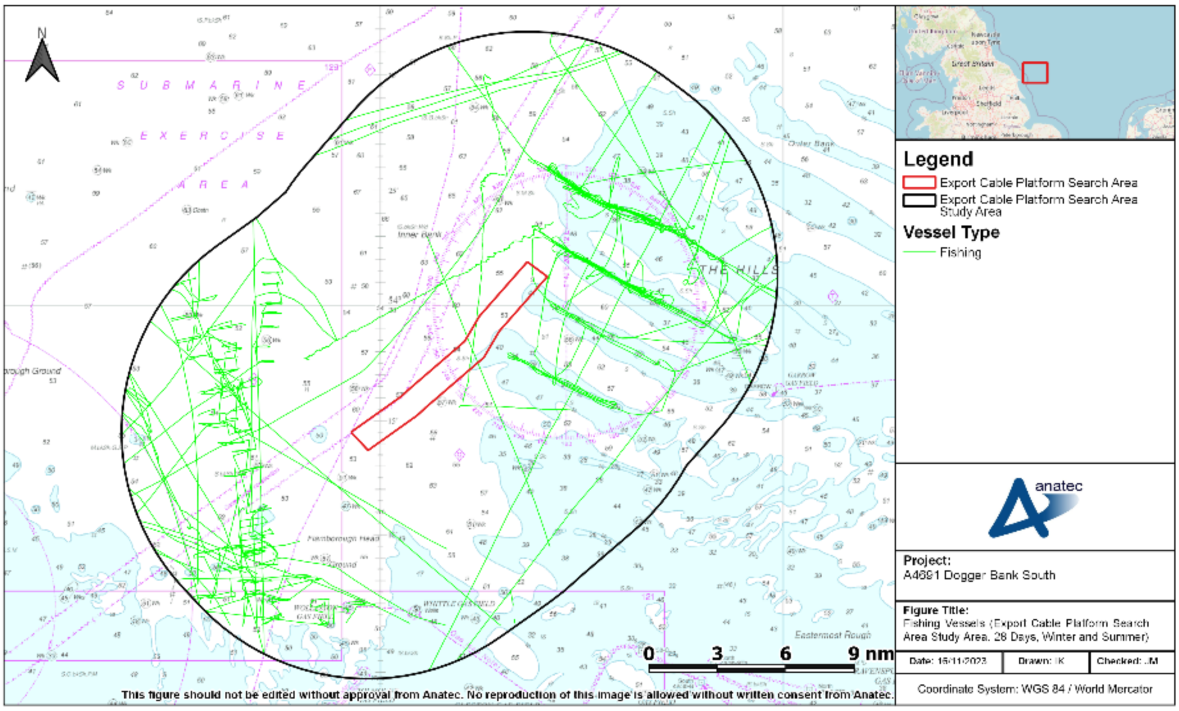

Figure 10-51 Fishing Vessels (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

287. Fishing vessels displaying behaviour characteristic of active fishing were prevalent to the north-east and south-west of the export cable platform search area. An average of one to two unique fishing vessels per day were recorded within the export cable platform search area study area during the 28-day survey period, with an average of one intersection through the export cable platform search area every ten days recorded. The fishing activity to the north-east was largely trawling, with the activity to the south-west being from potters.

10.3.7 Oil and Gas Vessels

288. **Figure 10-52** presents the oil and gas vessels recorded within the export cable platform search area study area during the 28-day survey period.

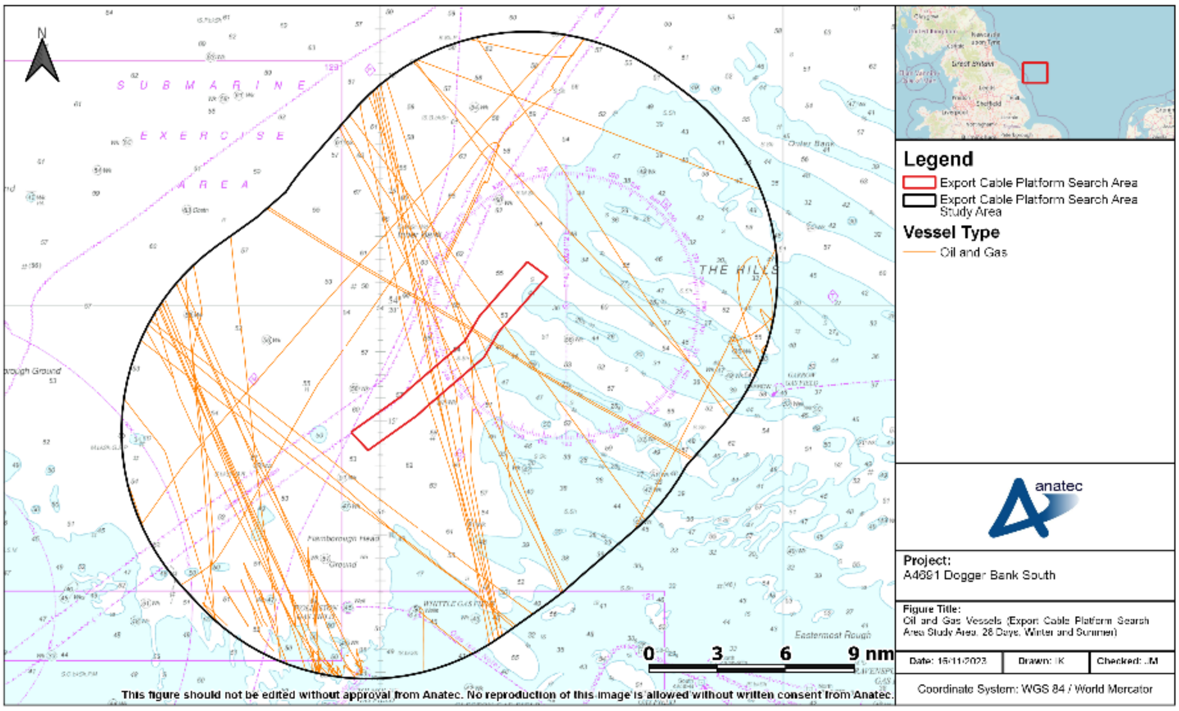

Figure 10-52 Oil and Gas Vessels (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

289. Oil and gas vessels were mainly seen in north-west to south-east transit to installations in proximity. An average of two unique oil and gas vessels per day were recorded within the export cable platform search area study area during the 28-day survey period, with an average of one intersection through the export cable platform search area every two to three days recorded.

10.3.8 Recreational Vessels

290. **Figure 10-53** presents the recreational vessels recorded within the export cable platform search area study area during the 28-day survey period.

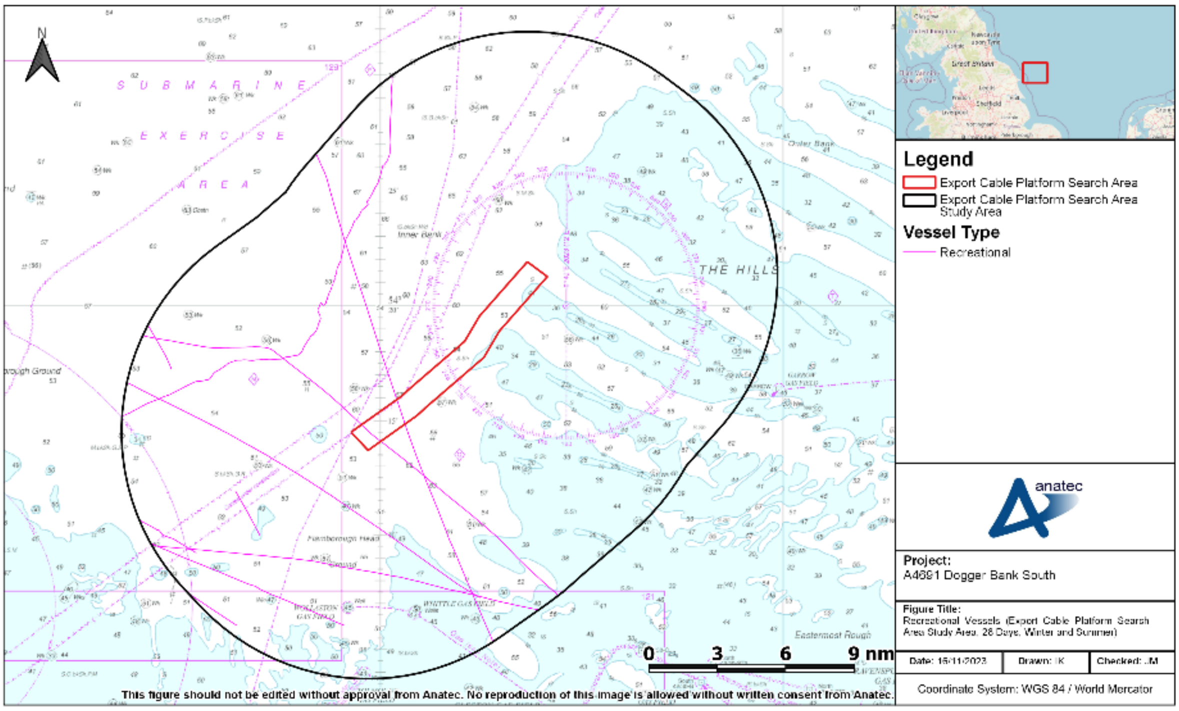

Figure 10-53 Recreational Vessels (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

291. Recreational vessels were mainly seen in coastal transit, and entirely in summer. An average of one unique recreational vessel every two to three days was recorded within the export cable platform search area study area during the 28-day survey period, with an average of one intersection through the export cable platform search area every two weeks recorded.

10.3.9 Vessel Size

10.3.9.1 Vessel Length

292. Vessel length information was available for approximately 99% of all vessels recorded throughout the combined summer and winter survey periods. A plot of all vessel tracks (excluding temporary traffic) recorded within the export cable platform search area study area throughout the survey periods, colour-coded by length, is presented in **Figure 10-54**. Following this, the distribution of these length classes is presented in **Figure 10-55**.

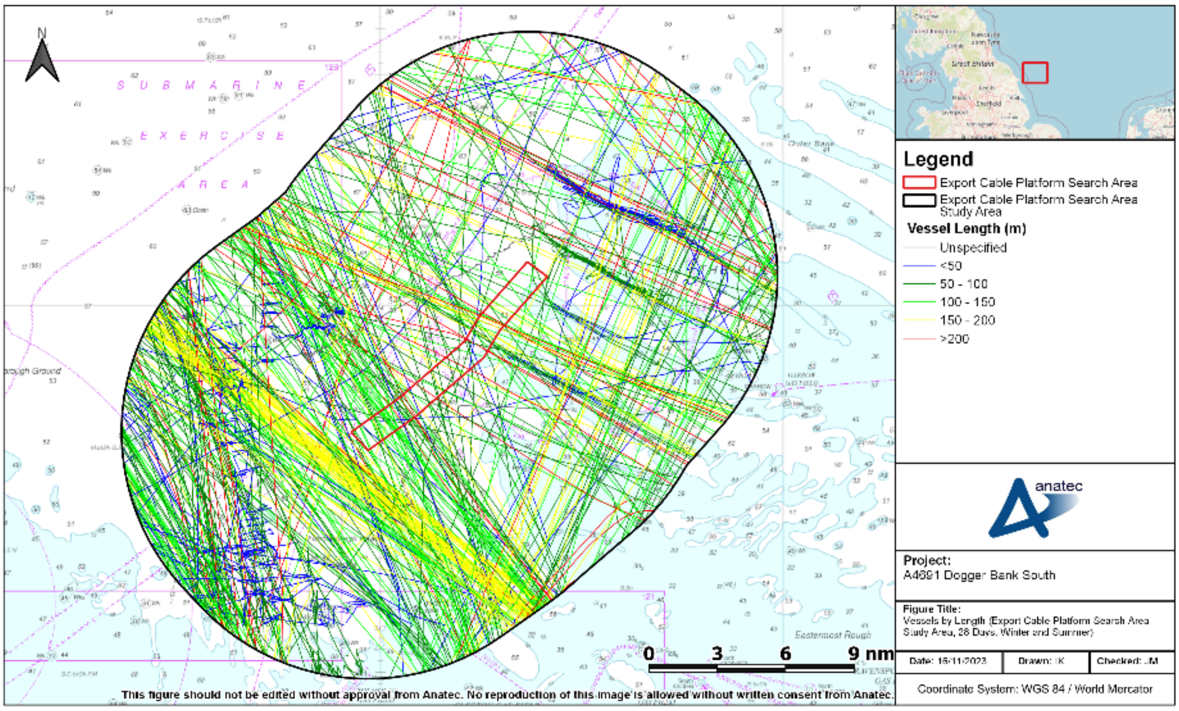

Figure 10-54 Vessels by Length (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

293. The majority of vessels of smaller length were noted as being fishing or recreational.

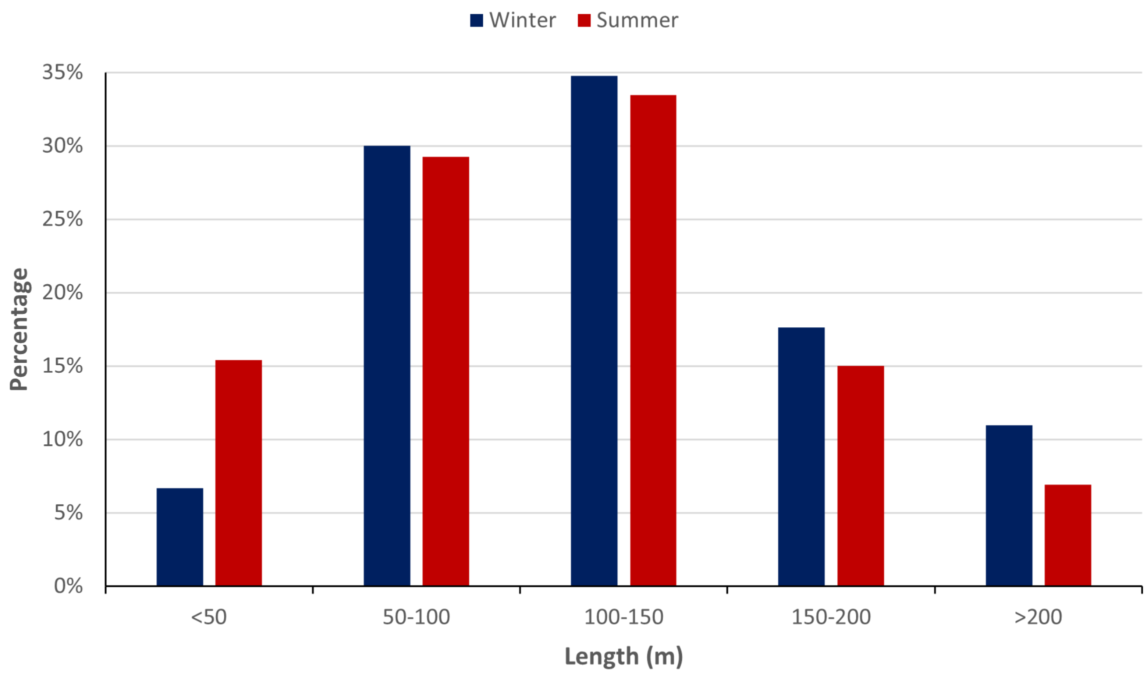

Figure 10-55 Export Cable Platform Search Area Study Area Distribution of Vessel Lengths

294. The average length recorded within the export cable platform search area study area during the winter survey period was 128m. For the summer survey period, the average vessel length was 111m. Overall, the longest vessels recorded were two 330m-length cruise liners, both recorded on one occasion.

10.3.9.2 Vessel Draught

295. Vessel draught information was available for approximately 88% of all vessels recorded throughout the combined summer and winter survey periods. A plot of all vessel tracks (excluding temporary traffic) recorded within the export cable platform search area study area throughout the survey periods, colour-coded by draught, is presented in **Figure 10-56**. Following this, the distribution of these draught classes is presented in **Figure 10-57**.

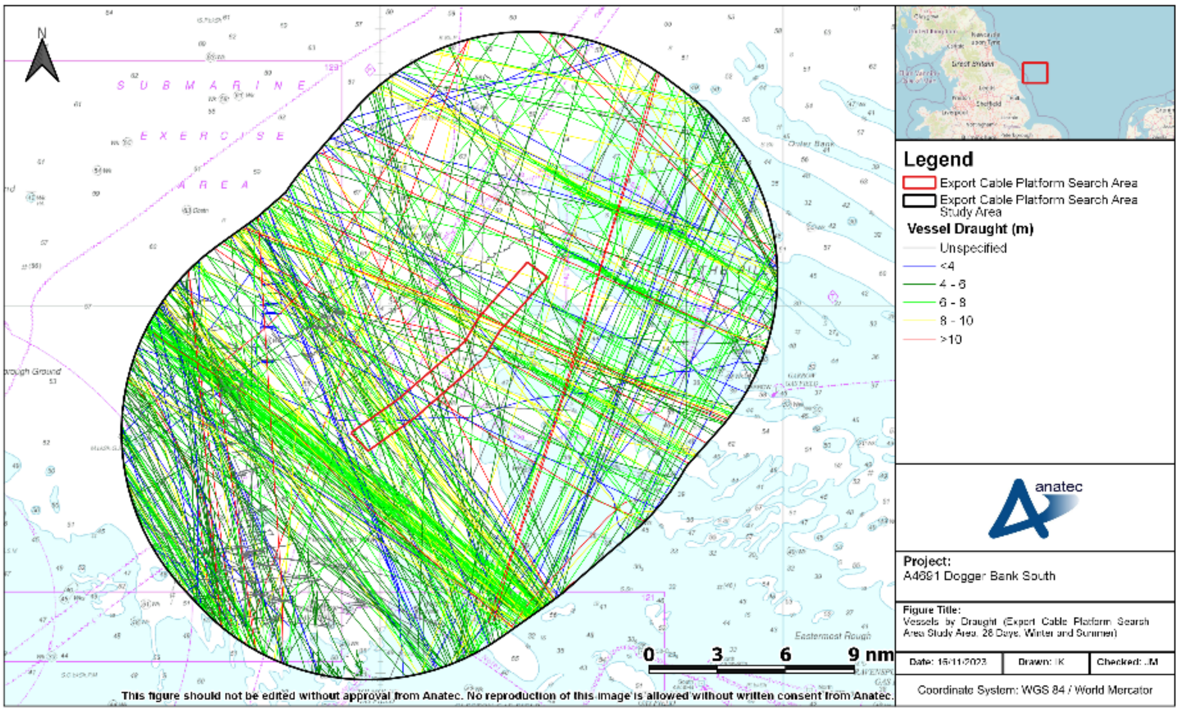

Figure 10-56 Vessels by Draught (Export Cable Platform Search Area Study Area, 28 Days Winter and Summer)

296. As with vessel length, the majority of vessels of smaller draught were noted as being fishing or recreational vessels.

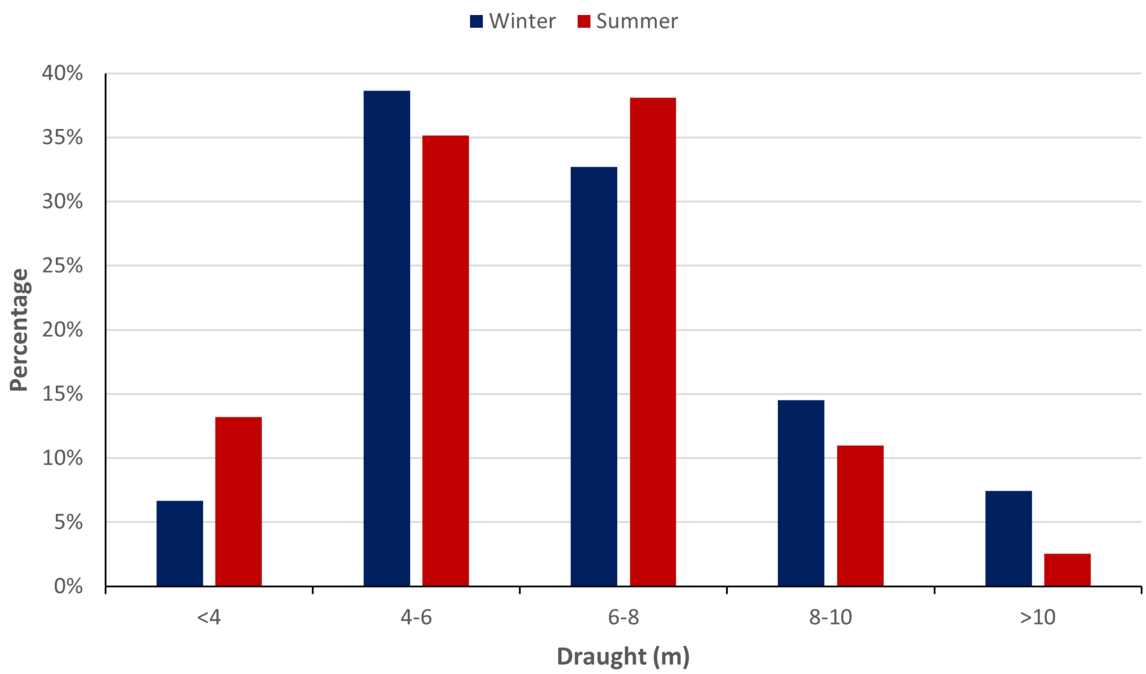

Figure 10-57 Export Cable Platform Search Area Study Area Distribution of Vessel Draughts

297. The average draught recorded within the export cable platform search area study area during the winter survey period was 6.5m. For the summer survey period, the average vessel draught was 6.0m. Overall, the vessel of deepest draught was a shuttle tanker at 14.2m.

10.4 Anchored Vessels

298. The same criteria as outlined for the DBS Array Areas has been used to identify anchored vessels within the export cable platform search area study area.

299. Throughout the 28-day survey period, no vessels were recorded as likely to be anchoring within the export cable platform search area study area.

11 Base Case Vessel Routeing

11.1 Definition of a Main Commercial Route

300. Main commercial 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 is also interrogated to show vessels (by name and/or operator) that frequently transit those routes. The route width is then calculated using the 90th percentile rule from the mean position of the potential shipping route as shown in **Figure 11-1**.

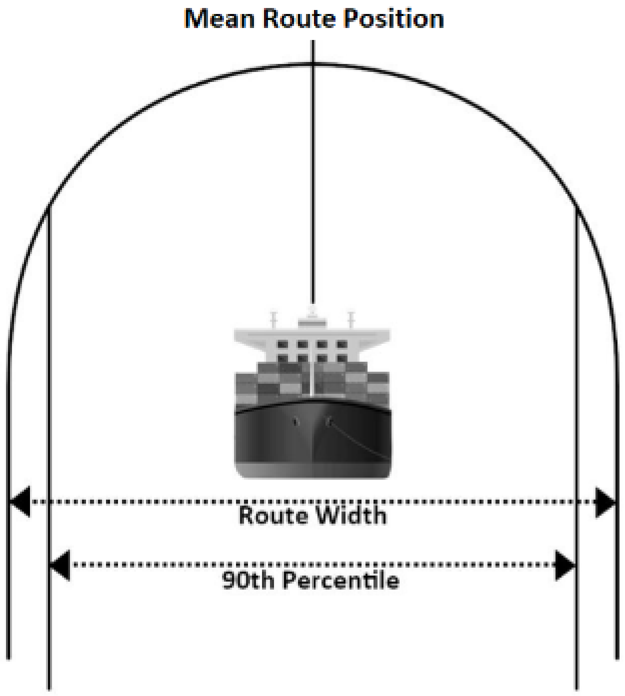

Figure 11-1 Illustration of Main Route Calculation

11.2 Pre Wind Farm Main Commercial Routes

11.2.1 DBS Array Areas

301. A total of ten main commercial routes within the DBS Array Areas study area were identified from the 28-day survey period. These main commercial routes and corresponding 90th percentiles within the study area are shown relative to the DBS Array Areas in **Figure 11-2**. Following this, a description of each route is provided in **Table 11-1**, including the average number of vessels per day, start and end locations, main vessel types, and details of commercial ferry routeing (where applicable). It is noted that the start and end locations are based on the most common destinations transmitted via AIS by vessels on these routes.

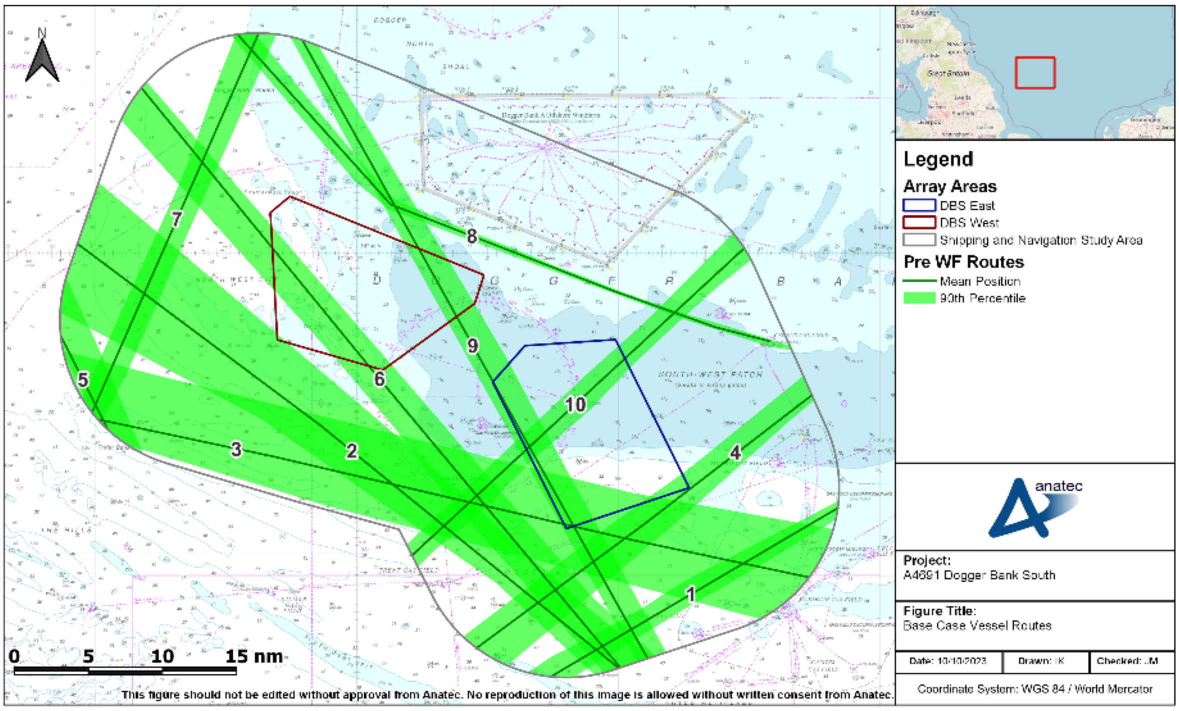

Figure 11-2 Base Case Main Commercial Routes (DBS Array Areas)

Table 11-1 Description of Main Commercial Routes (DBS Array Areas)

Route Number	Average Vessels per Day	Average Vessels per Week	Description
1	1	7 to 8	**Immingham – Gothenburg.** Mainly used by cargo vessels (95%), including the DFDS Seaways operated RoRo cargo services between Immingham and Gothenburg/Immingham and Brevik and the Finnlines operated RoRo cargo services between Immingham and Helsinki.
2	1	7 to 8	**Aberdeen – Rotterdam (Netherlands).** Generally used by tankers (53%) and cargo vessels (22%).
3	0 to 1	3 to 4	**Tees (UK) – Gdynia (Poland).** Generally used by cargo vessels (62%), tankers (19%), and tugs (19%).
4	0 to 1	3 to 4	**Grimsby (UK) – Thyborøn (Denmark).** Mainly used by cargo vessels (92%).
5	0 to 1	2 to 3	**Rotterdam – Tórshavn (Faroe Islands).** Mainly used by cargo vessels (78%).
6	0 to 1	2	**Aberdeen – Rotterdam.** Generally used by oil and gas vessels (56%) and cargo vessels (28%).
7	0 to 1	2	**Immingham – Odda (Norway).** Mainly used by cargo vessels (78%).
8	0 to 1	1 to 2	**Aberdeen – Cygnus gas field.** Only used by oil and gas vessels (100%).
9	0 to 1	1 to 2	**Rotterdam – Icelandic ports.** Mainly used by cargo vessels (86%).

Route Number	Average Vessels per Day	Average Vessels per Week	Description
10	0 to 1	1 to 2	**Immingham – Kristiansand (Norway).** Mainly used by cargo vessels (89%).

11.2.2 Export Cable Platform Search Area

302. A total of eleven main commercial routes were identified for the export cable platform search area study area from the 28-day survey period. These main commercial routes and corresponding 90th percentiles within the export cable platform search area study area are shown in **Figure 11-3**. Following this, a description of each route is provided in **Table 11-2**, including the average number of vessels per day, start and end locations, main vessel types, and details of commercial ferry routeing (where applicable). Again, it is noted that the start and end locations are based on the most common destinations transmitted via AIS by vessels on these routes.

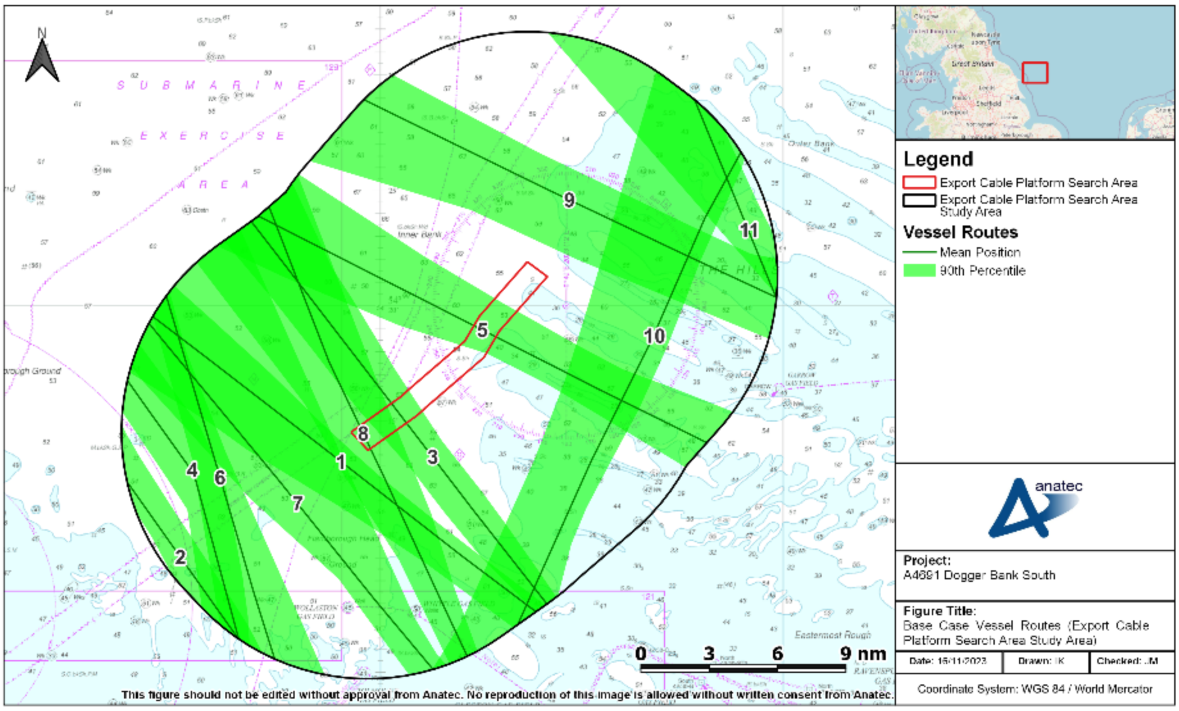

Figure 11-3 Base Case Main Commercial Routes (Export Cable Platform Search Area)

Table 11-2 Description of Main Commercial Routes (Export Cable Platform Search Area)

Route Number	Average Vessels per Day	Average Vessels per Week	Description
1	1 to 2	11	**Newcastle – Ijmuiden.** Generally used by passenger vessels (38%), cargo vessels (30%), and tankers (25%). Includes the DFDS Seaways operated RoPax service between North Shields and Ijmuiden.
2	1 to 2	10 to 11	**Grangemouth – Rotterdam.** Generally used by tankers (56%) and cargo vessels (39%)
3	1	6 to 7	**Grangemouth – Antwerp.** Generally used by tankers (58%) and cargo vessels (31%).
4	1	5 to 6	**Grangemouth – Immingham.** Generally used by tankers (57%) and cargo vessels (30%).
5	0 to 1	5 to 6	**Tees – Dutch ports.** Generally used by cargo vessels (52%) and tankers (38%).
6	0 to 1	4 to 5	**Aberdeen – Immingham.** Generally used by tankers (47%), cargo vessels (36%), and oil and gas vessels (18%).
7	0 to 1	4 to 5	**Tees – Dutch ports.** Generally used by tankers (70%) and cargo vessels (30%).
8	0 to 1	4	**Grangemouth – Rotterdam.** Generally used by cargo vessels (56%) and tankers (38%).
9	0 to 1	4	**Newcastle – Amsterdam.** Generally used by cargo vessels (75%) and tankers (19%).
10	0 to 1	3 to 4	**Hull – Norwegian ports.** Mainly used by cargo vessels (87%).
11	0 to 1	3 to 4	**Rotterdam – Þorlákshöfn (Iceland).** Generally used by cargo vessels (60%) and tankers (33%).

12 Adverse Weather Routeing

303. Some vessels and vessel operators may operate alternative routes during periods of adverse weather. This section focuses on vessel movements in adverse weather given the implications if a commercial vessel is unable to make passage or a small craft is unable to access safe havens in adverse weather due to the presence of the Projects or activities associated with the Projects.

304. Adverse weather includes wind, wave, and tidal conditions as well as reduced visibility due to fog that may hinder a vessel's standard route, speed of navigation and/or ability to enter the destination port. Adverse weather routes are assessed to be significant course adjustments to mitigate vessel motion in adverse weather conditions. When transiting in adverse weather conditions, a vessel is likely to encounter various types of weather and tidal phenomena, which may lead to severe roll motions, potentially causing damage to cargo, equipment and/or discomfort and danger to persons on board. The sensitivity of a vessel to these phenomena depends upon the actual stability parameters, hull geometry, vessel type, vessel size, and speed.

12.1 Affected Routes

305. Regular RoRo and RoPax routeing has been examined to identify routes in proximity to the DBS Array Areas and export cable platform search area that alter transits due to adverse weather. From these, only Route 4 (Newcastle to Ijmuiden) was affected.

306. The Newcastle to Ijmuiden route is undertaken by two RoPax vessels – the *King Seaways* and *Princess Seaways*. Both of these vessels are operated by DFDS Seaways. Based on Anatec's experience with existing routes in this region, as well as prior consultation with DFDS Seaways, during adverse weather this route shifts further west, and so passes further clear of the ESP. By this measure, it is not anticipated that the ESP will adversely impact vessels on this route and DFDS Seaways have confirmed this to be the case.

12.2 Identification of Periods of Adverse Weather

307. The survey data has been checked for instances of adverse weather, based on the weather log maintained by the on-site survey vessel. The sea state was rough during the 2nd of November causing the survey vessel to move to deeper water for approximately 12 hours, although it remained within full coverage of the relevant study area. This was the only recorded instance of adverse weather.

12.3 Commercial Routeing Changes

308. No adverse weather routeing was identified from the vessel traffic survey data during the 2nd of November when adverse weather was known to be present.

309. However, based on previous experience of the area, as well as Anatec's ShipRoutes database and the NRA for Hornsea Four (Anatec, 2022), it has been identified that the DFDS Seaways-operated Immingham-Gothenburg route occasionally passes west of the DBS Array Areas (likely beyond the DBS West study area) during periods of adverse weather, rather than passing to the south. DFDS Seaways have confirmed during consultation that there is no lose approach to the DBS Array Areas in normal or adverse weather conditions for the Immingham-Gothenburg route and thus there is no direct impact.

13 Navigation, Communication, and Position-Fixing Equipment

310. This section discusses the potential effects on the use of navigation, communication and position fixing equipment of vessels that may arise due to the infrastructure associated with the Projects.

13.1 Very High Frequency Communications (including Digital Selective Calling)

311. In 2004, trials were undertaken at the North Hoyle Offshore Wind Farm, located off the coast of North Wales. As part of these trials, tests were undertaken to evaluate the operational use of typical small vessel Very High Frequency (VHF) (transceivers) (including Digital Selective Calling (DSC)) when operated close to wind turbines.

312. The wind turbines had no noticeable effect on voice communications within the array or ashore. It was noted that if small craft vessel to vessel and vessel to shore communications were not affected significantly by the presence of wind turbines, then it is reasonable to assume that larger vessels with higher powered and more efficient systems would also be unaffected.

313. During this trial, a number of telephone calls were made from ashore, both within and offshore of the array area. No effects were recorded using any system provider (MCA and QinetiQ, 2004).

314. Furthermore, as part of SAR trials carried out at North Hoyle in 2005, radio checks were undertaken between the Sea King helicopter and both Holyhead and Liverpool coastguards. The aircraft was positioned offshore of the array area and communications were reported as very clear, with no apparent degradation of performance. Communications with the service vessel located within the array were also fully satisfactory throughout the trial (MCA, 2005).

315. In addition to the North Hoyle trials, a desk-based study was undertaken for the Horns Rev 3 Offshore Wind Farm in Denmark in 2014 and it was concluded that there were not expected to be any conflicts between point-to-point radio communications networks and no interference upon VHF communications (Energinet, 2014).

316. Following consideration of these reports and noting that since the trials detailed above there have been no significant issues with regards to VHF observed or reported, the presence of the Projects is anticipated to have no significant impact upon VHF communications.

13.2 Very High Frequency Direction Finding

317. During the North Hoyle trials in 2004, the VHF Direction Finding (DF) equipment carried in the trial boats did not function correctly when very close to wind turbines (within approximately 50m). This is deemed to be a relatively small-scale impact due to the limited use of VHF DF equipment and would not impact operational or SAR activities (MCA and QinetiQ, 2004).

318. Throughout the 2005 SAR trials carried out at North Hoyle, the Sea King radio homer system was tested. The Sea King radio homer system utilises the lateral displacement of a vertical bar on an instrument to indicate the sense of a target relative to the aircraft heading. With the aircraft and the target vessel within the array, at a range of approximately 1nm, the homer system operated as expected with no apparent degradation.

319. Since the trials detailed above, no significant issues with regards to VHF DF have been observed or reported, and therefore the presence of the Projects is anticipated to have no significant impact upon VHF DF equipment.

13.3 Automatic Identification System

320. No significant issues with interference to AIS transmission from operational offshore wind farms have been observed or reported to date. Such interference was also absent in the trials carried out at North Hoyle (MCA and QinetiQ, 2004).

321. In theory there could be interference when there is a structure located between the transmitting and receiving antennas (i.e., blocking line of sight) of the AIS. However, given no issues have been reported to date at operational developments or during trials, no significant impact is anticipated due to the presence of the Projects.

13.4 Navigational Telex System

322. The Navigational Telex (NAVTEX) system is used for the automatic broadcast of localised Maritime Safety Information (MSI) and either prints it out in hard copy or displays it on a screen, depending upon the model.

323. There are two NAVTEX frequencies. All transmissions on NAVTEX 518 Kilohertz (kHz), the international channel, are in English. NAVTEX 518 kHz provides the mariner (both recreational and commercial) with weather forecasts, severe weather warnings and navigation warnings such as obstructions or buoys off station. Depending on the user’s location, other information options may be available such as ice warnings for high latitude sailing.

324. The 490 kHz national NAVTEX service may be transmitted in the local language. In the UK full use is made of this secondary frequency including useful information for smaller craft, such as the inshore waters forecast and actual weather observations from weather stations around the coast.

325. Although no specific trials have been undertaken, no significant effect on NAVTEX has been reported to date at operational developments, and therefore no significant impact is anticipated due to the presence of the Projects.

13.5 Global Positioning System

326. Global Positioning System (GPS) is a satellite based navigational system. GPS trials were also undertaken throughout the 2004 trials at North Hoyle and it was stated that "*no problems with basic GPS reception or positional accuracy were reported during the trials*".

327. The additional tests showed that "*even with a very close proximity of a wind turbine to the GPS antenna, there were always enough satellites elsewhere in the sky to cover for any that might be shadowed by the wind turbine tower*" (MCA and QinetiQ, 2004).

328. Therefore, there are not expected to be any significant impacts associated with the use of GPS systems within or in proximity to the Projects, noting that there have been no reported issues relating to GPS within or in proximity to any operational offshore wind farms to date.

13.6 Electromagnetic Interference

329. A compass, magnetic compass or mariner's compass is a navigational instrument for determining direction relative to the earth's magnetic poles. It consists of a magnetised pointer (usually marked on the north end) free to align itself with the Earth's magnetic field. A compass may be used to calculate heading, used with a sextant to calculate latitude, and with a marine chronometer to calculate longitude.

330. Like any magnetic device, compasses are affected by nearby ferrous materials as well as by strong local electromagnetic forces, such as magnetic fields emitted from power cables. As the compass still serves as an essential means of navigation in the event of power loss or as a secondary source, it is important that potential impacts from Electromagnetic Field (EMF) are minimised to ensure continued safe navigation.

331. The vast majority of commercial traffic uses non-magnetic gyrocompasses as the primary means of navigation, which are unaffected by EMF. Therefore, it is considered highly unlikely that any interference from EMF as a result of the presence the Projects would have a significant impact on vessel navigation. However, some smaller craft (fishing or leisure) may rely on it as their sole means of navigation.

13.6.1 Sub-Sea Cables

332. The array cables would carry Alternating Current (AC) and inter-platform cables could carry either AC or Direct Current (DC). Studies indicate that AC does not emit an EMF significant enough to impact marine magnetic compasses (Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), 2008). Therefore, electromagnetic interference due to AC cables are not considered any further.

333. The export cables for the Projects will be Direct Current (DC). The Moray Offshore Renewables Environmental Statement (Moray Offshore Renewables, 2012) notes that for both buried and protected DC cables the magnetic field would decrease exponentially with vertical distance from the seabed and with horizontal distance from the cables (within a few metres), irrespective of whether cables are buried or protected. It states that "*in all cases, where cables are buried to 1m depth, the predicted magnetic field is expected to be below the earth's magnetic field (assumed to be 50 microtesla (µT)). Where DC cables cannot be buried and are instead protected, the magnetic field is expected to be below the earth's magnetic field within 5m from the seabed*".

334. The following are therefore considered to be important factors affecting the likelihood of EMF to affect compass deviation as a result of the presence of export cables:

- Water depth;
- Burial depth (or protection);
- Type of current (alternating or direct) running through the cables; and/or
- Spacing or separation of the cables.

335. **Table 13-1** details assumed EMF mitigation relating to export cables.

Table 13-1 EMF Mitigation

Mitigation	Reasoning	Percentage of Export Cable Applied To
Cables are installed in close proximity/bundled	Industry experiences in cable installation and offshore renewables show that bundled cables or cables closely installed mitigate the effects of EMF (NorthConnect, 2018).	100%
Water depth greater than 10m	Increased water depth (vertical distance) mitigates the effects of EMF.	Approximately 96% is within depths greater than 10m below CD.
Water depth greater than 20m	Increased water depth (vertical distance) mitigates the effects of EMF.	Approximately 87% is within depths greater than 20m below CD.
Cable burial	Burial depth also increases vertical distance (minimum 0.5m/maximum 1.5m).	At least 80% of export cables will be buried.
Cable route alignment relative to passing traffic	Vessel movements within the Offshore Export Cable Corridor study area primarily cross perpendicular to the direction the cables will be routed.	Across 100% of the export cables traffic is assumed to pass primarily perpendicular to the cable direction. Where vessels are not transiting over the cables, the time during which the vessel is directly above the cables will be limited given the width of the cables. It is considered an unlikely event that a vessel would track the route of the cables.

Mitigation	Reasoning	Percentage of Export Cable Applied To
Width of cables	DC cables produce static magnetic fields, which decrease with (horizontal) distance from the Offshore Export Cable Corridor. Therefore, assuming a worst case of 250m (assuming six cables buried side by side with minimum 50m spacing) compass interference would potentially only be experienced directly above or in direct proximity to the cables, noting again effects decrease quickly with horizontal distance.	100% given the effects will only be present when vessels are directly over the cables or in very close proximity (within metres).
Compass deviation study undertaken pre construction	MCA request a maximum three-degree deviation for 95% of the route and no more than five-degrees for the remaining 5% acceptable.	100%

336. Given that all export cables will be buried and 96% (approximately) will be located in water depths of greater than 10m, there are not anticipated to be any effects on compass deviation for the majority of the Offshore Export Cable Corridor. This will be verified by the compass deviation study if deemed necessary to comply with the MCA's requirements.

13.6.2 Wind Turbines

337. MGN 654 (MCA, 2021) notes that small vessels with simple magnetic steering and hand bearing compasses should be wary of using these close to wind turbines as with any structure in which there is a large amount of ferrous material (MCA and QinetiQ, 2004). Potential effects are deemed to be within acceptable levels when considered alongside other mitigation such as the mariner being able to make visual observations (not wholly reliant on the magnetic compass), lighting, sound signals and identification marking in line with MGN 654.

13.6.3 Experience at Operational Offshore Wind Farms

338. No issues with respect to magnetic compasses have been reported to date in any of the trials (MCA and QinetiQ, 2004) undertaken (inclusive of SAR helicopters) nor in any published reports from operational offshore wind farms.

13.7 Marine Radar

339. This section summarises the results of trials and studies undertaken in relation to Radar effects from offshore wind farms in the UK. It is important to note that since the time of the trials and studies discussed, wind turbine technology has advanced significantly, most notably in terms of the size of wind turbines available to be installed and utilised. The use of these larger wind turbines allows for a greater

spacing between wind turbines than was achievable at the time of the studies being undertaken, which is beneficial in terms of Radar interference effects (and surface navigation in general) as detailed below.

13.7.1 Trials

340. During the early years of offshore renewables within the UK, maritime regulators undertook a number of trials (both shore-based and vessel-based) into the effects of wind turbines on the use and effectiveness of marine Radar.

341. In 2004 trials undertaken at North Hoyle (MCA, 2004) identified areas of concern regarding the potential impact on marine- and shore-based Radar systems due to the large vertical extents of the wind turbines (based on the technology at that time). This resulted in Radar responses strong enough to produce interfering side lobes and reflected echoes (often referred to as false targets or ghosts).

342. Side lobe patterns are produced by small amounts of energy from the transmitted pulses that are radiated outside of the narrow main beam. The effects of side lobes are most noticeable within targets at short range (below 1.5nm) and with large objects. Side lobe echoes form either an arc on the Radar screen similar to range rings, or a series of echoes forming a broken arc, as illustrated in **Figure 13-1**.

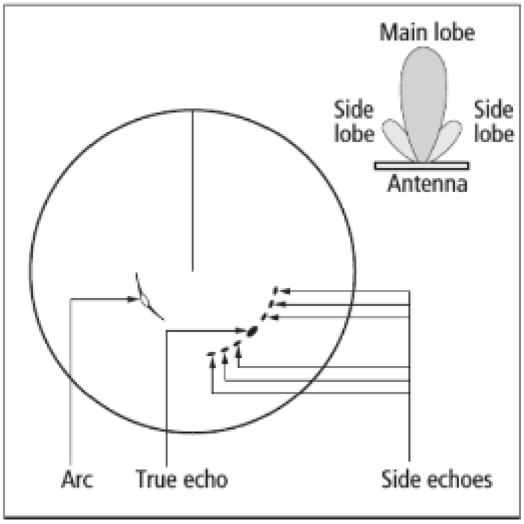

Figure 13-1 Illustration of Side Lobes on Radar Screen

343. Multiple reflected echoes are returned from a real target by reflection from some object in the Radar beam. Indirect echoes or 'ghost' images have the appearance of true echoes but are usually intermittent or poorly defined; such echoes appear at a false bearing and false range, as illustrated in **Figure 13-2**.

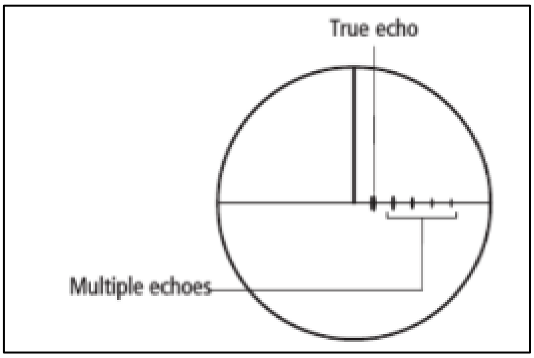

Figure 13-2 Illustration of Multiple Reflected Echoes on Radar Screen

344. Based on the results of the North Hoyle trials, the MCA produced a Shipping Route Template designed to give guidance to mariners on the distances which should be established between shipping routes and offshore wind farms. However, as experience of effects associated with use of marine Radar in proximity to offshore wind farms grew, the MCA refined their guidance, offering more flexibility within the most recent Shipping Route Template contained within MGN 654 (MCA, 2021).

345. A second set of trials conducted at Kentish Flats Offshore Wind Farm in 2006 on behalf of the British Wind Energy Association (BWEA) (BWEA, 2007) – now called RenewableUK – also found that Radar antennas which are sited unfavourably with respect to components of the vessel's structure may exacerbate effects such as side lobes and reflected echoes. Careful adjustment of Radar controls suppressed these spurious Radar returns but mariners were warned that there is a consequent risk of losing targets with a small Radar cross section, which may include buoys or small craft, particularly yachts or Glass Reinforced Plastic (GRP) constructed craft; therefore, due care should be taken in making such adjustments.

346. Theoretical modelling of the effects of the development of the proposed Atlantic Array Offshore Wind Farm, which was to be located off the south coast of Wales, on marine Radar systems was undertaken by the Atlantic Array project (Atlantic Array, 2012) and considered a wider spacing of wind turbines than that considered within the early trials[5]. The main outcomes of the modelling were the following:

- Multiple and indirect echoes were detected under all modelled parameters;
- The main effects noticed were stretching of targets in azimuth (horizontal) and appearance of ghost targets;
- There was a significant amount of clear space amongst the returns to ensure recognition of vessels moving amongst the wind turbines and safe navigation;
- Even in the worst case with Radar operator settings artificially set to be poor, there is significant clear space around each wind turbine that does not contain any multipath or side lobe ambiguities to ensure safe navigation and allow differentiation between false and real (both static and moving) targets;

[5] It is acknowledged that other theoretical analysis has been undertaken.

- Overall, it was concluded that the amount of shadowing observed was very little (noting that the model considered lattice-type foundations which are sufficiently sparse to allow Radar energy to pass through);
- The lower the density of wind turbines the easier it is to interpret the Radar returns and fewer multipath ambiguities are present;
- In dense, target rich environments S-Band Radar scanners suffer more severely from multipath effects in comparison to X-Band Radar scanners;
- It is important for passing vessels to keep a reasonable separation distance between the wind turbines in order to minimise the effect of multipath and other ambiguities;
- The Atlantic Array study undertaken in 2012 noted that the potential for Radar interference was mainly a problem during periods of reduced visibility when mariners may not be able to visually confirm the presence of other vessels in proximity (those without AIS installed which are usually fishing vessels and recreational craft). It is noted that this situation would arise with or without wind turbines in place; and
- There is potential for the performance of a vessel's ARPA to be affected when tracking targets in or near the array. Although greater vigilance is required, during the Kentish Flats trials it was shown that false targets were quickly identified as such by the mariners and then by the equipment itself.

347. In summary, experience in UK waters has shown that mariners have become increasingly aware of any Radar effects as more offshore wind farms become operational. Based on this experience, the mariner can interpret the effects correctly, noting that effects are the same as those experienced by mariners in other environments such as in close proximity to other vessels or structures. Effects may be effectively mitigated by "*careful adjustment of Radar controls*".

348. The MCA has also produced guidance for mariners operating in proximity to OREIs in the UK which highlights Radar issues amongst others to be taken into account when planning and undertaking voyages in proximity to OREIs (MCA, 2008). The interference buffers presented in **Table 13-2** are based on MGN 654 (MCA, 2021) and MGN 372 Amendment 1 (MCA, 2022). It is noted that technical information has also been carried forward from MGN 371 (MCA, 2008) and MGN 543 (MCA, 2016) which have been withdrawn.

Table 13-2 Distances at which Impacts on Marine Radar Occur

Distance at Which Effect Occurs (nm)	Identified Effects
0.5	▪ Intolerable impacts may be experienced. ▪ X-Band Radar interference is intolerable under 0.25nm. ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45nm.
1.5	▪ Under MGN 654, impacts on Radar are considered to be tolerable with mitigation between 0.5 and 3.5nm. ▪ S-Band Radar interference starts at 1.5nm. ▪ Echoes develop at approximately 1.5nm, with progressive deterioration in the Radar display as the range closes. Where a main vessel route passes within this range considerable interference may be expected along a line of wind turbines. ▪ The wind turbines produce strong Radar echoes giving early warning of their presence. ▪ Target size of the wind turbine echo increases close to the wind turbine with a consequent degradation on both X- and S-Band Radars.

349. As noted in **Table 13-2**, the onset range from the wind turbines of false returns is approximately 1.5nm, with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) *Rule 6 Safe Speed* are particularly applicable and must be observed with due regard to the prevailing circumstances (IMO, 1972/77). In restricted visibility, *Rule 19 Conduct of Vessels in Restricted Visibility* applies and compliance with *Rule 6* becomes especially relevant. In such conditions mariners are required, under *Rule 5 Look-out* to take into account information from other sources which may include sound signals and VHF information, for example from a Vessel Traffic Service (VTS) or AIS (MCA, 2016).

13.7.2 Experience from Operational Developments

350. The evidence from mariners operating in proximity to existing offshore wind farms is that they quickly learn to adapt to any effects. **Figure 13-3** presents the example of the Galloper and Greater Gabbard Offshore Wind Farms, which are located in proximity to IMO routeing measures. Despite this proximity to heavily trafficked Traffic Separation Scheme (TSS) lanes, there have been no reported incidents or issues raised by mariners operating in close proximity. The interference buffers presented in **Figure 13-3** are as per **Table 13-2**.

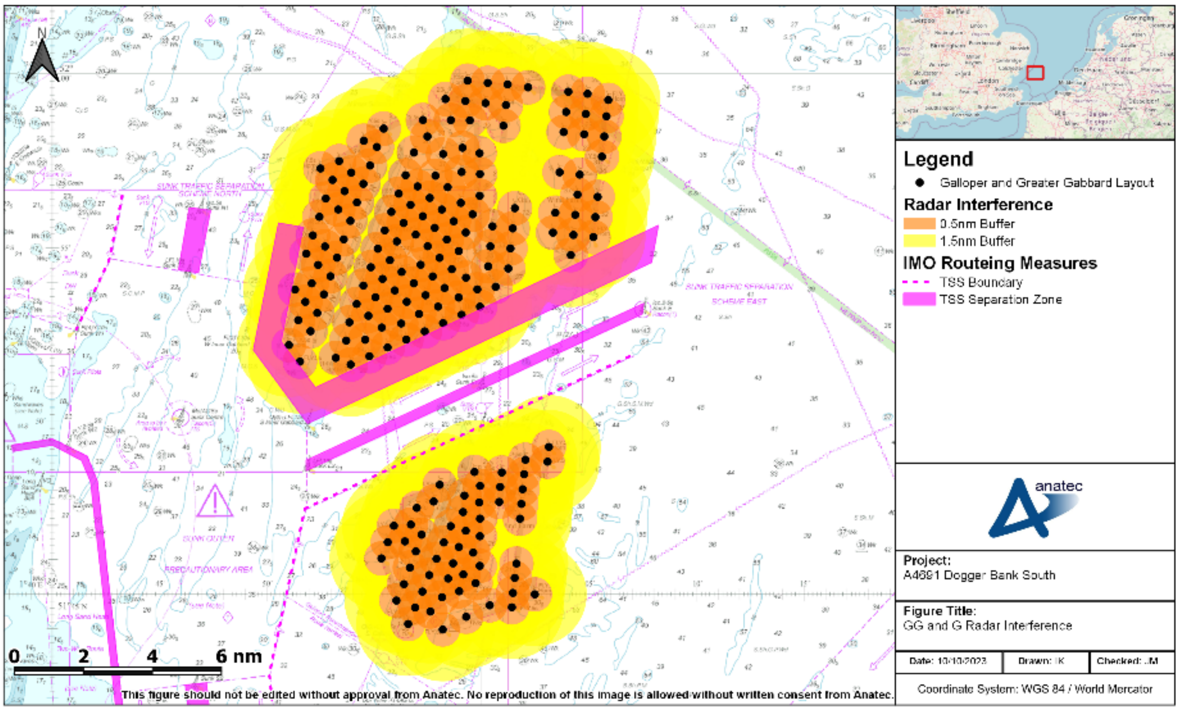

Figure 13-3 Illustration of Potential Radar Interference at Galloper and Greater Gabbard Offshore Wind Farms

351. As indicated by **Figure 13-3**, vessels utilising these TSS lanes would experience some Radar interference based on the available guidance. Both developments are operational, and the lanes are used by a minimum of eight vessels per day on average. However, to date, there have been no incidents recorded (including any related to Radar use) or concerns raised by the users.

352. AIS information may also be used to verify the targets of larger vessels (generally vessels over 15m LOA – the minimum threshold for fishing vessel AIS carriage requirements). Approximately 1% of the vessel traffic recorded within the DBS array study areas was under 15m in length, although throughout the vessel traffic surveys approximately 97% of vessel tracks were recorded on AIS, indicating a high level of AIS take-up among vessels for which AIS carriage is not mandatory.

353. For any smaller vessels, particularly fishing vessels and recreational vessels, AIS Class B devices are becoming increasingly popular and allow the position of these small craft to be verified when in proximity to an offshore wind farm.

13.7.3 Increased Radar Returns

354. Beam width is the angular width, horizontal or vertical, of the path taken by the Radar pulse. Horizontal beam width ranges from 0.75° to 5°, and vertical beam width from 20° to 25°. How well an object reflects energy back towards the Radar depends upon its size, shape and aspect angle.

355. Larger wind turbines (either in height or width) would return greater target sizes and/or stronger false targets. However, there is a limit to which the vertical beam width would be affected (20° to 25°) dependent upon the distance from the target, and at closer distances this five degree width would be limited much further. Therefore, increased wind turbine height in the array would not create any effects in addition to those already identified from existing operational wind farms (interfering side lobes, multiple and reflected echoes). Additionally, the level and way Radar returns occur is not expected to differ significantly for different foundation types (i.e., monopiles and jacket foundations).

356. Again, when taking into consideration the potential options available to marine users (such as reducing gain to remove false returns) and feedback from operational experience, this shows that the effects of increased returns may be managed effectively.

13.7.4 Fixed Radar Antenna Use in Proximity to an Operational Offshore Wind Farm

357. It is noted that there are multiple operational offshore wind farms including Galloper that successfully operate fixed Radar antenna from locations on the periphery of the array. These antennas are able to provide accurate and useful information to onshore coordination centres.

13.7.5 Application to the Projects

358. Upon development of the Projects, some commercial vessels may pass within 1.5nm of the wind farm structures and therefore may be subject to a minor level of Radar interference. Trials, modelling, and experience from existing developments note that any impact may be mitigated by adjustment of Radar controls.

359. **Figure 13-4** presents an illustration of potential Radar interference due to the Projects, with Dogger Bank A included for context. The Radar effects have been applied to the indicative full build out array layout (Layout A) introduced in section 6.2.1 to maximise the extent of potential Radar interference.

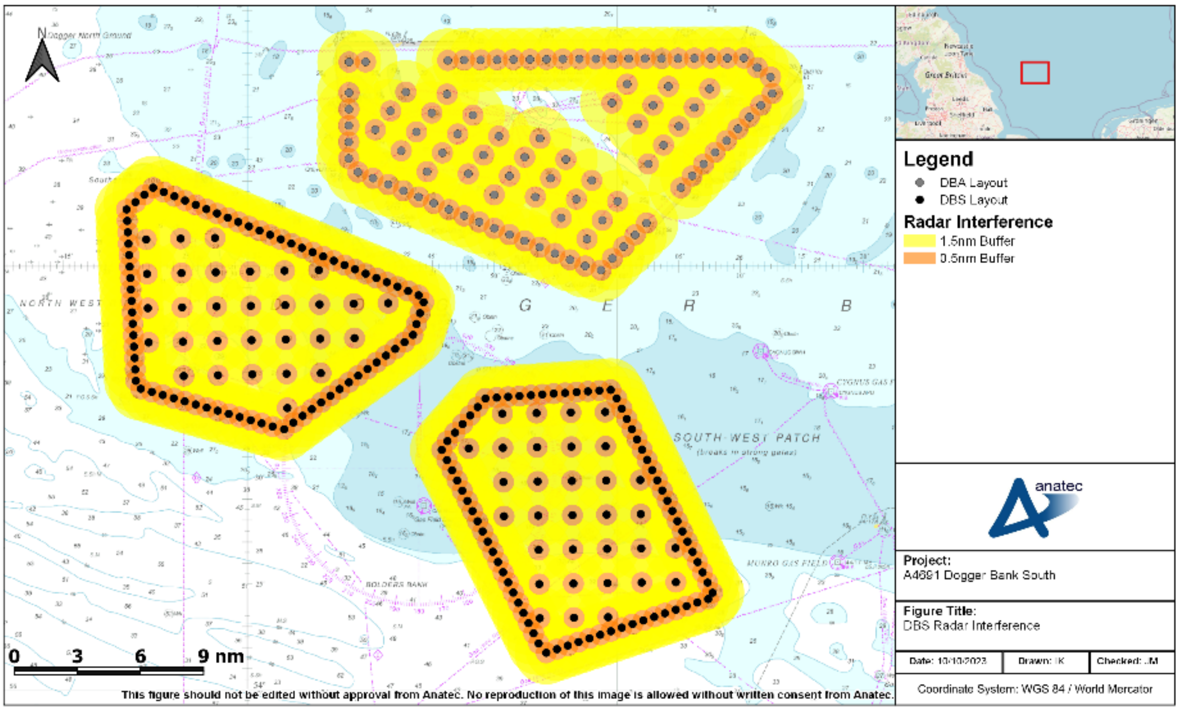

Figure 13-4 Illustration of Potential Radar Interference at the Projects

360. Vessels passing within the arrays would be subject to a greater level of interference with impacts becoming more substantial in close proximity to wind turbines. This would require additional mitigation by any vessels including consideration of the navigational conditions (visibility) when passage planning and compliance with the COLREGs (IMO, 1972/77) would be essential.

361. For vessels passing the arrays, the gaps between the DBS Array Areas and between DBS West and Dogger Bank A are sufficient to allow vessels to safely pass without being subjected to more notable effects.

362. Overall, the impact on marine Radar is expected to be low and no further hazard relating to navigational safety is anticipated outside the parameters which may be mitigated by operational controls.

13.8 Sound Navigation Ranging Systems

363. No evidence has been found to date with regard to existing offshore wind farms to suggest that Sound Navigation Ranging (SONAR) systems produce any kind of SONAR interference which is detrimental to the fishing industry, or to military systems. No impact is therefore anticipated in relation to the presence of the Projects.

13.9 Noise

364. No evidence has been found to date with regard to existing offshore wind farms to suggest that prescribed sound signals are in any way impacted by acoustic noise produced by the wind farm.

13.10 Summary of Potential Effects on Use

365. Based on the detailed technical assessment of the effects due to the presence of the Projects on navigation, communication and position fixing equipment in the previous subsections, **Table 13-3** summarises the assessment of frequency of occurrence and severity of consequence and the resulting significance of risk for each component of this hazard.

Table 13-3 Summary of Risk to Navigation, Communication, and Position Fixing Equipment

Topic	Frequency of Occurrence	Severity of Consequence	Significance of Risk
VHF	Negligible	Minor	Broadly Acceptable
VHF DF	Extremely Unlikely	Minor	Broadly Acceptable
AIS	Negligible	Minor	Broadly Acceptable
NAVTEX	Negligible	Minor	Broadly Acceptable
GPS	Negligible	Minor	Broadly Acceptable
EMF	Extremely Unlikely	Negligible	Broadly Acceptable
Marine Radar	Remote	Minor	Broadly Acceptable
SONAR	Negligible	Minor	Broadly Acceptable
Noise	Negligible	Minor	Broadly Acceptable

366. On the basis of these findings, associated risks are screened out of the risk assessment undertaken in section 16, noting that as part of the SAR Checklist completed post consent, VHF trials may be undertaken to investigate effects due to larger wind turbines.

14 Cumulative and Transboundary Overview

14.1 Screened in Other Developments

14.1.1 Offshore Wind Farms

367. In addition to the Projects, there are a number of other offshore wind farm developments located in the region. **Table 14-1** includes details of these offshore wind farm developments, whether they are screened into the cumulative risk assessment, and the cumulative tier applied (where applicable). The project statuses listed are as of November 2023.

368. As per the cumulative risk assessment methodology, any development greater than 50nm from the DBS Array Areas or greater than 5nm from the Offshore Export Cable Corridor is not considered.

369. **Figure 14-1** presents the locations of the offshore wind farm developments screened into the cumulative risk assessment alongside baseline developments.

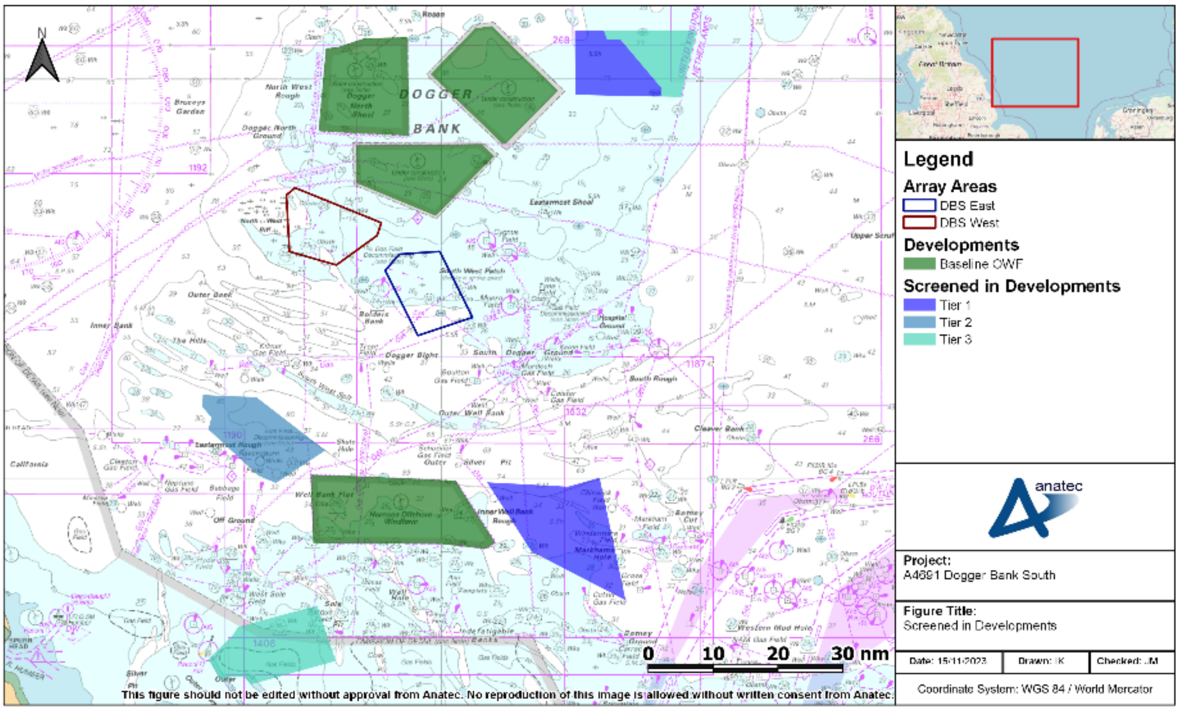

Figure 14-1 Screened in Developments

Table 14-1 Cumulative Screening

Development	Development Type	Development Status (as of November 2023)	Closest Distance (nm)			Data Confidence	Cumulative Risk Assessment Screened In/Out	Cumulative Tier
			Array Areas	Offshore Export Cable Corridor	Export Cable Platform Search Area			
Aminth Interconnector	Sub-sea cable	In planning	Unknown	Unknown	Unknown	Low	Screened out – preliminary status and low data confidence	N/A
Eastern Green Link 2	Sub-sea cable	In planning	Unknown	Unknown	Unknown	Low	Screened out – low data confidence	N/A
Boulton	Oil and gas platform	Operational	9.4	9.4	51	High	Screened out – baseline	N/A
Cavendish	Oil and gas platform	Operational	1.9	0	37	High	Screened out – baseline	N/A
Cygnus A	Oil and gas platform	Operational	8.7	8.7	57	High	Screened out – baseline	N/A
Cygnus B	Oil and gas platform	Operational	6.8	6.8	54	High	Screened out – baseline	N/A
Dogger Bank A	Offshore wind farm	Under construction	4.7	4.7	40	High	Screened out – baseline	N/A
Dogger Bank B	Offshore wind farm	Under construction	9.4	9.4	41	High	Screened out - baseline	N/A

Development	Development Type	Development Status (as of November 2023)	Closest Distance (nm)			Data Confidence	Cumulative Risk Assessment Screened In/Out	Cumulative Tier
			Array Areas	Offshore Export Cable Corridor	Export Cable Platform Search Area			
Dogger Bank C	Offshore wind farm	Consented	31	39	75	High	Screened in	1
Dogger Bank D	Offshore wind farm	Scoped	40	49	86	High	Screened in	3
Hornsea Four	Offshore wind farm	Consented	13	22	13	High	Screened in	2
Hornsea Project One	Offshore wind farm	Operational	25	25	42	High	Screened out – baseline	N/A
Hornsea Three	Offshore wind farm	Consented	24	34	58	High	Screened in	1
Hornsea Project Two	Offshore wind farm	Operational	22	24	33	High	Screened out – baseline	N/A
Munro	Oil and gas platform	Operational	6.0	6.0	56	High	Screened out – baseline	N/A
Outer Dowsing	Offshore wind farm	Scoped	44	43	43	High	Screened in	3
Sofia	Offshore wind farm	Under construction	18	18	59	High	Screened out - baseline	N/A

14.1.2 Oil and Gas Infrastructure

370. The various existing oil and gas infrastructure (listed in **Table 14-1**) is considered as part of the baseline and is therefore screened out of the cumulative risk assessment.

14.1.3 Marine Aggregate Dredging Areas

371. There are no marine aggregate exploration areas in the region. The 2021/22 marine aggregate tender round does include several areas within the southern North Sea, although geographical information is unavailable. Based on the information available, there is not expected to be any proximity to the Offshore Development Areas, and therefore these potential future areas are screened out of the cumulative risk assessment.

14.1.4 Sub-Sea Cables

372. The Aminth Interconnector (listed in **Table 14-1**) is a planned sub-sea cable development between Mablethorpe and the Danish North Sea Energy Island. An application for an electricity interconnector licence was made to the Gas and Electricity Markets Authority and published in November 2022 (Ofgem, 2022). It is possible that this development may pass in proximity to the DBS Array Areas; however, given the preliminary status and low data confidence, it has been screened out of the cumulative risk assessment.

14.2 Pre Wind Farm Interaction with Screened in Developments

14.2.1 DBS Array Areas

373. The main commercial routes identified within the DBS array study areas which interact with screened in cumulative developments are summarised in **Table 14-2**. As per the methodology for re-routeing due to the Projects in isolation (see section 15.4), it is assumed that any main commercial route within 1nm of a surface piercing installation would require a deviation.

Table 14-2 Anticipated Main Commercial Route Interaction with Cumulative Developments

Route Number	Average vessels per Day	Average Vessels per Week	Main Ports	Interaction with Cumulative Developments		
				Hornsea Three	Hornsea Four	Dogger Bank C
2	1	7 to 8	Aberdeen – Rotterdam	✓		
5	0 to 1	2 to 3	Rotterdam – Tórshavn		✓	
6	0 to 1	2	Aberdeen – Rotterdam	✓		
9	0 to 1	1 to 2	Rotterdam – Icelandic ports	✓		
10	0 to 1	1 to 2	Immingham – Kristiansand			✓

374. In summary, three main commercial routes are anticipated to be permanently displaced by the additional presence of Hornsea Three (Tier 1), with one main commercial route displaced by the presence of Hornsea Four (Tier 2) and Dogger Bank C (Tier 1).

14.2.2 Export Cable Platform Search Area

375. Given that build out within the export cable platform search area would consist of a maximum of one structure only, deviations associated with cumulative developments in addition to the export cable platform search area (see section 15.4.2) are not anticipated to result in a material risk to shipping and navigation. The closest cumulative development to the worst case ESP location is Hornsea Four, located approximately 17nm west of the ESP. This distance is sufficient to allow mariners to adequately adjust their passage to avoid cumulative issues, particularly when considered alongside the small-scale nature of ESP deviations.

15 Future Case Vessel Traffic

376. The characterisation of vessel traffic established in the baseline (see section 10) is used as input to the risk assessment (see section 17). However, it is also necessary to consider potential future case vessel traffic, in terms of general volume and size changes, port developments which may influence movements, and changes to movements associated with the presence of the Projects (the post wind farm scenario).

377. The following subsections provide a high level future case scenario which has been used to inform the risk assessment.

15.1 Increases in Commercial Vessel Activity

378. There is uncertainty associated with long-term predictions of vessel traffic growth including the potential for any other new developments in UK or transboundary ports and the long-term effects of Brexit.

379. Therefore, two independent scenarios of potential growth in commercial vessel movements of 10% and 20% have been estimated throughout the lifetime of the Projects.

15.2 Increases in Commercial Fishing Vessel and Recreational Vessel Activity

380. There is similar uncertainty associated with long-term predictions for commercial fishing vessel and recreational vessel transits given the limited reliable information on future trends upon which any firm assumption could be made. There are no known major developments which would increase commercial fishing or recreational vessel activity in the region, although should the prohibition of fishing with towed bottom-contacting gear within the Dogger Bank SAC be revoked in the future this may affect volumes of commercial fishing vessels.

381. Therefore, a conservative potential growth in commercial fishing vessel and recreational vessel movements of 10% and 20% has been estimated throughout the lifetime of the Projects.

15.3 Increases in Traffic Associated with Project Operations

382. During the construction phase up to 11,489 annual round trips to port would be made by vessels involved in the installation of the Projects (see section 6.4). During the operation and maintenance phase, up to 473 annual round trips to port would be made by vessels involved in the operation and maintenance of the Projects (see section 6.5).

15.4 Commercial Traffic Routeing (Projects in Isolation)

15.4.1 Methodology

383. It is not possible to consider all potential alternative routeing options for commercial traffic and therefore alternatives have been considered where possible in consultation with operators. Assumptions for re-routeing include:

- All alternative routes maintain a minimum mean distance of 1nm from offshore installations and existing offshore wind farm boundaries in line with industry experience. This distance is considered for shipping and navigation from a safety perspective as explained below; and
- All mean routes take into count sandbanks, aids to navigation and known routeing preferences.

384. Annex 1 of MGN 654 defines a methodology for assessing passing distance from offshore wind farm boundaries but states that it is "*not a prescriptive tool but needs intelligent application*".

385. To date, internal and external studies undertaken by Anatec on behalf of the UK Government and individual clients show that vessels do pass consistently and safely within 1nm of established offshore wind farms (including between distinct developments) and these distances vary depending upon the sea room available as well as the prevailing conditions. This evidence also demonstrates that the Mariner defines their own safe passing distance based upon the conditions and nature of the traffic at the time, but they are shown to frequently pass 1nm off established developments. Evidence also demonstrates that commercial vessels do not transit through arrays.

386. The NRA also aims to establish the MDS based on navigational safety parameters, and when considering this the most conservative realistic scenario for vessel routeing is when main commercial routes pass 1nm off developments. Evidence collected during numerous assessments at an industry level confirms that it is a safe and reasonable distance for vessels to pass; however, it is likely that a large number of vessels would instead choose to pass at a greater distance depending upon their own passage plan and the current conditions.

15.4.2 Main Commercial Route Deviations

15.4.2.1 DBS Array Areas

387. An illustration of the anticipated worst case shift in the mean positions of the main commercial routes within the DBS Array Areas study area following the development of the Projects is presented in **Figure 15-1**. These deviations are based on Anatec's assessment of the MDS.

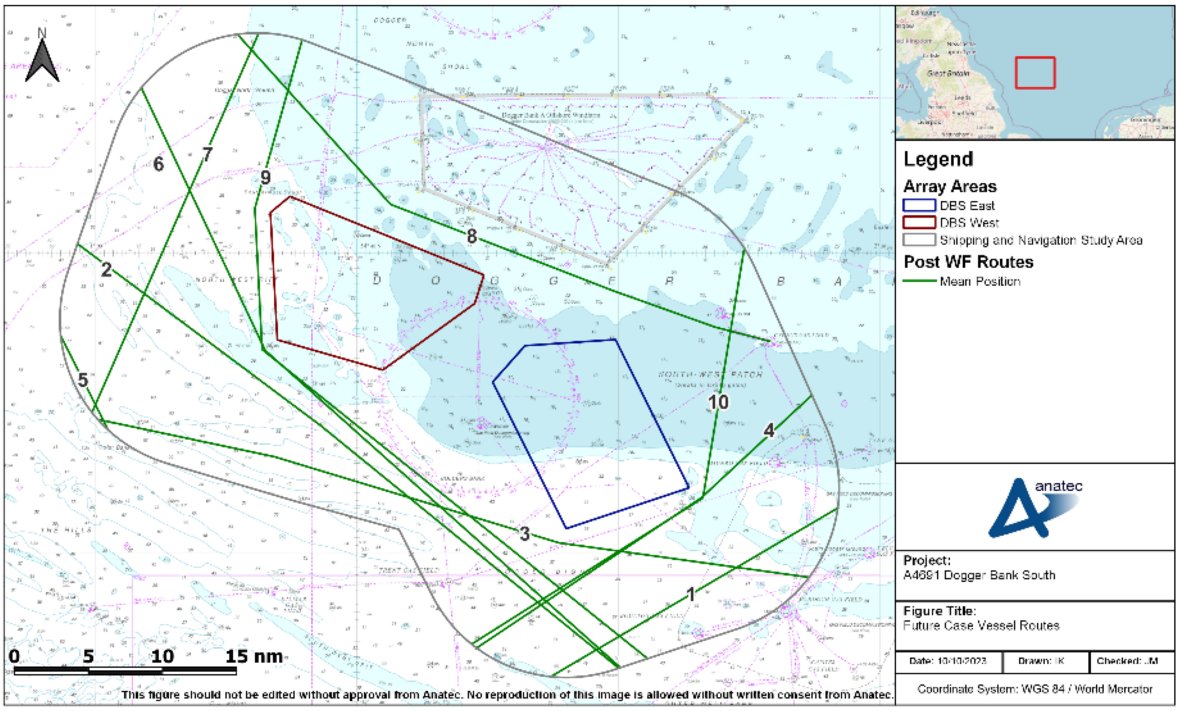

Figure 15-1 Future Case Main Commercial Routes (DBS Array Areas)

388. Deviations from the pre wind farm scenario would be required for five out of the ten main commercial routes identified, with the level of deviation varying between a 0.1nm increase for Routes 3 and 4, and a 6.8nm increase for Route 9. For the displaced routes, the increase in distance from the pre wind farm scenario is presented in **Table 15-1**.

Table 15-1 Summary of Post Wind Farm Main Commercial Deviations within the DBS Array Areas Study Area

Route Number	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)	Nature of Deviation
3	0.1	<0.1	Passing south of the DBS East Array Area.
4	0.1	<0.1	Passing slightly further east of the DBS East Array Area.
6	1.0	0.3	Passing west of the DBS West Array Area.
9	6.8	0.6	Passing west of the DBS West Array Area.
10	4.4	1.1	Passing south and east of the DBS East Array Area.

389. In the case of Route 9, although the increase in route length is relatively high, due to the total distance involved in the transit, the percentage change in total route length is low.

15.4.2.2 Export Cable Platform Search Area

390. An illustration of the anticipated worst case shift in the mean positions of the main commercial routes within the export cable platform search area study area following the development of the Projects is presented in **Figure 15-2**. These deviations are based on Anatec's assessment of the MDS.

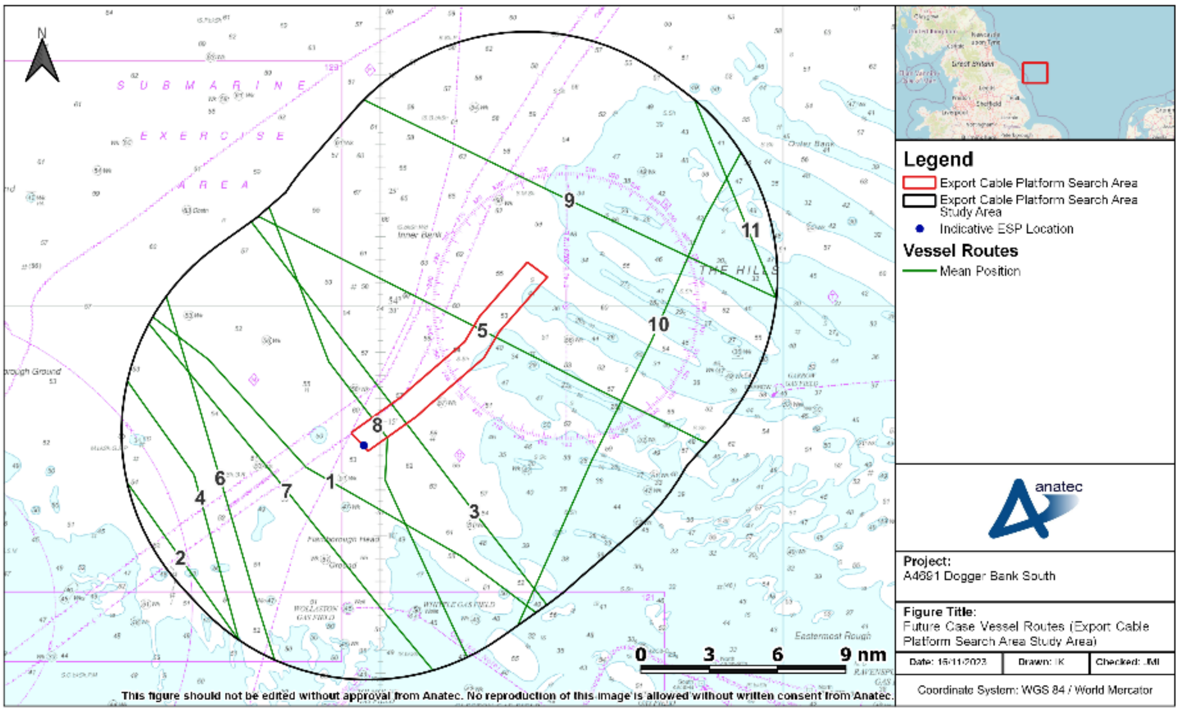

Figure 15-2 Future Case Main Commercial Routes (Export Cable Platform Search Area)

391. Deviations from the pre wind farm scenario would be required for two out of the eleven main commercial routes identified. For the displaced routes, the increase in distance from the pre wind farm scenario is presented in **Table 15-2**.

Table 15-2 Summary of Post Wind Farm Main Commercial Deviations within the Export Cable Platform Search Area Study Area

Route Number	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)	Nature of Deviation
1	0.2	<0.1	Passing slightly further west of the ESP.
8	0.1	<0.1	Passing east of the ESP.

15.5 Commercial Traffic Routeing (Cumulative)

392. An illustration of the anticipated worst case shift in the mean positions of the main commercial routes that are likely to deviate within the DBS Array Areas study area following the development of the Projects, Tier 1, and Tier 2 cumulative developments is presented in **Figure 15-3**. Again, these deviations are based on Anatec's assessment of the MDS and follow the same methodology outlined for deviations due to the Projects in isolation (see section 15.4.1).

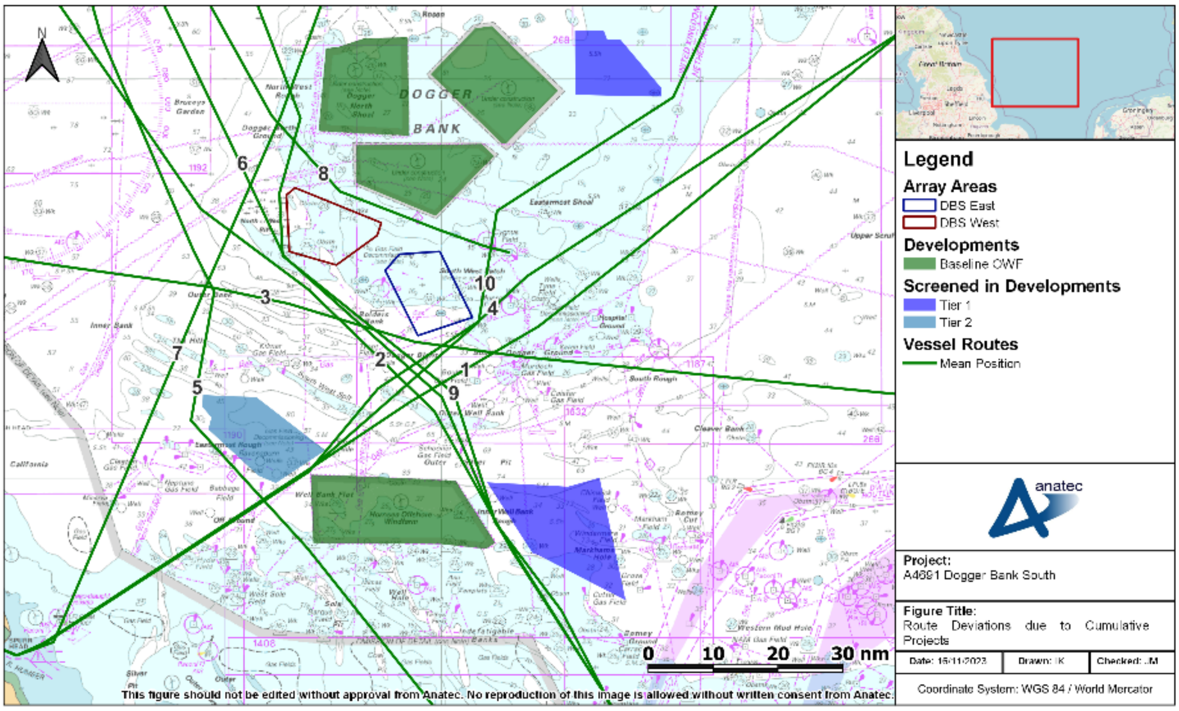

Figure 15-3 Route Deviations due to Cumulative Projects

393. Based on the cumulative screening, cumulative deviations from the pre wind farm scenario would be required for seven out of the 10 main commercial routes identified, with the level of deviation varying from 0.1nm for Route 3 to 7.3nm for Route 9. For the displaced routes, the increase in distance from the pre wind farm scenario is presented in **Table 15-3.**

Table 15-3 Summary of Post Wind Farm Main Commercial Deviations

Route Number	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)	Nature of Deviation
2	0.6	0.2	Passing through the navigation corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three.
3	0.1	<0.1	Passing south of the DBS East Array Area.
4	0.7	0.2	Passing slightly further east of the DBS East Array Area and through the navigation corridor between Hornsea Project Two and Hornsea Four.
5	4.7	0.7	Passing west of Hornsea Four.
6	2.1	0.6	Passing west of the DBS West Array Area and through the navigation corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three.
9	7.3	0.6	Passing west of the DBS West Array Area and through the navigation corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three.
10	6.5	1.6	Passing south and east of the DBS East Array Area, through the navigation corridor between Hornsea Project Two and Hornsea Four, and east of Dogger Bank C.

394. It is noted that the deviations associated with Routes 2 and 5 are due to the presence of the cumulative developments only, i.e., the presence of the Projects does not affect these routes.

16 Collision and Allision Risk Modelling

16.1 Overview

395. To inform the risk assessment, a quantitative assessment of some of the major hazards associated with the Projects has been undertaken. The following subsections outline the inputs and methodology used for the collision and allision risk modelling.

16.1.1 Scenarios Under Consideration

396. For each element of the quantitative assessment, both a pre and post wind farm scenario with base and future case traffic levels have been considered. As a result, six distinct scenarios have been modelled:

- Pre wind farm with base case traffic levels;
- Pre wind farm future case with a 10% increase on base case traffic levels;
- Pre wind farm future case with a 20% increase on base case traffic levels;
- Post wind farm with base case traffic levels;
- Post wind farm future case with a 10% increase on base case traffic levels; and
- Post wind farm future case with a 20% increase on base case traffic levels.

397. The results of the base case scenarios are detailed in full in the following subsections, with the equivalent results for each future case scenario provided in section 16.2.2.

16.1.2 Hazards Under Consideration

398. Hazards considered in the quantitative assessment are as follows:

- Increased vessel to vessel collision risk;
- Increased powered vessel to structure allision risk;
- Increased drifting vessel to structure allision risk; and
- Increased fishing vessel to structure allision risk.

399. The pre wind farm assessment has been informed by the vessel traffic survey data (see section 10) and other baseline data sources (such as Anatec's ShipRoutes database). Conservative assumptions have been made with regard to route deviations and future shipping growth over the lifetime of the Projects.

16.2 Array Areas

16.2.1 Pre Wind Farm Modelling

16.2.1.1 Vessel to Vessel Encounters

400. An assessment of current vessel to vessel encounters has been undertaken by replaying at high speed the vessel traffic data collected as part of the vessel traffic surveys (see section 5.2). The model defines an encounter as two vessels passing within 1nm of each other within the same minute. This helps to illustrate where existing shipping congestion is highest and therefore where offshore developments, such as an offshore wind farm, could potentially increase congestion and therefore also increase the risk of encounters and collisions. No account of whether encounters are head on or stern to head are given; only close proximity is identified for.

401. **Figure 16-1** presents a heat map based upon the geographical distribution of vessel encounter tracks within a density grid for the DBS array study areas. Following this, **Figure 16-2** illustrates the daily number of encounters recorded within the DBS East study area throughout the survey periods, with **Figure 16-3** presenting the encounters recorded for the DBS West study area.

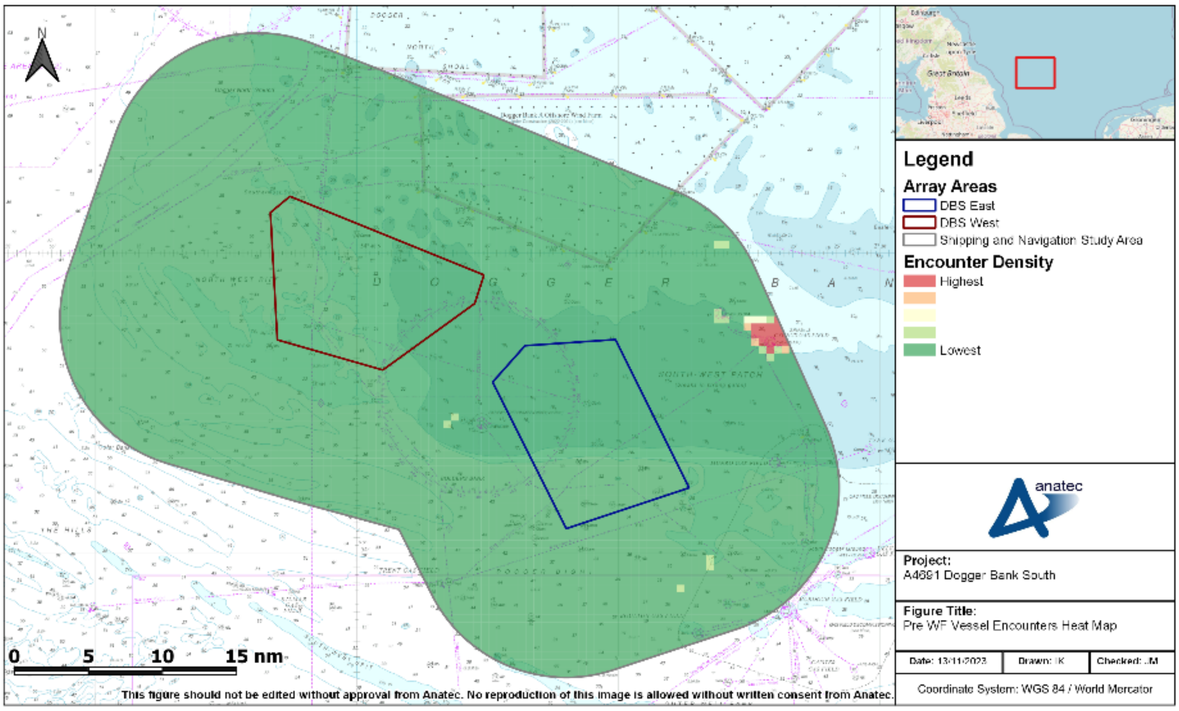

Figure 16-1 Post Wind Farm Vessel Encounters Heat Map (DBS Array Areas)

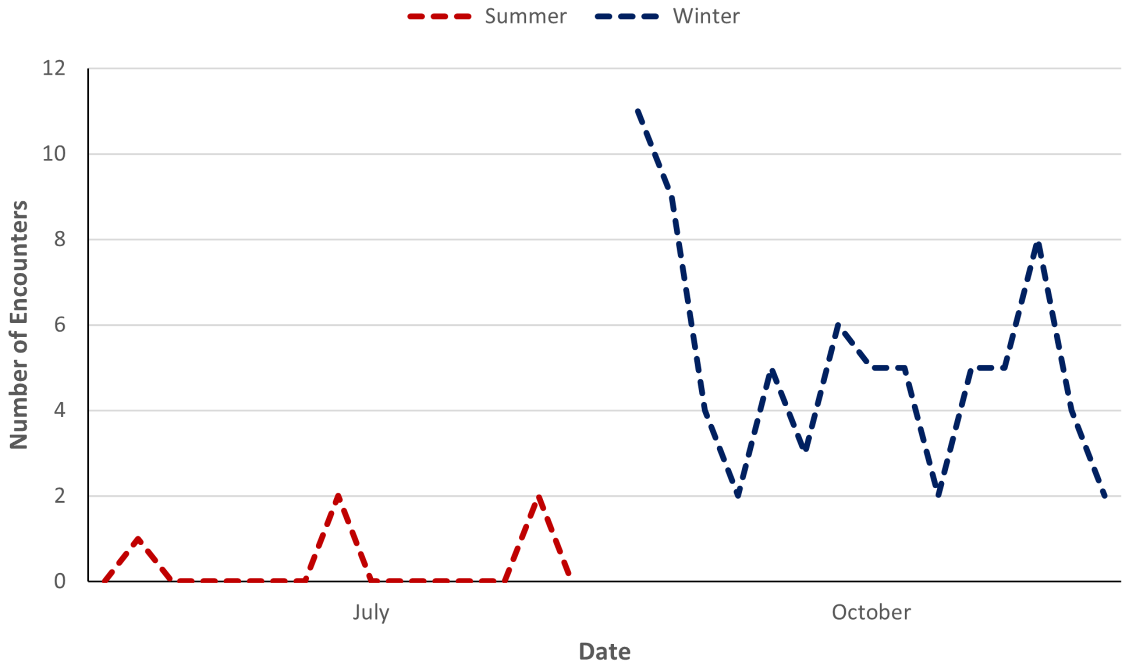

Figure 16-2 Vessel Encounters (DBS East Study Area)

402. There was an average of three encounters per day within the DBS East study area throughout the survey periods, noting that this was skewed towards the winter survey period. The greatest number of encounters recorded in one day was 11, on 16 October 2022. Encounter numbers were high during winter due to the presence of oil and gas traffic in the area.

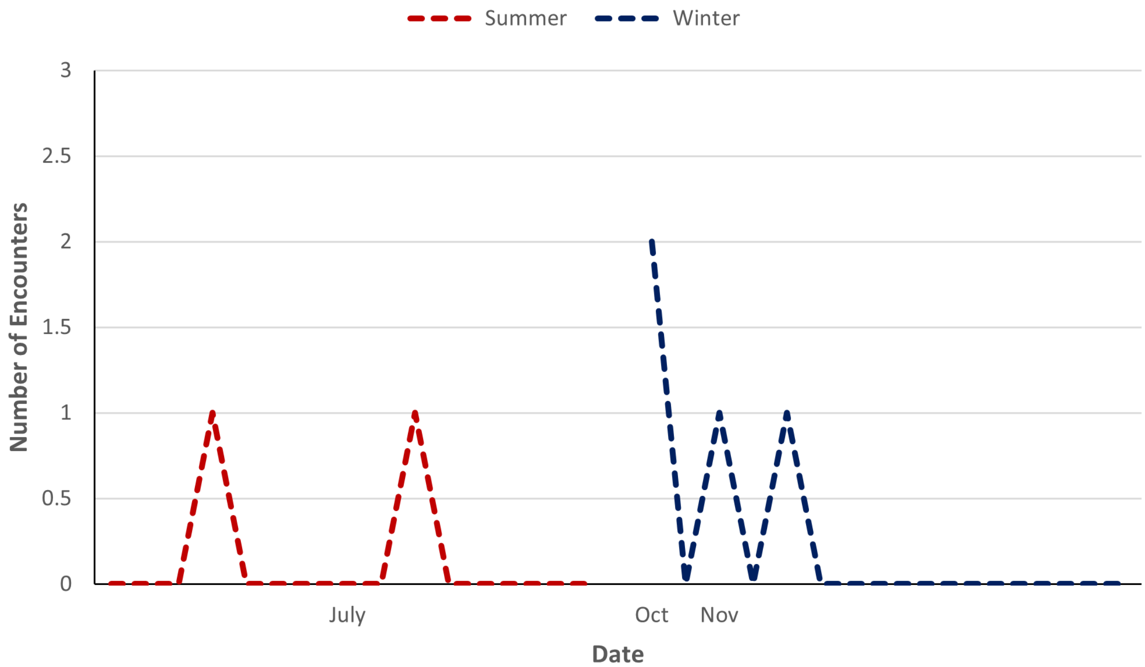

Figure 16-3 Vessel Encounters (DBS West Study Area)

403. There was an average of one encounter every five days within the DBS West study area throughout the survey periods. The greatest number of encounters recorded in one day was two, on 30th October 2022. Encounter volumes are low relative to other assessments due to relatively low traffic volumes.

16.2.1.2 Vessel to Vessel Collision Risk

404. Using the pre wind farm vessel routeing as input, Anatec's COLLRISK model has been run to estimate the existing vessel to vessel collision risk within the study area. The route positions and widths are based on the vessel traffic survey data.

405. A heat map based upon the geographical distribution of collision risk within a density grid for the pre wind farm base case is presented in **Figure 16-4.**

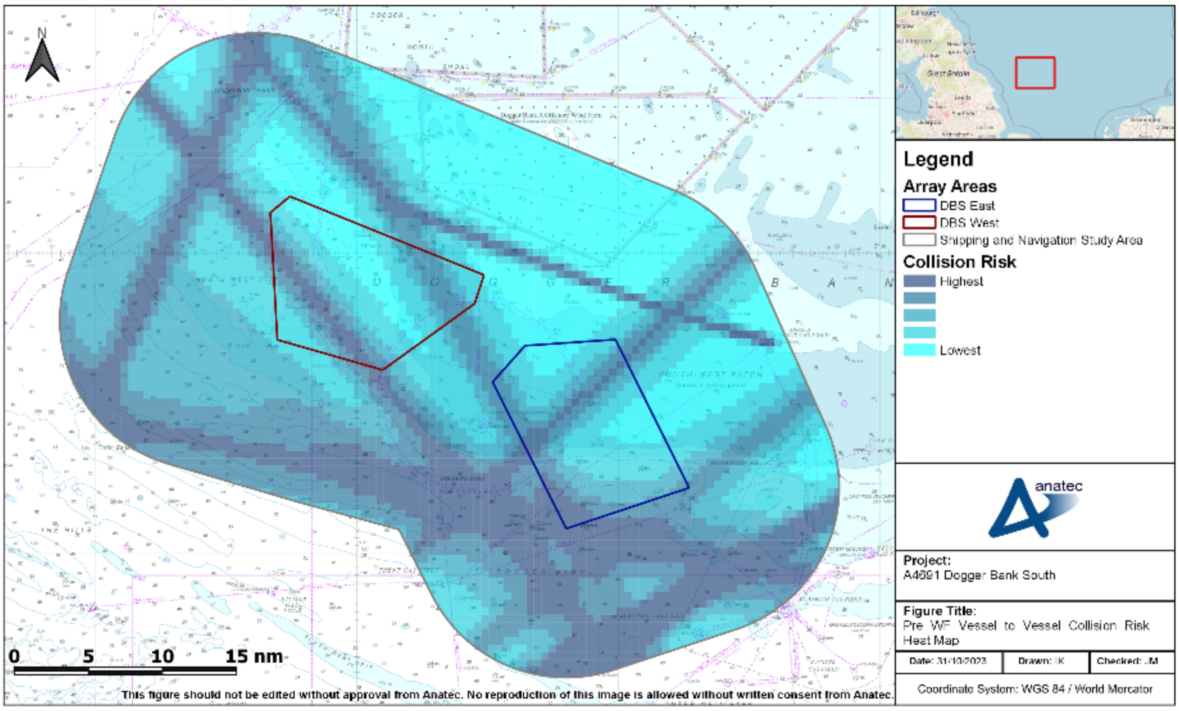

Figure 16-4 Pre Wind Farm Vessel to Vessel Collision Risk Heat Map (DBS Array Areas)

406. Assuming base case vessel traffic levels, the annual collision frequency pre wind farm was estimated to be 1.23×10^{-4}, corresponding to a return period of approximately one in 8,104 years. This is below the average for UK offshore wind farm developments and is reflective of the low traffic volumes, minimal commercial activity, and relatively large area covered by the study area. It is noted that the model is calibrated based upon major incident data at sea which allows for benchmarking but does not cover all incidents. Other incident data, which includes minor incidents, is presented in section 10.

16.2.2 Post Wind Farm Modelling

407. The methodology for determining the post wind farm routeing is outlined in section 15.

16.2.2.1 Simulated Automatic Identification System

408. Anatec's AIS Simulator software was used to gain an insight into the potential re-routed commercial traffic following the installation of the wind farm structures within the DBS Array Areas. The AIS Simulator uses the mean positions of the main commercial routes identified within the study area and the anticipated shift post wind farm, together with the standard deviations and average number of vessels on each main commercial route to simulate tracks.

409. A figure of 56 days of simulated AIS (matching the total duration of the vessel traffic surveys) within the study area, based on the deviated main commercial routes, is presented in **Figure 16-5**.

410. It is noted that the simulated AIS represents an MDS based on commercial routes passing at a minimum mean distance of 1nm from the DBS Array Areas.

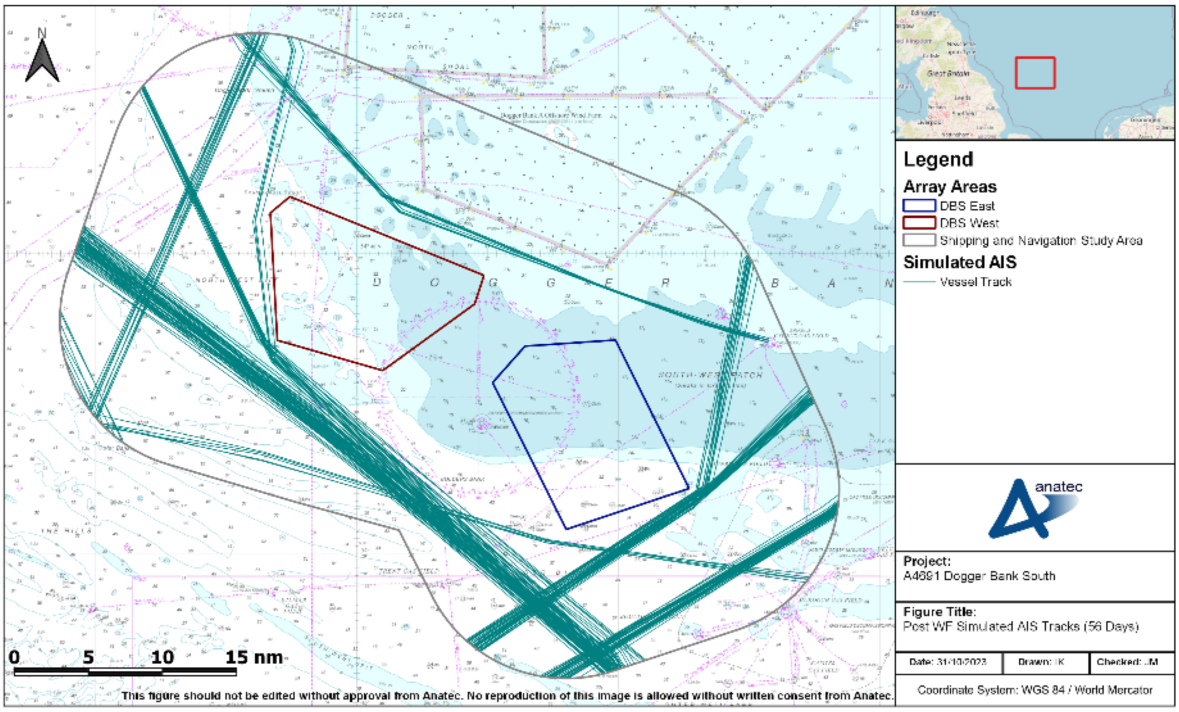

Figure 16-5 Post Wind Farm Simulated AIS Tracks (56 Days, DBS Array Areas)

16.2.2.2 Vessel to Vessel Collision Risk

411. Using the post wind farm routeing as input, Anatec's COLLRISK model has been run to estimate the anticipated vessel to vessel collision risk within the study area.

412. A heat map based on the geographical distribution of collision risk within a density grid for post wind farm base case is presented in **Figure 16-6**.

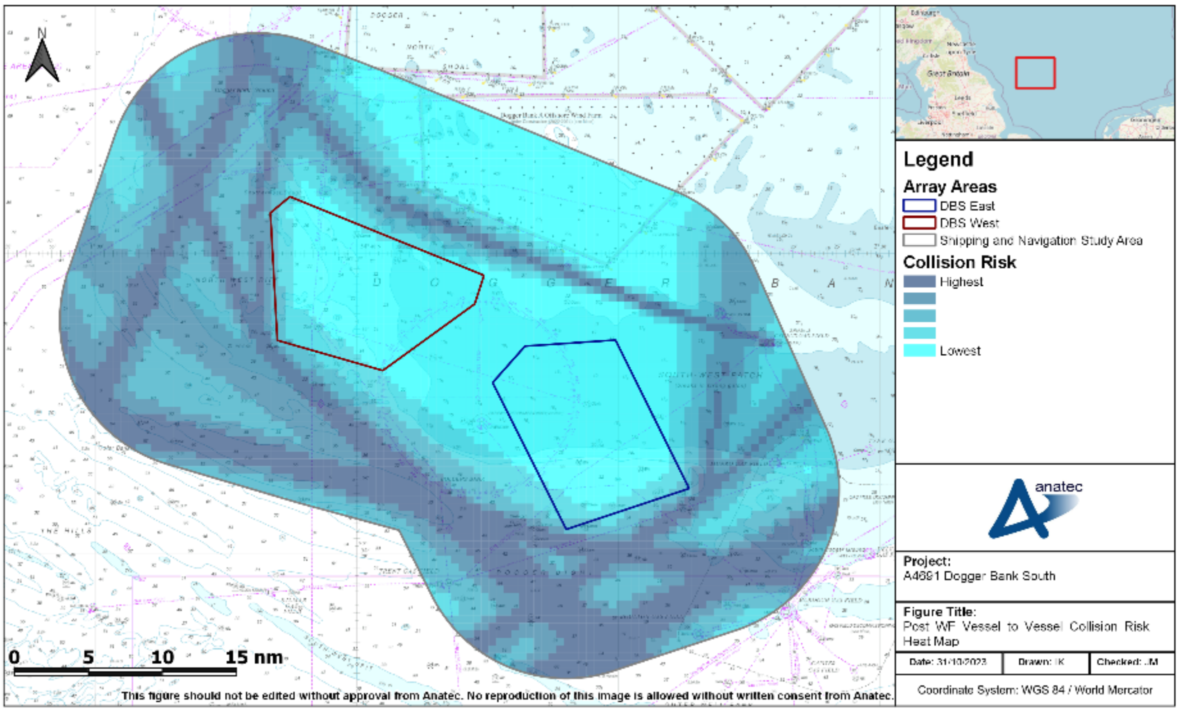

Figure 16-6 Post Wind Farm Vessel to Vessel Collision Risk Heat Map (DBS Array Areas)

413. Assuming base case traffic levels, the annual collision frequency post wind farm was estimated to be 1.79×10^{-4}, corresponding to a return period of approximately one in 5,593 years. This represents a 45% increase in collision frequency compared to the pre wind farm base case result.

414. The change in vessel-to-vessel collision risk between the base case pre wind farm and post wind farm scenarios is presented in a heat map in **Figure 16-7**.

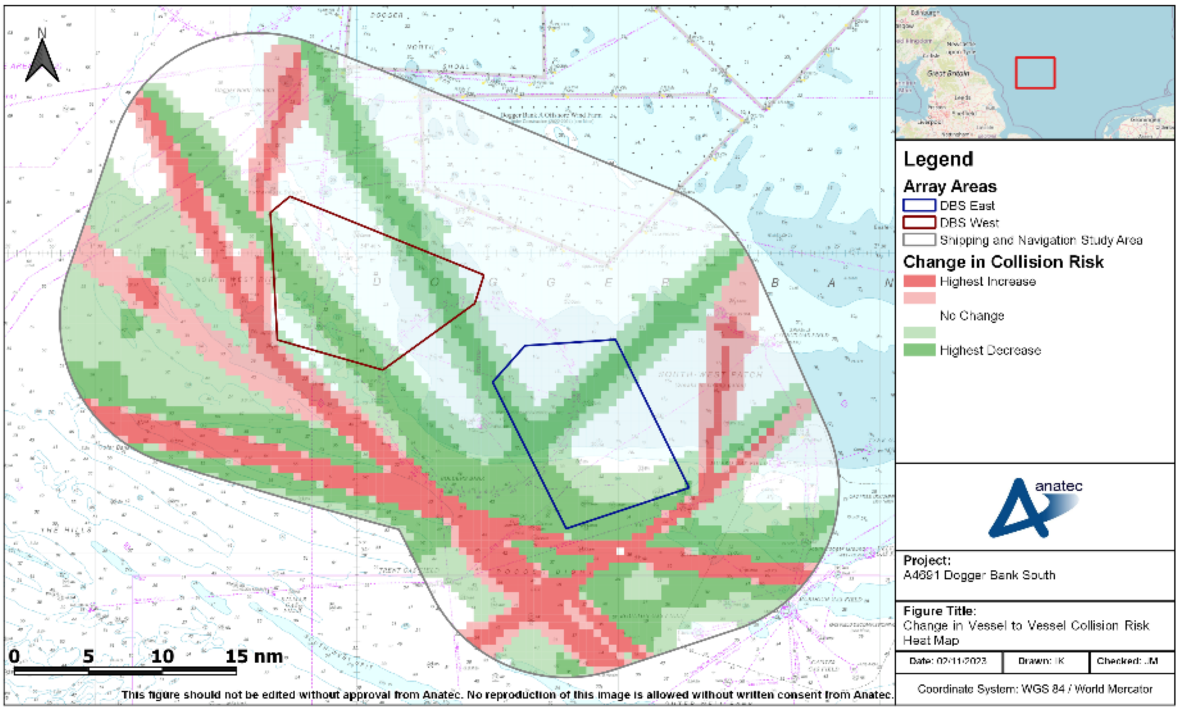

Figure 16-7 Change in Vessel to Vessel Collision Risk Heat Map (DBS Array Areas)

16.2.2.3 Powered Vessel to Structure Allision Risk

415. Based upon the vessel routeing identified in the routeing study area, the anticipated re-routeing as a result of the presence of the Projects, and assumptions that relevant embedded mitigation measures are in place (see section 20), the frequency of an errant vessel under power deviating from its route to the extent that it came into proximity with a wind farm structure associated with the Projects is considered to be low.

416. From consultation with the shipping industry, it is also assumed that commercial vessels would be highly unlikely to navigate between wind farm structures due to the restricted sea room and will instead be directed by the aids to navigation located in the region and those present at the Projects. During the construction and decommissioning phases this will primarily consist of the buoyed construction area whilst during the operations and maintenance phase this will primarily consist of the lighting and marking of the wind farm structures.

417. Using the post wind farm routeing as input, together with the worst case indicative array layout and local metocean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within the DBS Array Areas whilst under power. In order to maintain an MDS, the model did not consider one structure shielding another.

418. A plot of the annual powered allision frequency per structure for the base case is presented in **Figure 16-8**, with the chart background removed to increase the visibility of those structures with lower allision frequencies.

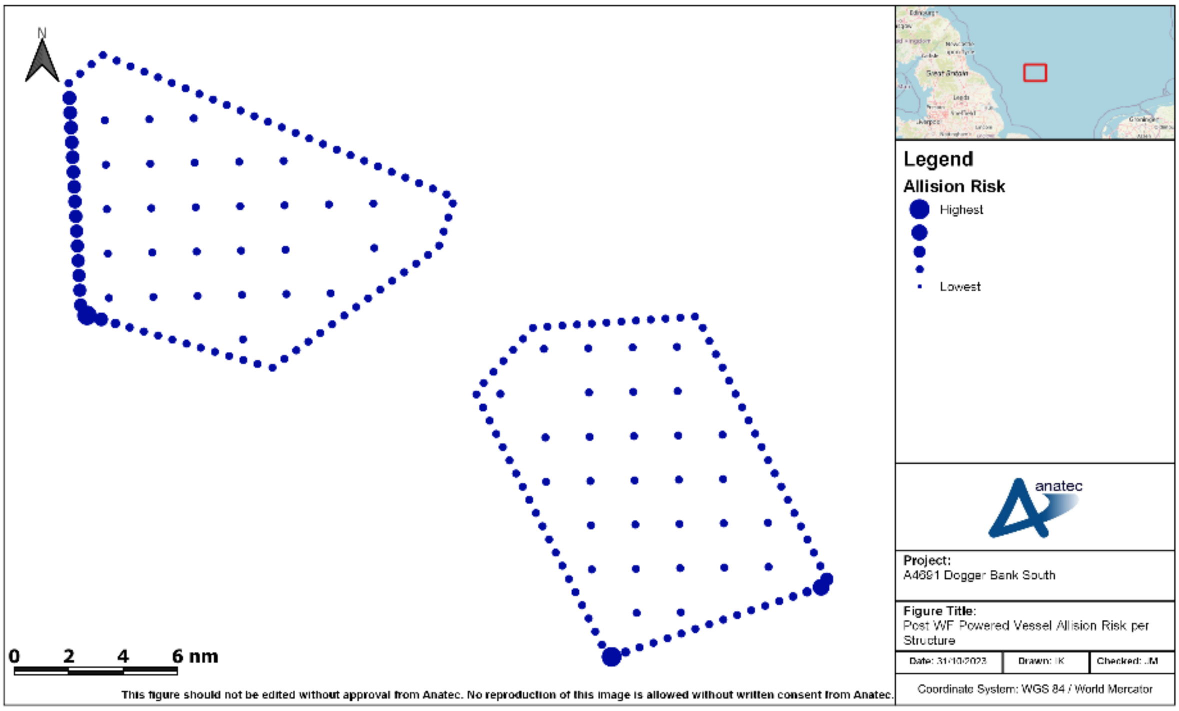

Figure 16-8 Post Wind Farm Vessel Allision Risk per Structure

419. Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 4.11×10^{-5}, corresponding to a return period of approximately one in 24,315 years.

420. The greatest powered vessel to structure allision risk was associated with structures at the western extent of the DBS West Array Area where a high volume of traffic from multiple main commercial routes pass in proximity to the platforms on the corner. The greatest individual allision risk was associated with the south-western structure of the DBS East Array Area (approximately 5.68×10^{-6} or one in 176,122 years).

16.2.2.4 Drifting Vessel to Structure Allision Risk

421. Using the post wind farm routeing as input, together with the worst case indicative array layout and local metocean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within the DBS Array Areas. The model is based on the premise that propulsion on a vessel must fail before drifting will occur. The model takes account of the type and size of the vessel, the number of engines and the average time required to repair but does not consider navigational errors caused by human actions.

422. The exposure times for a drifting scenario are based upon the vessel hours spent in proximity to the DBS Array Areas (up to 10nm from the DBS Array Areas). These have been estimated based on the vessel traffic levels, speeds, and revised routeing patterns. The exposure is divided by vessel type and size to ensure that these specific factors, which based upon analysis of historical incident data have been shown to influence incident rates, are taken into account for the modelling.

423. Using this information, the overall rate of mechanical failure in proximity to the DBS Array Areas was estimated. The probability of a vessel drifting towards a wind farm structure and the drift speed are dependent on the prevailing wind, wave, and tidal conditions at the time of the incident. Therefore, three drift scenarios were modelled, each using the metocean data provided in section 8:

- Wind;
- Peak spring flood tide; and
- Peak spring ebb tide.

424. After modelling the three drifting scenarios it was established that the wind dominated scenario produced the worst case results. A plot of the annual drifting allision frequency per structure for the base case is presented in **Figure 16-9**, with the chart background removed to increase the visibility of those structures with a low allision frequency.

425. It is noted that the probability of vessel recovery from drift is estimated based upon the speed of the drift and hence the time available before arriving at a wind farm structure. Vessels which do not recover within this time are assumed to allide. Conservatively, no account is made for another vessel (including a project vessel) rendering assistance.

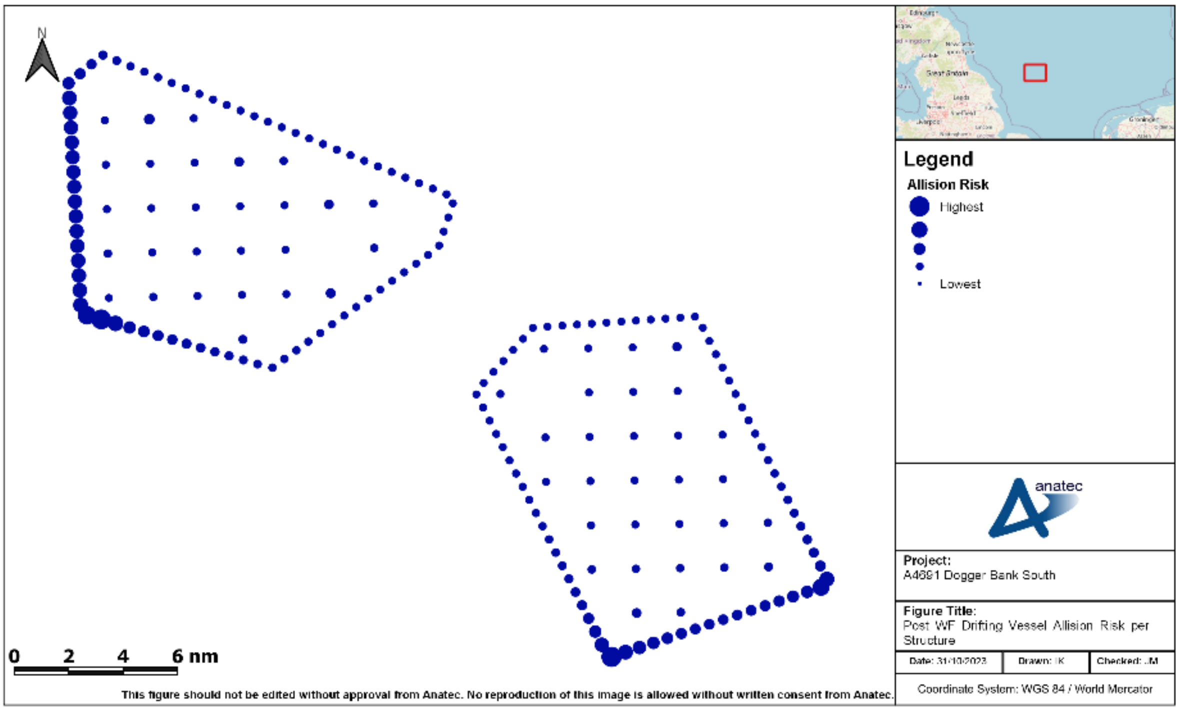

Figure 16-9 Post Wind Farm Drifting Vessel Allision Risk per Structure

426. Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 5.34×10^{-5}, corresponding to a return period of approximately one in 18,742 years.

427. The greatest drifting vessel to structure allision risk was associated with structures at the south-western extent of the DBS East and the west-facing boundary of DBS West Array Areas where a high volume of traffic from multiple main commercial routes pass in proximity to the platforms on the corner. The greatest individual allision risk was associated with the southernmost structure of the DBS East Array Area (approximately 4.04×10^{-6} or one in 247,325 years).

428. It is noted that historically there have been no reported drifting allision Incidents with wind farm structures in the UK. Whilst drifting vessel scenarios do occur every year in UK waters, in most cases the vessel has been recovered prior to any allision incident occurring (such as by anchoring, restarting engines, or being taken in tow).

16.2.2.5 Fishing Vessel to Structure Allision Risk

429. Using the vessel traffic survey data as input, Anatec's COLLRISK model was run to estimate the likelihood of a fishing vessel alliding with one of the wind farm structures within the DBS Array Areas.

430. A fishing vessel allision is classified separately from other allisions since fishing vessels may be either in transit or actively fishing within the DBS Array Areas (unlike the transiting commercial traffic characterised by the main commercial routes).

Additionally, fishing vessels could be observed internally within the DBS Array Areas (i.e., between structures) as well as externally. Anatec's model uses vessel numbers, sizes (length and beam), array layout and structure dimensions. The likelihood of a major allision incident has been calibrated against historical maritime incident data and historical AIS vessel traffic data within operational wind farm arrays. Given that not all fishing vessels broadcast on AIS, the vessel density observed is scaled up to account for non-AIS fishing vessels, with the scaling factor dependent on the distance of the arrays offshore.

431. The model conservatively assumes no change in baseline fishing activity i.e., no account is made of vessels passing over or in close proximity to structure locations choosing to increase passing distance post wind farm.

432. A plot of the annual fishing vessel allision frequency per structure for the base case is presented in **Figure 16-10**.

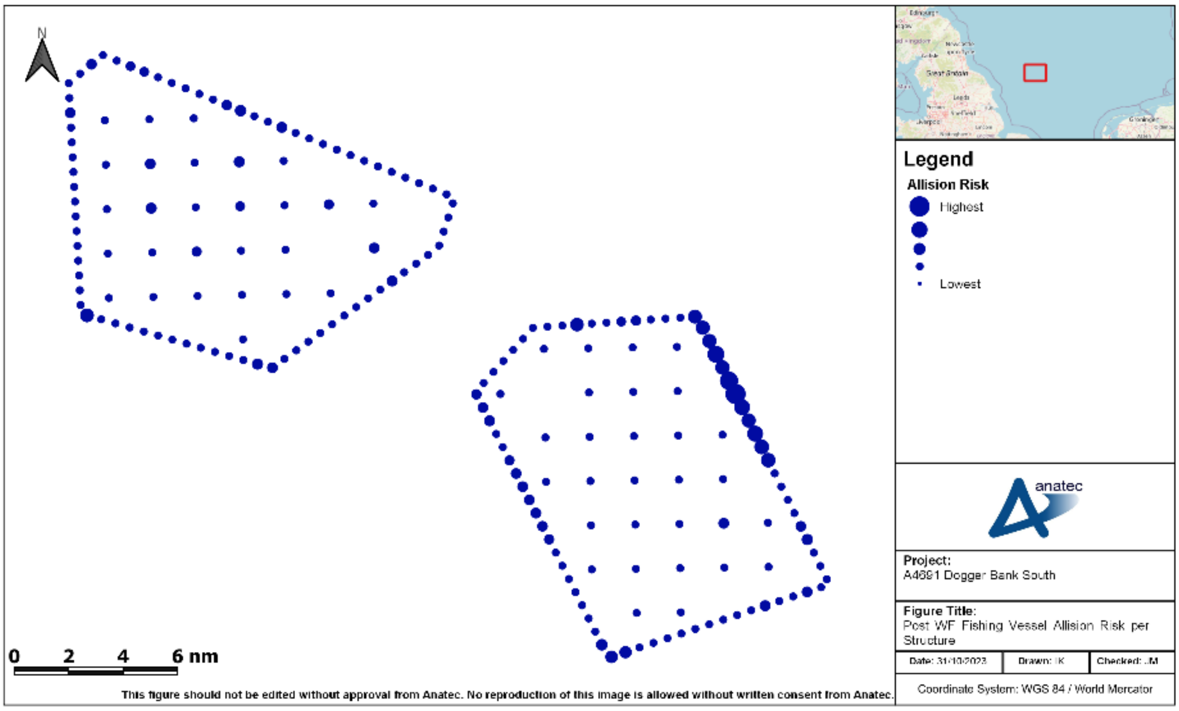

Figure 16-10 Post Wind Farm Fishing Vessel Allision Risk per Structure

433. Assuming base case traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 6.55×10^{-2}, corresponding to a return period of approximately one in 15.3 years.

434. The fishing vessel to structure allision risk was greatest at the north-eastern boundary of the DBS East Array Area, reflective of the fishing activity occurring in the region. The greatest individual allision risk was associated with a wind turbine in this section (approximately 7.41×10^{-3} or one in 135 years).

435. The model is calibrated against known allision incidents within UK wind farms (see section 9.6). Most likely consequences will be a low impact/minor contact with no significant damage, no injuries to persons, and no pollution (in line with incident statistics to date as per section 9.6.1).

16.2.3 Risk Results Summary

436. The previous subsections modelled two scenarios, namely the pre and post wind farm scenarios with base case traffic levels. In order to incorporate the potential for future traffic growth, pre and post wind farm scenarios have also been modelled for future case traffic levels (both 10% and 20% increases). **Table 16-1** summarises the results of all six scenarios for the DBS Array Areas.

437. Overall, the base case collision and allision frequency due to the presence of the Projects was estimated to increase by approximately 6.57×10^{-2} (equating to an additional collision or allision every 15.2 years).

Table 16-1 Summary of Annual Collision and Allision Risk Results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.23×10^{-4} (1 in 8,104 years)	1.79×10^{-4} (1 in 5,593 years)	5.60×10^{-5} (1 in 17,857 years)
	Future case (10%)	1.49×10^{-4} (1 in 6,722 years)	2.16×10^{-4} (1 in 4,628 years)	6.70×10^{-5} (1 in 14,925 years)
	Future case (20%)	1.78×10^{-4} (1 in 5,617 years)	2.57×10^{-4} (1 in 3,887 years)	7.90×10^{-5} (1 in 12,658 years)
Powered vessel to structure allision	Base case	-	4.11×10^{-5} (1 in 24,315 years)	4.11×10^{-5} (1 in 24,315 years)
	Future case (10%)	-	4.58×10^{-5} (1 in 21,842 years)	4.58×10^{-5} (1 in 21,842 years)
	Future case (20%)	-	4.88×10^{-5} (1 in 20,471 years)	4.88×10^{-5} (1 in 20,471 years)
Drifting vessel to structure allision	Base case	-	5.34×10^{-5} (1 in 18,742 years)	5.34×10^{-5} (1 in 18,742 years)
	Future case (10%)	-	5.89×10^{-5} (1 in 16,972 years)	5.89×10^{-5} (1 in 16,972 years)
	Future case (20%)	-	6.39×10^{-5} (1 in 15,658 years)	6.39×10^{-5} (1 in 15,658 years)
Fishing vessel to structure allision	Base case	-	6.55×10^{-2} (1 in 15.3 years)	6.55×10^{-2} (1 in 15.3 years)
	Future case (10%)	-	7.21×10^{-2} (1 in 13.9 years)	7.21×10^{-2} (1 in 13.9 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
	Future case (20%)	-	7.86×10^{-2} (1 in 12.7 years)	7.86×10^{-2} (1 in 12.7 years)
Total	**Base case**	**1.23×10^{-4} (1 in 8,104 years)**	**6.58×10^{-2} (1 in 15.2 years)**	**6.57×10^{-2} (1 in 15.2 years)**
	Future case (10%)	**1.49×10^{-4} (1 in 6,722 years)**	**7.24×10^{-2} (1 in 13.8 years)**	**7.23×10^{-2} (1 in 13.8 years)**
	Future case (20%)	**1.78×10^{-4} (1 in 5,617 years)**	**7.90×10^{-2} (1 in 12.7 years)**	**7.88×10^{-2} (1 in 12.7 years)**

16.3 Export Cable Platform Search Area

16.3.1 Pre Wind Farm Modelling

16.3.1.1 Vessel to Vessel Encounters

438. An assessment of current vessel to vessel encounters within the export cable platform search area study area has been undertaken.

439. **Figure 16-11** presents a heat map based upon the geographical distribution of vessel encounter tracks within a density grid. Following this, **Figure 16-12** illustrates the daily number of encounters recorded within the export cable platform search area study area throughout the survey periods.

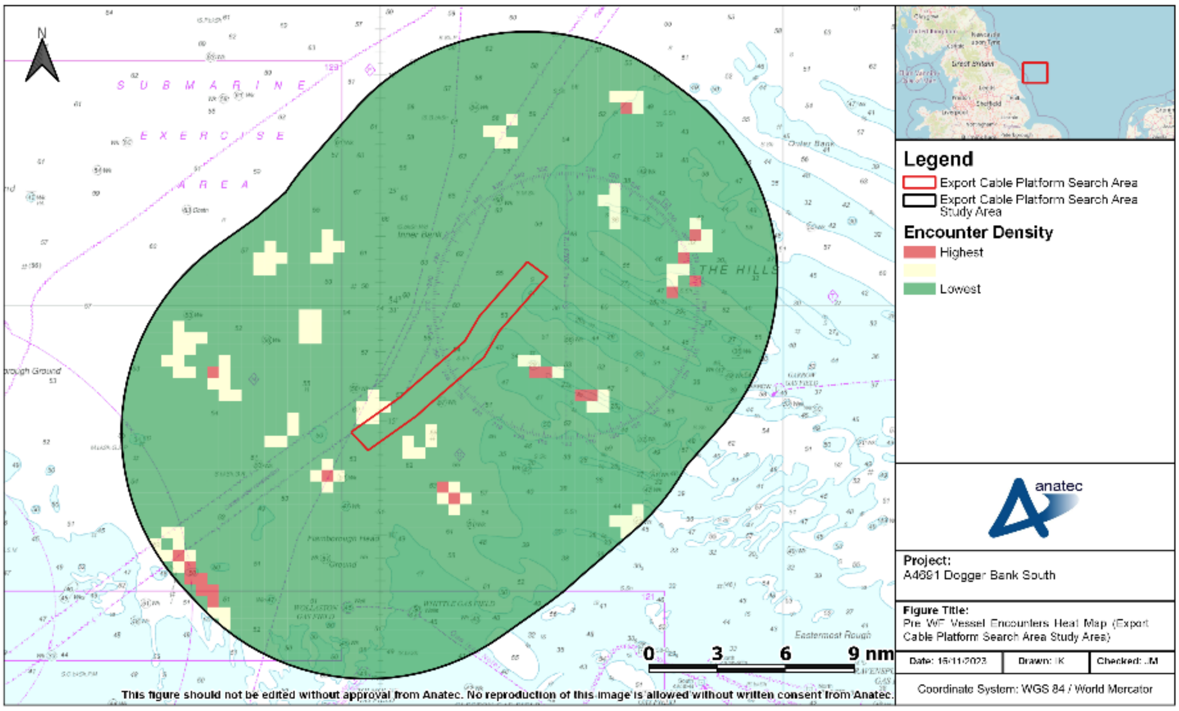

Figure 16-11 Pre Wind Farm Vessel Encounters Heat Map (Export Cable Platform Search Area)

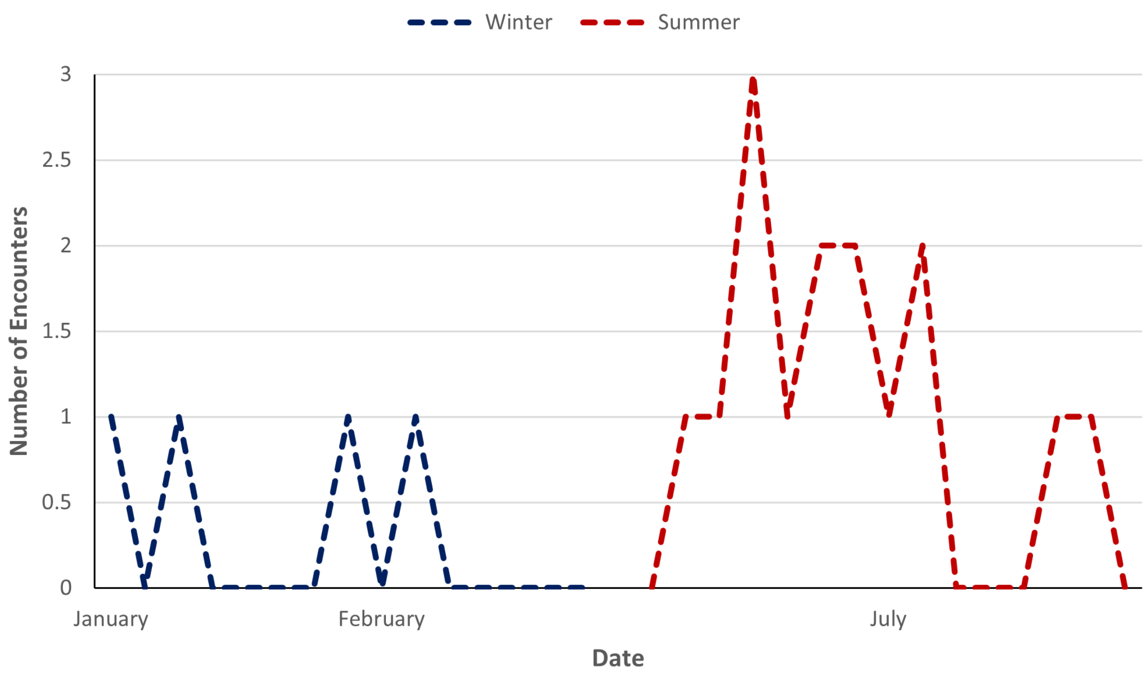

Figure 16-12 Vessel Encounters per Day (Export Cable Platform Search Area)

440. There was on average one encounter every two days within the export cable platform search area study area throughout the survey periods. The greatest number of encounters recorded in one day was three, on 20th July 2023, due to a high number of cargo vessels active in proximity to the export cable platform search area. Encounter volumes are low relative to other assessments due to relatively low traffic volumes.

16.3.1.2 Vessel to Vessel Collision Risk

441. Using the pre wind farm vessel routeing as input, Anatec's COLLRISK model has been run to estimate the existing vessel to vessel collision risk within the export cable platform search area study area. The route positions and widths are based on the vessel traffic survey data.

442. A heat map based upon the geographical distribution of collision risk within a density grid for the pre wind farm base case is presented in **Figure 16-13**.

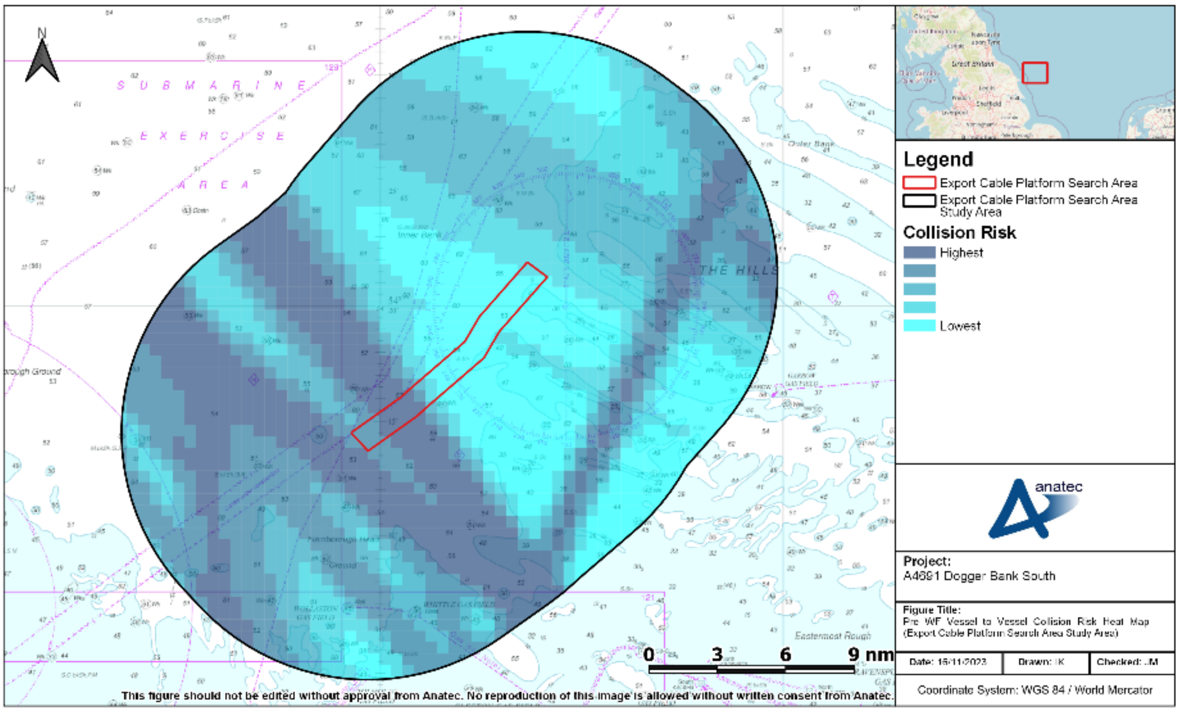

Figure 16-13 Pre Wind Farm Vessel to Vessel Collision Risk Heat Map (Export Cable Platform Search Area)

443. Assuming base case vessel traffic levels, the annual collision frequency pre wind farm was estimated to be 5.84×10^{-4}, corresponding to a return period of approximately one in 1,713 years. This is a relatively average return period for an offshore structure in the North Sea. It is noted that the model is calibrated based upon major incident data at sea which allows for benchmarking but does not cover all incidents.

16.3.2 Post Wind Farm Modelling

16.3.2.1 Simulated Automatic Identification System

444. A figure of 28 days of simulated AIS (matching the total duration of the vessel traffic surveys) within the export cable platform search area study area, based on the deviated main commercial routes, is presented in **Figure 16-14**.

445. It is noted that the simulated AIS represents an MDS based on commercial routes passing at a minimum mean distance of 1nm from the ESP.

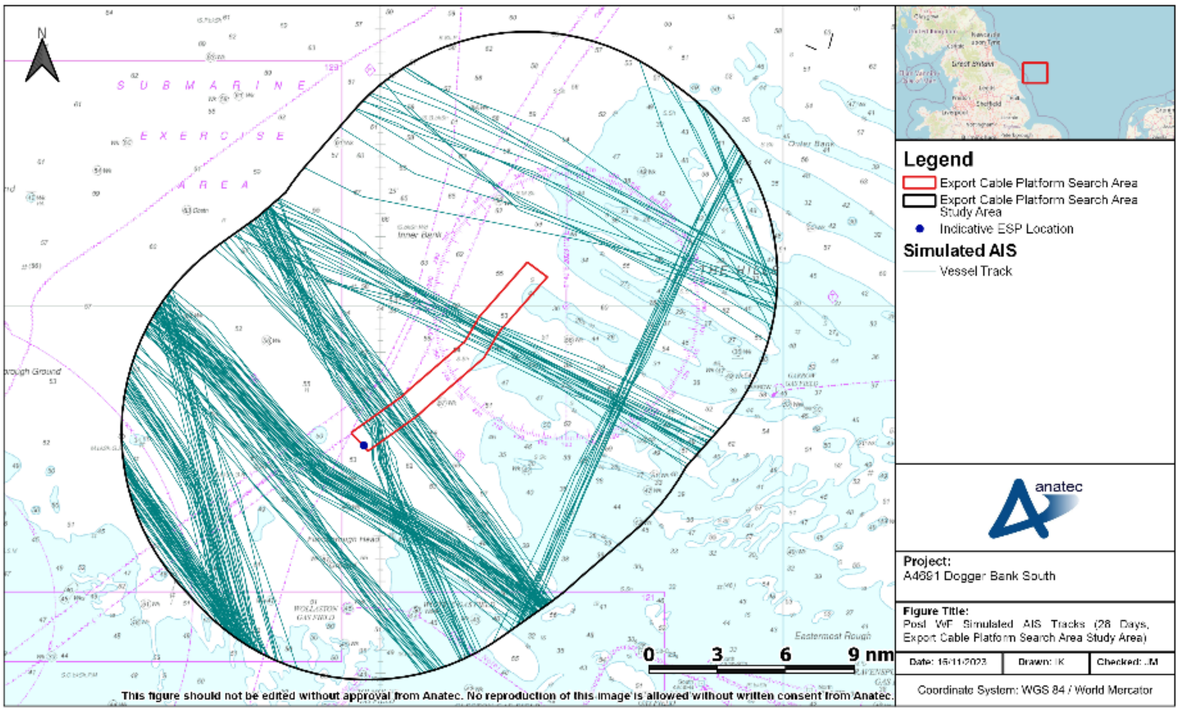

Figure 16-14 Post Wind Farm Simulated AIS Tracks (28 Days, Export Cable Platform Search Area)

16.3.2.2 Vessel to Vessel Collision Risk

446. A heat map based on the geographical distribution of collision risk within a density grid for post wind farm base case in the export cable platform search area study area is presented in **Figure 16-15**.

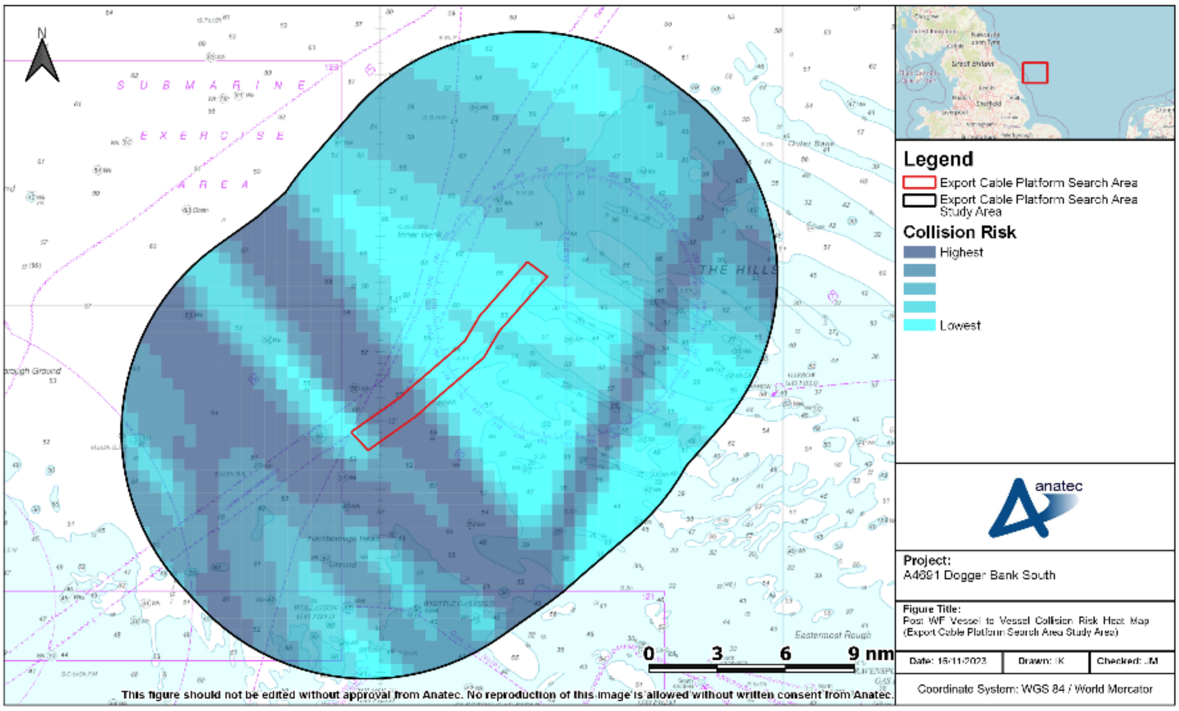

Figure 16-15 Post Wind Farm Vessel to Vessel Collision Risk Heat Map (Export Cable Platform Search Area)

447. Assuming base case traffic levels, the annual collision frequency post wind farm was estimated to be 5.91×10^{-4}, corresponding to a return period of approximately one in 1,693 years. This represents a 1% increase in collision frequency compared to the pre wind farm base case result.

448. The change in vessel-to-vessel collision risk between the base case pre wind farm and post wind farm scenarios is presented in a heat map in **Figure 16-16**. Given that only two main commercial routes require a deviation and the deviations are small (0.1 to 0.2nm), the change in collision risk is local to the areas through which these routes pass.

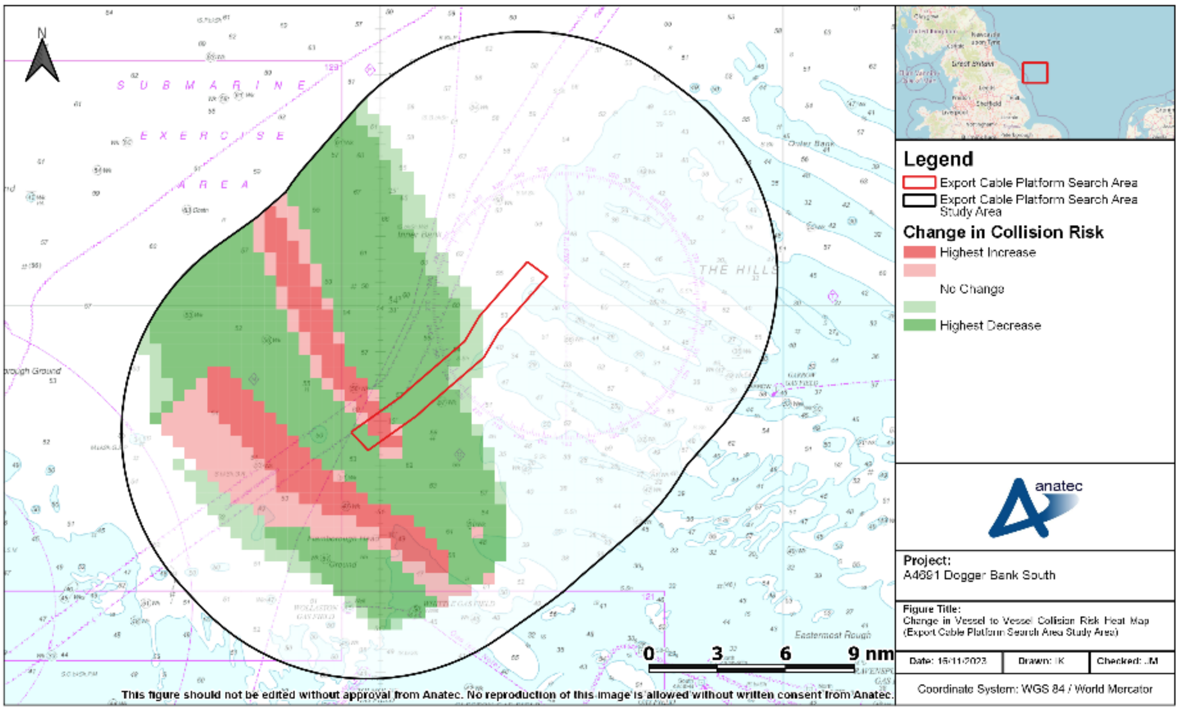

Figure 16-16 Change in Vessel to Vessel Collision Risk Heat Map (Export Cable Platform Search Area)

16.3.2.3 Powered Vessel to Structure Allision Risk

449. Using the post wind farm routeing as input, together with the worst case indicative array layout and local metocean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with the ESP whilst under power.

450. Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 2.56×10^{-4}, corresponding to a return period of approximately one in 3,910 years.

16.3.2.4 Drifting Vessel to Structure Allision Risk

451. Using the post wind farm routeing as input, together with the worst case indicative array layout and local metocean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with the ESP.

452. After modelling the same three drifting scenarios outlined in section 16.2.2.4, it was established that the wind dominated scenario produced the worst case results.

453. Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 9.55×10^{-6}, corresponding to a return period of approximately one in 104,738 years.

16.3.2.5 Fishing Vessel to Structure Allision Risk

454. Using the vessel traffic survey data as input, Anatec's COLLRISK model was run to estimate the likelihood of a fishing vessel alliding with one of the wind farm structures within the DBS Array Areas.

455. Assuming base case traffic levels, the annual fishing vessel to structure allision frequency was negligible. This is due to the negligible levels of fishing vessel activity in proximity to the worst case ESP location.

16.3.3 Risk Results Summary

456. The previous sections modelled two scenarios, namely the pre and post wind farm scenarios with base case traffic levels. In order to incorporate the potential for future traffic growth, pre and post wind farm scenarios have also been modelled for future case traffic levels (both 10% and 20% increases). **Table 16-2** summarises the results of all six scenarios for the export cable platform search area, noting that fishing vessel to structure allision risk has been excluded since the results were negligible.

457. Overall, the base case collision and allision frequency due to the presence of the ESP was estimated to increase by approximately 2.72×10^{-4} (equating to an additional collision or allision every 3,672 years).

Table 16-2 Summary of Annual Collision and Allision Risk Results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	5.84×10^{-4} (1 in 1,713 years)	5.91×10^{-4} (1 in 1,693 years)	7.00×10^{-6} (1 in 142,857 years)
	Future case (10%)	6.52×10^{-4} (1 in 1,534 years)	6.60×10^{-4} (1 in 1,516 years)	8.00×10^{-6} (1 in 125,000 years)
	Future case (20%)	7.87×10^{-4} (1 in 1,271 years)	7.96×10^{-4} (1 in 1,256 years)	9.00×10^{-6} (1 in 111,111 years)
Powered vessel to structure allision	Base case	-	2.56×10^{-4} (1 in 3,910 years)	2.56×10^{-4} (1 in 3,910 years)
	Future case (10%)	-	2.82×10^{-4} (1 in 3,541 years)	2.82×10^{-4} (1 in 3,541 years)
	Future case (20%)	-	3.08×10^{-4} (1 in 3,246 years)	3.08×10^{-4} (1 in 3,246 years)
Drifting vessel to structure allision	Base case	-	9.55×10^{-6} (1 in 104,738 years)	9.55×10^{-6} (1 in 104,738 years)
	Future case (10%)	-	1.05×10^{-5} (1 in 94,863 years)	1.05×10^{-5} (1 in 94,863 years)
	Future case (20%)	-	1.15×10^{-5} (1 in 86,977 years	1.15×10^{-5} (1 in 86,977 years

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Total	Base case	5.84×10^{-4} (1 in 1,713 years)	8.56×10^{-4} (1 in 1,168 years)	2.72×10^{-4} (1 in 3,672 years)
	Future case (10%)	6.52×10^{-4} (1 in 1,534 years)	9.53×10^{-4} (1 in 1,049 years)	3.01×10^{-4} (1 in 3,323 years)
	Future case (20%)	7.87×10^{-4} (1 in 1,271 years)	1.12×10^{-3} (1 in 896 years)	3.29×10^{-4} (1 in 3,044 years)

17 Risk Assessment

17.1 Hazard 1 Vessel Displacement and Increased Vessel to Vessel Collision Risk Between Third-Party Vessels (All Phases)

458. *Activities associated with the installation, maintenance and decommissioning of structures and sub-sea cables as well as the presence of surface structures may displace third-party vessels from their existing routes or activity, increasing the collision risk with other third-party vessels.*

17.1.1 DBS East and DBS West Together – All Users

17.1.1.1 Main Commercial Route Displacement

459. During the construction and decommissioning phases, a buoyed construction/ decommissioning area would be deployed around each DBS Array Area. No restrictions on entry would be enforced for the buoyed construction/decommissioning area or the arrays during the operations and maintenance phase outside of any statutory safety zones. However, based on experience at previously under construction and existing operational offshore wind farms, it is anticipated that commercial vessels would choose not to navigate internally within the buoyed construction/decommissioning area or the operational arrays.

460. Main commercial routes have been identified in line with the principles set out in MGN 654 (MCA, 2021) based primarily on vessel traffic data collected during dedicated surveys (28 days in winter and summer 2022) and Anatec's ShipRoutes database. Further details of the methodology for main commercial route identification are provided in section 15.4.1, noting that the vessel traffic data has been agreed as appropriate by the MCA and Trinity House. As part of the future case considerations, increases in 10% and 20% of all traffic including commercial vessels is assumed.

461. A deviation would be required for all phases of the Projects for five of the main commercial routes, noting that this assumes full build out of the DBS Array Areas (Layout A). The level of deviation varies between an increase of 0.1nm for Route 4 and an increase of 6.8nm for Route 9, with the maximum percentage change in total route length being 1.1% for Route 10. The size of these deviations is small when considered relative to the length of the routes overall, which typically cross the North Sea.

462. The deviated route with the highest vessel traffic was Route 3, with approximately one transit per day, i.e., deviations are expected to be a frequent occurrence. Regular RoRo and RoPax vessels were only recorded on Route 1, which is not expected to require deviation due to the presence of the DBS Array Areas.

463. The most likely consequences of vessel displacement would be increased journey times and distances for affected third-party vessels. The hazard will occur over a local spatial extent given that the buoyed construction/ decommissioning area would be deployed around the maximum extent of the DBS Array Areas.

464. As a worst case, there could be disruption to schedules, particularly for the DFDS Seaways-operated RoRo route. However, given that no deviations are anticipated for this route, and the international nature of routeing in the region alongside the ability to passage plan, disruptions to schedule are expected to be minimal.

17.1.1.2 Collision Risk

465. From historical incident data, no collision incidents between third-party vessels have occurred directly as a result of a UK offshore wind farm.

466. In poor visibility, third-party vessels may experience limitations regarding visual identification of other third-party vessels, either when passing on another side of the buoyed construction/decommissioning areas and operational arrays, or when navigating internally within the operational arrays (small craft only). These limitations may increase the potential for an encounter. However, this would be mitigated by the application of the COLREGs (including reduced speeds) in adverse weather conditions. Moreover, the minimum spacing between structures (830m) will be sufficient to ensure any visual hindrance is very short-term in nature.

467. Based on the pre wind farm modelling, the baseline collision risk levels within the study area are low, with an estimated vessel to vessel collision risk of one every 8,104 years. This is due to the volume of traffic in the area relative to available sea space.

468. Post wind farm, the collision frequency was estimated at one in 5,593 years, representing a 45% increase on the pre wind farm scenario. Although this is a high increase, the likelihood of a collision incident remains low, and is also reflected when considering future case traffic levels.

469. Given the presence of surface infrastructure to both the port and starboard side, it is possible that limitations in available sea room may increase collision risk between the DBS Array Areas, or between the DBS West Array Area and Dogger Bank A. For the gap between the DBS Array Areas, the minimum distance of 4.4nm is considered broadly acceptable[6] and would allow encountering vessels to safely pass each other. Additionally, and noting the presence of Dogger Bank A to the north-east, no main commercial routes are anticipated to use this gap. Therefore, the likelihood of an encounter arising whilst two vessels are transiting through the gap is exceptionally low and stakeholders were in agreement during consultation.

470. For the gap between the DBS West Array Area and Dogger Bank A, there is a consistent width of 4.1nm (conservatively measured from the Dogger Bank A

[6] As per the Shipping Route Template included in MGN 654 (MCA, 2021).

boundary rather than the nearest planned surface structures). Again, this distance is considered broadly acceptable[6]. Unlike for the gap between the DBS Array Areas, it is anticipated that a main commercial route – Route 8 – may use this gap. Therefore, the 20-degree rule provided in MGN 654 has been applied, with the length of the gap[7] measured to be approximately 5.8nm. Under the 20-degree rule, a corridor of this length should achieve a minimum width of 2.1nm and thus the gap is MGN 654 compliant.

471. It is also acknowledged that Route 8 is used only by oil and gas vessels accessing the nearby Cygnus gas field and such vessels will have good familiarity and experience operating in proximity to surface structures.

472. The most likely consequences in the event of an encounter between two or more third-party vessels is the implementation of avoidance action in line with the COLREGs, with the vessels involved able to resume their respective passages with no long-term consequences.

473. Should an encounter develop into a collision incident, it is most likely to involve minor contact resulting in minor damage to the vessels with no harm to people and no substantial reputational risks. As a worst case with very low frequency of occurrence one of the vessels could receive substantial damage or founder with Potential Loss of Life (PLL) and pollution, with this outcome more likely where one of the vessels is a small craft (e.g., fishing vessel, recreational vessel or CTV).

474. It is acknowledged that vessel traffic monitoring will be undertaken throughout the construction phase and the first three years of the operation and maintenance phase to characterise changes to routeing patterns. These will be compared against anticipated deviations to allow a comprehensive review of the embedded mitigation measures applied at the time.

17.1.1.3 Adverse Weather Routeing

475. From the vessel traffic survey data, no instances of alternative routeing due to possible adverse weather were recorded, although from previous experience of the area it has been identified that the DFDS Seaways route between Immingham and Gothenburg does occasionally pass west of the DBS Array Areas during periods of adverse weather. These instances occur a sufficient distance from the DBS Array Areas to assert that disruption due to the presence of the DBS Array Areas will be minimal.

476. The most likely consequences of displacement of adverse weather routeing are similar to that of displacement of standard weather routeing, i.e., increased journey times and distances for affected third-party vessels with the hazard occurring over a

[7] The length of the gap has been measured as the distance over which there are surface structures to both port and starboard for a vessel passing through.

local spatial extent given that the buoyed construction/decommissioning areas and infrastructure will be deployed around the maximum extent of the DBS Array Areas.

477. As a worst case, the deviated route may be considered unsafe for navigation in adverse weather conditions resulting in the vessel being unable to make the transit. It is considered highly unlikely that the vessel would undertake an unsafe transit and therefore risk to the vessel or crew are negligible due to the very low frequency of occurrence.

17.1.1.4 Promulgation of Information and Passage Planning

478. All vessels operating in the area are expected to comply with international flag state regulations (including the COLREGs and SOLAS) and will have a raised level of awareness of construction and decommissioning activities given the promulgation of information relating to the Projects including the charting of the construction/ decommissioning areas on relevant nautical charts and the use of safety zones. The buoyed construction/ decommissioning areas will also serve to maximise awareness. Likewise, during the operations and maintenance phase infrastructure will be appropriately marked on relevant nautical charts and awareness of the operational arrays will be very high and continue to increase with the longevity of the Projects.

479. All vessels are expected to comply with flag state regulations including Regulation 34 of SOLAS Chapter V – which states that "*the voyage plan shall identify a route which… anticipates all known navigational hazards and adverse weather conditions*" (IMO, 1974) – and IMO Resolution A.893(21) on the Guidelines for Voyage Planning (IMO, 1999). The promulgation of information relating to the Projects will assist such passage planning.

17.1.1.5 Small Craft Displacement

480. From the vessel traffic survey data (which incorporates Radar and visual observations in addition to AIS) regular transits by commercial fishing vessels and recreational vessels through the DBS Array Areas are infrequent (noting that displacement of commercial fishing vessels engaged in fishing activity is assessed in **Volume 7, Chapter 13: Commercial Fisheries (application ref: 7.13)**).

481. Based on experience at previously under construction offshore wind farms, it is anticipated that commercial fishing vessels and recreational vessels would choose not to navigate internally within the buoyed construction/ decommissioning areas. Therefore, some displacement of transits by small craft may be required during the construction and decommissioning phases.

482. For the operations and maintenance phase, based on experience at existing operational offshore wind farms, commercial fishing vessels and recreational vessels may choose to navigate internally within the operational arrays, particularly in favourable weather conditions and as awareness of the arrays increases throughout the operations and maintenance phase. The Cruising Association confirmed during

consultation that where the array layout is compact it is more likely that a recreational vessel would pass around altogether. In situations where small craft do navigate internally, the level of displacement is considered negligible.

17.1.1.6 Collision Risk Involving Small Craft

483. From the vessel traffic survey data (which incorporates Radar and visual observations in addition to AIS) regular transits by commercial fishing vessels and recreational vessels through the DBS Array Areas are infrequent.

484. In the event of a collision incident the likelihood of a worst case outcome (the small craft foundering with PLL and pollution) is greater due to the size and likely hull material of the small craft.

17.1.2 DBS East or DBS West in Isolation – All Users

17.1.2.1 DBS East in Isolation

485. Should only DBS East in isolation be developed, this would result both in a greater area of available sea room for routeing commercial vessels, and fewer routes requiring a deviation; four route deviations would be necessary compared to five for DBS East and DBS West together. Therefore, it is expected that both the severity of consequence and frequency of occurrence for this hazard would decrease compared to if both DBS East and DBS West are built together, although would remain in the same risk level as for DBS East and DBS West with consideration of those vessels transiting further west. For example, as Route 6 transits through DBS West only, vessels on this route would not be required to deviate.

17.1.2.2 DBS West in Isolation

486. Should only DBS West in isolation be developed, this would result both in a greater area of available sea room able to be utilised, and fewer routes requiring a deviation; two route deviations would be necessary compared to five for DBS East and DBS West together. Therefore, it is expected that the frequency of occurrence would decrease compared to if both DBS East and DBS West are built together, with the severity of consequence remaining the same risk level as for DBS East and DBS West together but with the frequency of occurrence remote (rather than reasonably probable). The decreases are particularly noticeable in the absence of DBS East with consideration of those vessels transiting further east. For example, as Routes 4 and 10 transit through DBS East only, vessels on this route would not be required to deviate.

17.1.3 Export Cable Platform Search Area – All Users

487. During the construction and decommissioning of the ESP, a safety zone of 500m radius would be deployed around the structure. As with DBS Array Areas, main commercial routes in the vicinity of the export cable platform search area have been

identified from primary vessel traffic data collected during dedicated surveys covering 28 days in winter and summer 2023, as well as Anatec's ShipRoutes database (see section 15.4.1).

488. Deviations will be required for all phases of the Projects for two of the main commercial routes. These include a 0.2nm deviation for Route 1, and a 0.1nm deviation for Route 8. Both the absolute value of deviation, as well as the percentage deviation of the overall route length (less than 0.1% for both) are relatively small and are not expected to materially affect journey times and distances for third-party vessels. However, with one to two transits per day, both routes are frequently operated. Regular RoPax vessels were identified on Route 1, but deviation on this route is expected to be minimal.

489. The most likely consequences of vessel displacement will be increased journey times and distances for affected third-party vessels. The hazard will occur over a local spatial extent given that the safety zone will be implemented around the ESP during construction, major maintenance, and decommissioning.

17.1.4 Significance of Risk

490. The frequency of occurrence, severity of consequence, and resulting significance of risk resulting from vessel displacement and third-party collision risk for each scenario is presented in **Table 17-1**.

Table 17-1 Significance of Risk for Vessel Displacement and Third-Party Collision Risk

Scenario	Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
DBS East and DBS West together	Construction	Displacement with effects on schedule and collision incident occurs with vessel damage, PLL, and/or pollution.	Reasonably Probable	Moderate	**Tolerable with Mitigation**
	Operations and maintenance		Reasonably Probable	Moderate	**Tolerable with Mitigation**
	Decommissioning		Reasonably Probable	Moderate	**Tolerable with Mitigation**
DBS East in isolation	Construction	Displacement with effects on schedule and collision incident occurs with vessel damage, PLL, and/or pollution.	Reasonably Probable	Moderate	**Tolerable with Mitigation**
	Operations and maintenance		Reasonably Probable	Moderate	**Tolerable with Mitigation**
	Decommissioning		Reasonably Probable	Moderate	**Tolerable with Mitigation**
DBS West in isolation	Construction	Displacement with effects on schedule and collision incident	Remote	Moderate	**Tolerable with Mitigation**
	Operations and maintenance		Remote	Moderate	**Tolerable with Mitigation**

Scenario	Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
	Decommissioning	occurs with vessel damage, PLL, and/or pollution.	Remote	Moderate	**Tolerable with Mitigation**
Export cable platform search area	Construction	Displacement with effects on schedule and collision incident occurs with vessel damage, PLL, and/or pollution.	Reasonably Probable	Moderate	**Tolerable with Mitigation**
	Operations and maintenance		Reasonably Probable	Moderate	**Tolerable with Mitigation**
	Decommissioning		Reasonably Probable	Moderate	**Tolerable with Mitigation**

17.1.5 Additional Mitigation Measures and Residual Significance of Risk

491. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Tolerable with Mitigation** for all scenarios.

17.2 Hazard 2 Increased Vessel to Vessel Collision Risk Between a Third-Party Vessel and a Project Vessel (All Phases)

492. *The presence of vessels associated with construction, operations and maintenance, and decommissioning activities may result in increased risk of a collision between a third-party vessel and a project vessel.*

17.2.1 DBS East and DBS West Together – All Users

493. The construction/decommissioning phases may last for up to seven years with up to 11,489 return trips by construction vessels made throughout the construction phase, including vessels Restricted in Ability to Manoeuvre (RAM). It is assumed that construction vessels will be on-site throughout the construction phase. The operations and maintenance phase may last for up to 32 years (for the sequential build out scenario) with up to 473 annual return trips by operations and maintenance vessels made throughout this period.

494. From historical incident data, there has been one instance of a third-party vessel colliding with a project vessel associated with a UK offshore wind farm. In this incident, occurring in 2011, moderate vessel damage was reported with no harm to persons. Since then, awareness of offshore wind farm developments and the application of the measures outlined below has improved or been refined considerably in the interim, with no further collision incidents reported since.

495. Project vessel movements will be managed by the Applicants' marine coordination and any associated procedures implemented will account for those areas where collision risk is assessed as greatest (where regular commercial routeing passes close

to the arrays). Additionally, project vessels will carry AIS and be compliant with Flag State regulations including IMO conventions such as the COLREGs, and information for fishing vessels will be promulgated through ongoing liaison with fishing fleets via an appointed Fisheries Liaison Officer (FLO).

496. Furthermore, an application for safety zones of 500m will be sought during the construction phase. These will serve to protect project vessels engaged in construction activities associated with surface piercing structures. Minimum advisory passing distances, as defined by a risk assessment, may also be applied, with advanced warning and accurate locations of both safety zones and any minimum advisory passing distances provided by Notifications to Mariners and Kingfisher Bulletins.

497. Also, the Projects will exhibit lights, marks, sounds, signals and other aids to navigation as required by Trinity House and MCA, including the buoyed construction/decommissioning area. These navigational aids will further maximise mariner awareness when in proximity, both in day and night conditions including in poor visibility.

498. Third-party vessels may experience restrictions on visually identifying project vessels entering and exiting the array during reduced visibility; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and AIS carriage by project vessels.

499. Should an encounter occur between a third-party vessel and a project vessel, it is likely to be very localised and occur for only a short duration. With collision avoidance action implemented in line with the COLREGs, the vessels involved will likely be able to resume their respective passages and/or activities with no long-term consequences.

500. Should an encounter develop into a collision incident, the most likely consequences would be similar to that outlined for the case of a collision between two third-party vessels. As an unlikely worst case, one of the vessels could founder resulting in PLL and pollution, with this outcome more likely where one of the vessels is a small craft (e.g., fishing vessel, recreational vessel or CTV). If pollution were to occur in proximity to the Projects or involving a project vessel, then pollution planning protocols would be implemented to minimise the environmental risks.

17.2.2 DBS East or DBS West In Isolation – All Users

501. Should only one DBS Array Area in isolation be developed, it would result in fewer project vessels being on-site for all phases, leading to fewer encounter opportunities. Additionally, more sea room would be available for third-party vessels to navigate and maintain a safe passing distance from project vessels. As a result, the likelihood of a collision would be lower than if both sites were to be built together, with the frequency of occurrence remaining negligible.

17.2.3 Export Cable Platform Search Area – All Users

502. As the export cable platform search area would include only a maximum of a single structure, there will be relatively few project vessels required on-site across all three phases. The likelihood of a project vessel encountering a third-party vessel would therefore be low. Additionally, the open sea room in the vicinity of the ESP will allow vessels to safely take avoiding action should an encounter situation arise.

17.2.4 Significance of Risk

503. The frequency of occurrence, severity of consequence, and resulting significance of risk resulting from increased third-party with project vessel collision risk for each scenario is presented in **Table 17-2**.

Table 17-2 Significance of Risk for Increased Third-Party with Project Vessel Collision Risk

Scenario	Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
DBS East and DBS West together	Construction	Collision incident occurs with vessel damage, PLL, and/or pollution.	Negligible	Moderate	**Broadly Acceptable**
	Operations and maintenance		Negligible	Moderate	**Broadly Acceptable**
	Decommissioning		Negligible	Moderate	**Broadly Acceptable**
DBS East or DBS West in isolation	Construction	Collision incident occurs with vessel damage, PLL, and/or pollution.	Negligible	Moderate	**Broadly Acceptable**
	Operations and maintenance		Negligible	Moderate	**Broadly Acceptable**
	Decommissioning		Negligible	Moderate	**Broadly Acceptable**
Export cable platform search area	Construction	Collision incident occurs with vessel damage, PLL, and/or pollution.	Negligible	Moderate	**Broadly Acceptable**
	Operations and maintenance		Negligible	Moderate	**Broadly Acceptable**
	Decommissioning		Negligible	Moderate	**Broadly Acceptable**

17.2.5 Additional Mitigation Measures and Residual Significance of Risk

504. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable** for all scenarios.

17.3 Hazard 3 Creation of Vessel to Structure Allision Risk (Operation and Maintenance Phase)

505. *The presence of surface piercing structures during the operation and maintenance phase may result in the creation of a risk of allision for vessels.*

17.3.1 DBS East and DBS West Together – All Users

506. The main commercial route deviations and future case considerations described for the vessel displacement and collision risk hazard (see Section 17.1) have also been assumed for this hazard, noting that internal navigation by commercial vessels is not anticipated. However, commercial fishing vessels and recreational vessels may choose to navigate internally within the arrays, particularly in favourable weather conditions.

507. The presence of new surface structures introduces new allision risk which can be considered across three forms, all of which are localised in nature given that a vessel must be in close proximity to a structure for an allision incident to occur. These three forms are listed below alongside the indicative array layout considered the worst case for each:

- Powered allision risk – full build out (Layout A);
- Drifting allision risk – full build out (Layout A); and
- Internal allision risk – minimum spacing (Layout B).

17.3.1.1 Powered Allision Risk

508. From historical incident data, there have been two instances of a third-party vessel alliding with an operational wind farm structure in the UK. These incidents both involved a fishing vessel, with an RNLI lifeboat attending on each occasion.

509. Based on the post wind farm modelling, the base case annual powered vessel to structure allision frequency was estimated at one every 24,315 years. This is a low return period compared to that estimated for other UK wind farm developments, and is reflective of the relatively low volume of vessel traffic passing in proximity to the DBS Array Areas. The low return period is also reflected when considering future case traffic levels.

510. Vessels are expected to comply with international flag state regulations (including the COLREGs and SOLAS) and will be able to effectively passage plan a route which minimises risks given the promulgation of information relating to the Projects including the charting of infrastructure on relevant nautical charts and the use of safety zones (for major maintenance). On approach, the operational lighting and marking of the arrays will also assist in maximising marine awareness and project vessels may alert a vessel on a closing approach with a structure as required.

511. Should a powered allision incident occur, the consequences will depend on multiple factors including the energy of the allision, structural integrity of the vessel involved, type of structure contacted, and the sea state at the time of the contact. Small craft including commercial fishing vessels and recreational vessels are considered most vulnerable to the hazard given the size and likely hull material of the small craft.

512. With consideration for lesson learned, the most likely consequences are minor damage with the vessel involved able to resume passage and undertake a full inspection at the next port of call. As a worst case, the vessel could allide with a platform, resulting in foundering with PLL and pollution.

17.3.1.2 Drifting Allision Risk

513. A vessel adrift may only develop into an allision situation if in proximity to a wind farm structure. This is only the case where the adrift vessel is located internally within or in close proximity to the array and the direction of the wind and/or tide directs the vessel towards a structure.

514. Based on the post wind farm modelling, the base case annual drifting vessel to structure allision frequency was estimated at one every 18,742 years. This is again a low return period compared to that estimated for other UK wind farm developments, due to relatively low volume of vessel traffic passing in proximity to the DBS Array Areas. The low return period is also reflected when considering future case traffic levels.

515. Based on historical incident data, there have been no instances of a third-party vessel alliding with an operational wind farm structure whilst Not Under Command (NUC).

516. Should a vessel drift towards a structure, there are outcomes other than an allision incident which are more likely. A powered vessel may regain power prior to reaching the arrays (by rectifying any fault). Failing this, the vessel's emergency response procedures would be implemented – this may include an emergency anchoring event following a check of the relevant nautical charts to ensure the deployment of the anchor will not lead to other hazards (such as anchor snagging on a sub-sea cable or pipeline).

517. Should a drifting allision occur, the consequences will be similar to those noted for the case of a powered allision, including the determining factors. However, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel, thus reducing the allision energy and the likelihood of the worst case consequences arising.

518. The platforms again carry increased allision risk and consequences due to their greater size and resistant force, although this may again be mitigated by effective use of operational lighting and marking in accordance with requirements from Trinity House and MCA.

17.3.1.3 Internal Allision Risk

519. As noted previously, based on experience at existing operational offshore wind farms, it is anticipated that:

- Commercial vessels would choose not to navigate internally within the arrays;
- Fishing vessels may choose to navigate internally within the arrays, particularly in summer months; and
- Recreational vessels are unlikely to choose to navigate internally within the arrays (noting Cruising Association feedback received) with any decision likely to be influenced by the spacing between structures (noting RYA feedback received).

520. Therefore, the likelihood of an internal allision involving a commercial vessel is anticipated to be negligible.

521. Should bridge links be used between platforms then there is an additional allision risk should a vessel choose to navigate under the bridge link and between platforms. Given the maximum separation of 100m between platforms joined by a bridge link it is considered highly unlikely that a vessel would choose to navigate under a bridge link, particularly given the spacing of structures across the arrays as a whole. Additionally, the specific lighting and marking requirements for bridge links will be agreed with Trinity House to ensure that allision risk for vessels (including project vessels and recreational vessels) is minimised.

522. The base case annual fishing vessel to structure allision frequency is at a return period of approximately one in 15.3 years. This return period is reflective of the volume of fishing vessel traffic in the area, both in transit and engaged in fishing activities, and the conservative assumptions made within the modelling process. In particular, it has been assumed that the baseline fishing activity in terms of proximity to wind turbines will not change.

523. A minimum spacing of 830m is considered sufficient for safe internal navigation, allowing vessels to keep clear of the wind farm structures. This spacing is similar to many other consented offshore wind farms in the UK (Dogger Bank A and Dogger Bank B were consented with a minimum spacing of 700m (Forewind, 2013)) and is slightly greater than the minimum spacing at some consented offshore wind farms where evidence suggests that fishing vessels are comfortable operating internally in favourable conditions. Layout plans will be agreed with the MMO post-consent, following appropriate consultation with Trinity House and the MCA, and a safety justification for a SLoO layout will be completed should this be taken forward.

524. As with any passage, any vessel navigating within the array is expected to passage plan in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information including through ongoing liaison with fishing fleets via an appointed FLO will ensure that such vessels have good awareness of any maintenance works being undertaken. This includes the placement of safety zones of 500m radius which

will be applied for around major maintenance activities which itself will assist safe navigation internally within the arrays by guiding vessels on a safe passing distance.

525. The Projects will exhibit lights, marks, sounds, signals and other aids to navigation as required by Trinity House, MCA and Civil Aviation Authority (CAA). This will include unique identification marking of each wind farm structure in an easily understandable pattern to minimise the likelihood of a mariner navigating internally within the array becoming disoriented.

526. Should a recreational vessel under sail enter the proximity of a wind turbine, there is also potential for effects such as wind shear, masking and turbulence to occur. From previous studies of offshore wind developments, it has been concluded that wind turbines do reduce wind velocity downwind of a wind turbine (MCA, 2022) but that no negative effects on recreational craft have been reported on the basis of the limited spatial extent of the risk and its similarity to that experienced when passing a large vessel or close to other large structures (such as bridges) or the coastline. In addition, no practical issues have been raised by recreational users to date when operating in proximity to existing offshore wind developments.

527. For recreational vessels with a mast there is an additional allision risk when navigating internally within the array associated with the wind turbine blades. However, the minimum blade tip clearance is 34m above MSL which is much greater than the minimum 22m clearance above MHWS the RYA recommend for minimising allision risk (RYA, 2019) and which is also noted in MGN 654.

528. Should an internal allision occur, the consequences will be similar to those noted for the case of a powered allision, including the determining factors. However, as with a drifting allision, the speed at which the contact occurs will likely be lower than for an external allision (given that the vessel would knowingly be navigating in an area with allision hazards), resulting in reduced allision energy and a reduced likelihood of the worst case consequences arising.

17.3.2 DBS East or DBS West In Isolation – All Users

529. Allision risk is heavily dependent upon the number of surface piercing structures. Therefore, should only one DBS Array Area in isolation be installed then the likelihood of an allision incident will be reduced. As DBS West has fewer routes passing in close proximity, it is likely that it will have less exposure than DBS East, although the frequency of occurrence would be negligible for both.

17.3.3 Export Cable Platform Search Area – All Users

530. Based on the post wind farm modelling, the base case annual powered vessel to structure allision frequency was estimated at one every 3,910 years. For the base case annual drifting vessel to structure allision this was one every 104,738 years, with fishing vessel to structure internal allision risk being negligible.

531. Again, allision risk is heavily dependent upon the number of surface piercing structures. With the ESP being a single structure, the likelihood of an allision incident may be reduced. However, traffic volumes are generally greater in the region containing the export cable platform search area and a single structure is more exposed than a structure forming part of an array since there is no element of shielding by other structures or external aid to navigation presence in the event of a lighting failure.

532. Similarly to the OCPs, the ESP carries increased allision risk and consequences due to the greater size and resistant force. Embedded mitigation measures applicable to the DBS Array Areas are again relevant, including operational lighting (inclusive of availability standards in line with IALA guidance).

17.3.4 Significance of Risk

533. The frequency of occurrence, severity of consequence, and resulting significance of risk resulting from creation of vessel to structure allision risk for each scenario is presented in **Table 17-3**.

Table 17-3 Significance of Risk for Creation of Vessel to Structure Allision Risk of DBS East and DBS West Together

Scenario	Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
DBS East and DBS West together	Operations and maintenance	Allision incident occurs with a platform with the vessel foundering, PLL, and/or pollution.	Extremely Unlikely	Moderate	**Broadly Acceptable**
DBS East and DBS West in isolation	Operations and maintenance	Allision incident occurs with a platform with the vessel foundering, PLL, and/or pollution.	Negligible	Moderate	**Broadly Acceptable**
Export cable platform search area	Operations and maintenance	Allision incident occurs with a platform with the vessel foundering, PLL, and/or pollution.	Negligible	Serious	**Broadly Acceptable**

17.3.5 Additional Mitigation Measures and Residual Significance of Risk

534. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable** for all scenarios.

17.4 Hazard 4 Reduction of Under-Keel Clearance due to Cable Protection (Operation and Maintenance Phase)

535. *The presence of cable protection associated with the sub-sea cables may result in reductions to water depth and the creation of an under-keel clearance risk for vessels.*

17.4.1 DBS East and West Together – All Users

536. For the array cables the indicative target burial depth is between 0.5 and 1m, and for the inter platform cables and export cables it is between 0.5 and 1.5m. Seabed burial will be the primary means of cable burial and the burial depth of any external cable protection will be determined by the cable burial risk assessment.

537. Where cable burial is not possible, alternative cable protection methods may be deployed which will be determined within the cable burial risk assessment. It is noted that there are up to 40 pipeline crossings anticipated for the array cables, up to six cable crossings and 11 pipeline crossings anticipated for the inter platform cables, and up to six cable crossings and five pipeline crossings anticipated for the offshore export cables. The Applicants intend to follow the guidance contained in MGN 654 in relation to cable protection, namely that cable protection will not change the charted water depth by more than 5%, unless otherwise agreed with the MCA and Trinity House. This aligns with the RYA's recommendation that the "*minimum safe under keel clearance over submerged structures and associated infrastructure should be determined in accordance with the methodology set out in MGN 543 [since superseded by MGN 654]*" (RYA, 2019). With this guidance adhered to, the likelihood of an underwater allision is considered very low.

538. Should this percentage be exceeded, further assessment including consultation with the MCA and Trinity House may be required to determine whether any additional mitigation measures (e.g., post consent lighting and marking, charting, etc.) are necessary to ensure the safety of navigation.

539. Should an underwater allision occur, the consequences may include the grounding of the vessel. Minor damage incurred is the most likely consequence, and foundering of the vessel resulting in a PLL and pollution are the unlikely worst case consequences, with the environmental risks of the latter minimised by the implementation of the pollution planning protocols.

17.4.2 DBS East and DBS West In Isolation – All Users

540. Under keel clearance risk is heavily dependent upon the number of cables installed and cable burial method used. Therefore, should only one DBS Array Area in isolation be installed, then the likelihood of an incident relating to reduced under-keel clearance will be reduced. However, it is acknowledged that the sub-sea footprint within the Offshore Export Cable Corridor may not change substantially and so the lower likelihood of an incident relating to under keel clearance may be applicable to

the array cables only and the frequency of occurrence therefore remains extremely unlikely.

17.4.3 Export Cable Platform Search Area – All Users

541. Since there are no sub-sea cables associated with the export cable platform search area (any sub-sea cables within this area will be export cables which are considered above), this hazard does not apply in this circumstance.

17.4.4 Significance of Risk

542. The frequency of occurrence, severity of consequence, and resulting significance of risk resulting from reduction of under-keel clearance for each scenario is presented in **Table 17-4**.

Table 17-4 Significance of Risk for Reduction of Under-Keel Clearance

Scenario	Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
DBS East and DBS West together	Operations and maintenance	Grounding incident occurs with the vessel foundering, PLL, and/or pollution.	Extremely Unlikely	Minor	**Broadly Acceptable**
DBS East and DBS West in isolation	Operations and maintenance	Grounding incident occurs with the vessel foundering, PLL, and/or pollution.	Extremely Unlikely	Minor	**Broadly Acceptable**

17.4.5 Additional Mitigation Measures and Residual Significance of Risk

543. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable** for all scenarios.

17.5 Hazard 5 Anchor Interaction with Sub-sea Cables (Operation and Maintenance Phase)

544. *The presence of export cables, array cables, and inter-platform cables in the offshore environment may increase the potential for anchor interaction.*

17.5.1 DBS East and West Together – All Users

545. Up to 350nm of array cables may be located within the DBS Array Areas alongside up to 185nm of inter-platform cables. Up to 598nm of offshore export cables may be located within the Offshore Export Cable Corridor. Where available, the primary means of cable protection will be by seabed burial, with an indicative target burial depth of between 0.5 and 1m for the array and inter platform cables, and between

0.5 and 1.5m for the export cables. . Indicatively, up to 20% of all sub-sea cables may require alternative cable protection with a height (including for crossings) of 1.0m for array cables and 1.4m for inter platform and offshore export cables. The burial depth will be informed by the cable burial risk assessment.

546. There are three anchoring scenarios which are considered for this hazard:

- Planned anchoring – most likely as vessel awaits a berth to enter port but may also result from adverse weather conditions, machinery failure, or sub-sea operations;
- Unplanned anchoring – generally resulting from an emergency situation where the vessels has experienced steering failure; and
- Anchor dragging – caused by anchor failure.

547. Since the array cables would be fully contained within the DBS Array Areas, it is considered unlikely that a vessel will choose to anchor in close proximity to an array cable due to the distance offshore.

548. Unlike for the array cables, the export cables may be crossed frequently by vessels on passage following the UK east coast. Given that an interaction risk exists only where the anchoring occurs in proximity to a sub-sea cable, the hazard is local in nature and has a short temporal overlap – vessels enroute will be located over the export cables for only a short period of time.

549. However, the export cables associated with Dogger Bank A and B run adjacently with a section of the Offshore Export Cable Corridor (no crossings). Therefore, the spatial extent of the interaction risk will be greater for this section of the Offshore Export Cable Corridor.

550. From the vessel traffic data, anchoring activity within and in proximity to the Offshore Export Cable Corridor was limited, with one instance of a vessel anchoring recorded approximately 1.4nm south of the Offshore Export Cable Corridor, well clear of the location where Dogger Bank B export cables run concurrently. There are no charted anchorage areas located in proximity to the Offshore Export Cable Corridor.

551. It is anticipated that the charting of infrastructure including all sub-sea cables will inform the decision to anchor, as per Regulation 34 of SOLAS (IMO, 1974). This includes in an emergency situation with general feedback from mariners indicating that even where time for decision-making is limited a key priority for the bridge crew whilst the anchor is being readied would be to check charts.

552. Anchor dragging features a relatively wider extent than planned or unplanned anchoring. However, from the vessel traffic data, the likelihood of a vessel dragging anchor close enough to interact with a sub-sea cable is very low. In such a circumstance, it is likely that the anchor dragging will be stopped prior to any interaction with a sub-sea cable becoming possible.

553. The most likely consequences in the event of a vessel anchoring over an array cable is that no interaction occurs given the protection applied to the cable (by burial or other means). Should an interaction occur, historical incident data suggests that the consequences would be negligible, with no damage caused to the vessel or sub-sea cable. As a worst case, a snagging incident could occur to a commercial fishing vessel with damage caused to the anchor and/or the cable, compromising the stability of the vessel.

17.5.1.1 Frequency of Occurrence

554. The frequency of occurrence of risks due to anchor interaction with sub-sea cables is **extremely unlikely** for the operations and maintenance phase.

17.5.1.2 Severity of Consequence

555. The severity of consequence of risks due to anchor interaction with sub-sea cables is **minor** for the operations and maintenance phase.

17.5.2 DBS East or DBS West In Isolation – All Users

556. Anchor interaction risk is heavily dependent upon the number and length of sub-sea cables installed. Therefore, should only one DBS Array Area in isolation be installed then the likelihood of an anchor interaction incident will be reduced. However, it is acknowledged that the sub-sea footprint within the Offshore Export Cable Corridor may not change substantially and so the lower likelihood of an anchor interaction incident may be applicable to the array cables only. Therefore, the frequency of occurrence remains extremely unlikely.

17.5.3 Export Cable Platform Search Area – All Users

557. Since there are no sub-sea cables associated with the export cable platform search area (any sub-sea cables within this area will be export cables which are considered above), this hazard does not apply in this circumstance.

17.5.4 Significance of Risk

558. The frequency of occurrence, severity of consequence, and resulting significance of risk resulting from anchor interaction with sub-sea cables for each scenario is presented in **Table 17-5**.

Table 17-5 Significance of Risk for Anchor Interaction with Sub-Sea Cables

Scenario	Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
DBS East and DBS West together	Operations and maintenance	Anchor snagging incident occurs with anchor and/or cable	Extremely Unlikely	Minor	**Broadly Acceptable**

Scenario	Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
		damage and compromised vessel stability.			
DBS East and DBS West in isolation	Operations and maintenance	Anchor snagging incident occurs with anchor and/or cable damage and compromised vessel stability.	Extremely Unlikely	Minor	**Broadly Acceptable**

17.5.5 Additional Mitigation Measures and Residual Significance of Risk

559. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable** for all scenarios.

17.6 Hazard 6 Reduction of Emergency Response Capability (Including SAR Access) (Operation and Maintenance Phase)

560. *The presence of surface structures and operation and maintenance activities associated with the Projects may result in an increased likelihood of an incident occurring which requires an emergency response and may reduce access for surface and air responders, including SAR assets.*

17.6.1 DBS East and West Together – All Users

17.6.1.1 Emergency Response Resources

561. The operation and maintenance phase may last for up to 32 years (for the sequential scenario) with up to 19 operation and maintenance vessels located on-site simultaneously and making up to 473 annual round trips. With a full build out of the DBS Array Areas, these vessels will increase the likelihood of an incident requiring an emergency response and subsequently increase the likelihood of multiple incidents occurring simultaneously, diminishing emergency response capability.

562. There are various emergency response resources serving the region, including RNLI stations (closest at Flamborough approximately 55nm to the south-west) and SAR helicopter bases (closest at Humberside approximately 83nm to the south-west). Given the distances which would be travelled in the event of an emergency response incident in proximity to the DBS Array Areas, this hazard covers a regional spatial extent.

563. From historical incident data, there is a low rate of incidents in the region, with the likelihood of an incident relating to the Projects occurring at the same time being

unlikely. Additionally, based on the number of collision and allision incidents[8] associated with UK offshore wind farms reported to date, there is an average of one incident per 1,695 operational wind turbine years (as of November 2023). Therefore, the Projects are not expected to result in a marked increase in the frequency of incidents requiring an emergency response.

564. Additionally, should an incident occur in proximity to the DBS Array Areas, it is likely that a project vessel (either for the Projects or the other Dogger Bank offshore wind farm developments) would be well equipped to assist under SOLAS obligations (IMO, 1974) and in liaison with the MCA, most likely as the first responder given the distance offshore. This is reflected in past experience, with 12 known instances of a vessel (or persons on a vessel) being assisted by an industry vessel for a nearby UK offshore wind farm.

565. The most likely consequences in the event of an incident in the region requiring an emergency response is that emergency responders are able to assist without any limitations on capability. As a worst case, there could be a delay to a response request due to a simultaneous incident associated with the Projects leading to PLL, pollution, and vessel damage. However, this worst case scenario is highly unlikely.

17.6.1.2 Search and Rescue Access

566. With a full build out of the DBS Array Areas (Layout A), its physical presence may restrict access for SAR responders, either due to the incident in question occurring within the arrays or the arrays obstructing the most effective path to an incident (likely further offshore). The separation of the two Array Areas (introduced post PEIR) reduces the likelihood of this scenario arising, with the potential for SAR responders to navigate through the gap between the DBS Array Areas. Access issues are more likely to be a concern in adverse weather conditions. The Applicants would work within the parameters of MGN 654 to minimise risks.

567. From recent SAR helicopter taskings data, the frequency of UK SAR operations in proximity to the DBS Array Areas is moderate, with incidents reported primarily occurring related to the Cygnus platforms. Due to the Cygnus platforms being further offshore, it is likely that SAR access may be hindered by the DBS Array Areas due to the necessity of a longer flight path. However, the possibility remains of a SAR responder being able to fly over the DBS Array Areas altogether, particularly in suitable weather conditions. Consideration of third-party helicopter access to/from oil and gas platforms is given in **Volume 7, Chapter 15: Aviation and Radar (application ref: 7.15)**.

568. The total area covered by each of the DBS Array Areas is around 100nm^2, which represents a relatively moderate area to search compared to other offshore wind

[8] Although other types of incidents are acknowledged, collision and allision incidents have the potential to be among the most serious ad give a reasonable indication of the rate of incidents requiring an emergency response.

farms. It is unlikely that a SAR operation will require the full extent of both DBS Array Areas to be searched; it is much more likely that a search could be restricted to a specific portion of the DBS Array Areas depending upon the information available regarding the casualty location (inclusive of any assumptions on the drift of the casualty).

569. When considering the non-full build out array layout (Layout B), the minimum spacing between all structures of 830m is similar to many other consented offshore wind farms in the UK (Dogger Bank A and Dogger Bank B were consented with a minimum spacing of 700m (Forewind, 2013)). The array layout includes a SLoO and a safety justification for a SLoO layout will be completed should this be taken forward, including consideration of accessibility for SAR operations.

570. More fully, a layout plan will be agreed with the MMO following appropriate consultation with Trinity House and the MCA, with the final array layout agreed with the MCA and Trinity House post consent. However, the final array layout will be compliant with the requirements of MGN 654 (MCA, 2021), including:

- Safety justification for a SLoO (if taken forward);
- Inclusion of Helicopter Refuge Areas (HRA) as deemed necessary;
- Completion of a SAR Checklist;
- Completion of an Emergency Response Cooperation Plan (ERCoP); and
- Application of unique identification marking of structures in an easily identifiable pattern.

571. The SAR Checklist and ERCoP will remain live documents throughout the operation and maintenance phase.

572. The most likely consequences in the event of a SAR operation are that SAR assets are able to fulfil their objectives without any limitations on capability. As a worst case, it may not be possible to undertake an effective search. However, given compliance with MGN 654 for the final array layout, this is considered highly unlikely.

17.6.1.3 Existing Aids to Navigation

573. An indirect pathway to increasing the likelihood of an incident occurring which requires an emergency response is a risk to the use of existing aids to navigation due to the presence of the Projects.

574. There are no existing aids to navigation located within the DBS Array Areas or Offshore Export Cable Corridor. Additionally, the closest aids to navigation to the DBS Array Areas are the construction buoyage for Dogger Bank A which is expected to be removed by the operations and maintenance phase. Therefore, this element of the hazard is not considered notable.

17.6.2 DBS East and DBS West In Isolation – All Users

575. Should only one DBS Array Area in isolation be constructed, this may assist SAR access to the Cygnus field, particularly if it is DBS West. In this case a direct flight path would still be able to be maintained - construction of solely DBS East in isolation would still result in a direct flight path being obstructed by the array. Fewer wind turbines would also allow for emergency responders to locate incidents more efficiently within the array and create more unoccupied sea room. In addition, construction of one array would lead to fewer on-site project vessels, reducing the likelihood that an incident would occur requiring emergency response. Nevertheless, the frequency of occurrence remains within extremely unlikely parameters.

17.6.3 Export Cable Platform Search Area – All Users

576. Given that the ESP would be a solitary structure, it is not anticipated that it will provide material concerns regarding obstruction of SAR access to the immediate area. The ESP would likely not lead to obscuration of incidents, and the presence of project vessels will be minimal, leading to lower likelihood of an accident. However, this will also mean the likelihood of a project vessel serving as the first responder is lower. Given the distance offshore, the likelihood of a dedicated SAR asset providing the initial response would be greater than at the DBS Array Areas.

17.6.4 Significance of Risk

577. The frequency of occurrence, severity of consequence, and resulting significance of risk resulting from reduction of emergency response capability for each scenario is presented in **Table 17-6**.

Table 17-6 Significance of Risk for Reduction of Emergency Response Capability

Scenario	Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
DBS East and DBS West together	Operations and maintenance	Delay to a response request and inability to undertake an effective search leading to vessel damage, PLL, and pollution.	Extremely Unlikely	Moderate	**Broadly Acceptable**
DBS East and DBS West in isolation	Operations and maintenance	Delay to a response request and inability to undertake an effective search leading to vessel damage, PLL, and pollution.	Extremely Unlikely	Moderate	**Broadly Acceptable**

Scenario	Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Export cable platform search area	Operations and maintenance	Delay to a response request and inability to undertake an effective search leading to vessel damage, PLL, and pollution.	Negligible	Moderate	**Broadly Acceptable**

17.6.5 Additional Mitigation Measures and Residual Significance of Risk

578. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable** for all scenarios.

18 Cumulative Risk Assessment

579. This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the Projects cumulatively with those other developments identified from the cumulative screening (see section 14.1). The same inputs outlined for the in isolation risk assessment are applicable. The hazards assessed are as per the in isolation risk assessment.

18.1 Hazard 1 Vessel Displacement and Increased Third-Party Vessel to Vessel Collision Risk (All Phases)

580. *Activities associated with the installation, maintenance and decommissioning of structures and cables as well as the presence of surface structures may displace third-party vessels from their existing routes or activity, increasing the collision risk with other third-party vessels.*

18.1.1 Tier 1/2

581. Based on the cumulative assessment of vessel routeing (see section 15.5), a deviation will be required for seven of the 10 main commercial routes identified. It is anticipated that three of these routes will deviate around Hornsea Four (one of which also intersects with Dogger Bank C), with three also deviating around Hornsea Three. The largest deviation is anticipated to be 7.3nm, associated with Route 9 (Rotterdam to Icelandic ports and used by an average of one to two vessels per week). This increase equates to a 0.6% increase in route length.

582. The same main consequences (increased journey times and distances) and mitigation measures relevant for each phase of the equivalent hazard for the Projects in isolation are again applicable, including promulgation of information and marking on relevant nautical charts. Given the greater length of deviations compared to the in isolation scenario, the severity of consequence is greater, although remains within moderate parameters given the increased distances relative to the length of routes as a whole.

583. The navigation corridors between the Hornsea developments are of particular note – it is important that affected routes are able to safely approach and utilise these in the presence of the Projects.

584. There is approximately 45nm between the south-western corner of the DBS West Array Area and the corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three. The only existing navigational feature within this sea area is the Trent platform (noting that the Schooner platform close to the corridor has been removed). There is sea room available for vessels to pass east or west of the Trent platform, thus allowing flexibility for vessels when determining a suitable passage between the DBS Array Areas and Hornsea developments.

585. There is approximately 30nm between the eastern corner of the DBS East Array Area and the corridor between Hornsea Project Two and Hornsea Four. There are no existing navigational features within this sea area, and there is existing routeing through the future location of this corridor which passes well south of the DBS East Array Area (Route 1). Therefore, the ability for vessels to make passage utilising this corridor will not be impacted by the presence of the DBS Array Areas.

18.1.2 Tier 3

586. Of the Tier 3 developments, only Dogger Bank D may influence routeing in the area if built out in full. This may further impact on Route 10, which will be required to deviate due to Dogger Bank C. However, any deviation would be small and vessels may already pass at a suitable distance following deviations due to the presence of Dogger Bank C.

18.1.3 Significance of Risk

587. For all phases the frequency of occurrence in relation to cumulative vessel displacement and increased third-party vessel to vessel collision risk is considered **frequent** and the severity of consequence is considered **moderate**.

588. Overall, for all phases it is predicted that the significance of risk due to cumulative vessel displacement and increased third-party vessel to vessel collision risk is **Tolerable with Mitigation**.

18.2 Hazard 2 Increased Third-Party to Project Vessel Collision Risk (All Phases)

589. *Project vessels associated with construction, operation and maintenance, and decommissioning activities may increase encounters and collision risk for other vessels already operating in the area on a cumulative level.*

18.2.1 Tier 1/2/3

590. Construction activities for the Projects are not expected to commence until after construction activities have been completed for the consented Dogger Bank developments. Therefore, limited increases in project vessel movements across cumulative developments are expected in relation to construction activities.

591. There is potential for Dogger Bank D construction activities to overlap with that of the Projects. In such circumstances the marine coordination applicable to project vessels associated with the Projects would be extended as appropriate across both developments, thus ensuring that disruption to third-party vessel movements is minimised. This will also apply for operations and maintenance activities across all Dogger Bank developments, although with lower traffic volumes than would be applicable during construction. It is also anticipated that embedded mitigation measures identified for the equivalent Projects only impact would be applied across

all projects including AIS carriage and compliance with Flag State regulations for project vessels, ongoing liaison with fishing fleets via an appointed FLO, an application for safety zones, and promulgation of information.

592. For other cumulative developments, the distance between them and the Projects is such that no cumulative overlap in activities is anticipated.

18.2.2 Significance of Risk

593. For the construction and decommissioning phases, the frequency of occurrence in relation to cumulative third-party to project vessel collision risk is considered to be **extremely unlikely**. For the operation and maintenance phase, the frequency of occurrence is considered to be **remote**. For all phases the severity of consequence in relation to cumulative third-party to project vessel collision risk is considered to be **serious**.

594. Overall, for all phases it is predicted that the significance of risk due to cumulative third-party to project vessel collision risk is **Tolerable with Mitigation**.

18.3 Hazard 3 Creation of Vessel to Structure Allision Risk (Operations and Maintenance Phase)

595. *The presence of surface piercing structures during the operation and maintenance phase may result in the creation of a risk of allision for vessels on a cumulative level.*

18.3.1 Tier 1/2/3

596. Given the localised nature of vessel to structure allision risk, cumulative risk for this hazard is limited noting that Hornsea Four is the closest cumulative development, located approximately 22nm south-west of the DBS East Array Area.

597. The navigation corridors associated with the Hornsea developments are acknowledged and in particular the potential allision risk which may arise for vessels utilising these. However, as acknowledged with regard to vessel displacement, the distance between the DBS Array Areas and the Hornsea developments is sufficient to allow vessels to approach these corridors safely and avoid additional allision risk beyond that associated with the corridors in isolation.

18.3.2 Significance of Risk

598. For the operations and maintenance phase, the frequency of occurrence in relation to cumulative vessel to structure allision risk is considered to be **extremely unlikely** and the severity of consequence is considered to be **moderate**.

599. Overall, for the operations and maintenance phase it is predicted that the significance of risk due to cumulative vessel to structure allision risk is **Broadly Acceptable**.

18.4 Hazard 4 Reduction in Under Keel Clearance due to Cable Protection (Operations and Maintenance Phase)

600. *The presence of cable protection associated with sub-sea cables may result in reductions to water depth and the creation of an under keel clearance risk for vessels on a cumulative level.*

18.4.1 Tier 1/2/3

601. Given the localised nature of under keel clearance risk and the lack of proximity between sub-sea cables associated with the Project and cumulative developments, no additional under keel clearance risk is identified at the cumulative level.

18.4.2 Significance of Risk

602. The frequency of occurrence in relation to cumulative changes in under keel clearance is considered to be **extremely unlikely** and the severity of consequence is considered to be **minor**.

603. Overall, it is predicted that the significance of risk due to cumulative changes in under keel clearance is **Broadly Acceptable**.

18.5 Hazard 5 Anchor Interaction with Sub-sea Cables (Operations and Maintenance Phase)

604. *The presence of export cables, array cables, and inter-platform cables in the offshore environment may increase the potential for anchor interaction on a cumulative level.*

18.5.1 Tier 1/2/3

605. Given the localised nature of anchor interaction risk and the lack of proximity between sub-sea cables associated with the Project and cumulative developments, no additional anchor interaction risk is identified at the cumulative level.

18.5.2 Significance of Risk

606. The frequency of occurrence in relation to cumulative anchor interaction is considered to be **extremely unlikely** and the severity of consequence in relation to cumulative anchor interaction is considered to be **minor**.

607. Overall, it is predicted that the significance of risk due to cumulative anchor interaction is **Broadly Acceptable**.

18.6 Hazard 6 Reduction of Emergency Response Capability Including SAR (Operations and Maintenance Phase)

608. *Presence of structures, increased vessel activity, and personnel numbers on a cumulative level may reduce emergency response capability by increasing the number of incidents, increase consequences or reducing access for the responders.*

18.6.1 Tier 1/2/3

609. As with the Projects, it is assumed that cumulative developments will have mitigation measures in place to reduce the likelihood of emergency response capability being compromised. This includes marine coordination for project vessels and compliance with Flag State regulations. SOLAS obligations will also be applicable to all cumulative developments and may have a positive effect, e.g., a project vessel for the Dogger Bank developments may be able to assist with an incident associated with the Projects, or vice-versa. Nevertheless, the presence of structures and associated activities across multiple developments will increase the likelihood of an incident occurring that requires an emergency response.

610. Given that the DBS Array Areas are not immediately adjacent to any other cumulative development, there is not considered to be any cumulative risk associated with SAR access, noting that a 1nm separation is required by MGN 654.

18.6.2 Significance of Risk

611. The frequency of occurrence in relation to cumulative reduction of emergency response capability including SAR is considered to be **remote** and the severity of consequence is considered to be **serious**.

612. Overall, it is predicted that the significance of risk due to cumulative reduction of emergency response capability including SAR is **Tolerable with Mitigation**.

19 Risk Control Log

613. **Table 19-1** presents a summary of the risk assessment of shipping and navigation hazards. This includes (per hazard) the proposed embedded mitigation measures, frequency of occurrence, severity of consequence, and resulting significance of risk.

614. Any additional mitigation measures proposed are then listed per hazard alongside the residual risk.

Table 19-1 Risk Control Log

Hazard	Scenario	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel displacement and increased vessel to vessel collision risk between third-party vessels	DBS East and DBS West together	Construction	▪ Application for safety zones; ▪ Charting of infrastructure; ▪ Compliance with MGN 654; ▪ Guard vessel(s); ▪ Lighting and marking; ▪ Pollution prevention measures; ▪ Promulgation of information; and ▪ Traffic monitoring (construction phase and first three years of operations and maintenance phase only).	Reasonably Probable	Moderate	**Tolerable with Mitigation**	None	**Tolerable with Mitigation**
		Operations and maintenance		Reasonably Probable	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Decommissioning		Reasonably Probable	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	DBS East in isolation	Construction		Reasonably Probable	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Operations and maintenance		Reasonably Probable	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Decommissioning		Reasonably Probable	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	DBS West in isolation	Construction		Remote	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Operations and maintenance		Remote	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Decommissioning		Remote	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Export cable	Construction		Reasonably Probable	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**

Hazard	Scenario	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
	platform search area	Operations and maintenance		Reasonably Probable	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Decommissioning		Reasonably Probable	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
Increased vessel to vessel collision risk between a third-party vessel and a project vessel	DBS East and DBS West together	Construction	▪ Application for safety zones; ▪ Fishing liaison; ▪ Guard vessel(s); ▪ Lighting and marking; ▪ Marine coordination for project vessels; ▪ Project vessel compliance with international marine regulations; ▪ Pollution prevention measures; and ▪ Promulgation of information.	Negligible	Moderate	**Broadly Acceptable**	None	**Broadly Acceptable**
		Operations and maintenance		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
		Decommissioning		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
	DBS East or DBS West in isolation	Construction		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
		Operations and maintenance		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
		Decommissioning		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
	Export cable platform search area	Construction		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
		Operations and maintenance		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
		Decommissioning		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**

Hazard	Scenario	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Creation of vessel to structure allision risk	DBS East and DBS West together	Operations and maintenance	▪ Application for safety zones; ▪ Charting of infrastructure; ▪ Compliance with MGN 654; ▪ Fishing liaison; ▪ Layout plan; ▪ Lighting and marking; ▪ Minimum blade clearance; ▪ Pollution prevention measures; and ▪ Promulgation of information.	Extremely Unlikely	Moderate	**Broadly Acceptable**	None	**Broadly Acceptable**
	DBS East or DBS West in isolation			Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
	Export cable platform search area			Negligible	Serious	**Broadly Acceptable**		**Broadly Acceptable**
Reduction of under-keel clearance due to cable protection	DBS East and DBS West together	Operations and maintenance	▪ Cable burial risk assessment; ▪ Compliance with MGN 654; ▪ Pollution prevention measures; and ▪ Promulgation of information.	Extremely Unlikely	Minor	**Broadly Acceptable**	None	**Broadly Acceptable**
	DBS East or DBS West in isolation			Extremely Unlikely	Minor	**Broadly Acceptable**		**Broadly Acceptable**

Hazard	Scenario	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Anchor interaction with sub-sea cables	DBS East and DBS West together	Operations and maintenance	▪ Cable burial risk assessment; ▪ Charting of infrastructure; ▪ Guard vessel(s); and ▪ Promulgation of information.	Extremely Unlikely	Minor	**Broadly Acceptable**	None	**Broadly Acceptable**
	DBS East or DBS West in isolation			Extremely Unlikely	Minor	**Broadly Acceptable**		**Broadly Acceptable**
Reduction of emergency response capability	DBS East and DBS West together	Operations and maintenance	▪ Compliance with MGN 654; ▪ Layout plan; ▪ Lighting and marking; ▪ Marine coordination for project vessels; ▪ Pollution prevention measures; and ▪ Project vessel compliance with international marine regulations.	Extremely Unlikely	Moderate	**Broadly Acceptable**	None	**Broadly Acceptable**
	DBS East or DBS West in isolation			Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
	Export cable platform search area			Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**

20 Embedded Mitigation Measures

615. As part of the design process for the Projects, a number of embedded mitigation measures have been adopted to reduce the risk of hazards identified, including those relevant to shipping and navigation. These measures have and will continue to evolve over the development process as the EIA progresses and in response to consultation.

616. These measures typically include those that have been identified as good or standard practice and include actions that will be undertaken to meet existing legislation requirements. As there is a commitment to implementing these measures, and also to various standard sectoral practices and procedures, they are considered inherently part of the design of the Projects.

617. The embedded mitigation measures within the design relevant to shipping and navigation are outlined in **Table 20-1**.

Table 20-1 Embedded Mitigation Measures Relevant to Shipping and Navigation

Embedded Mitigation Measure	Details	Where commitment is secured
Aids to navigation management plan	One or more Aids To Navigation Management Plans (including marking and lighting) for the Projects would be agreed with the MMO following consultation with MCA, UKHO and Trinity House post-consent.	Aids to Navigation Management Plan Deemed Marine Licence (DML) 1 & 2 - Condition 10 DML 3 & 4 - Condition 8 DML 5 - Condition 6
Application for safety zones	One or more applications would be made to DESNZ for Safety Zones post consent including up to 500m around ongoing activities during construction, major maintenance, and decommissioning and up to 50m for installed structures pre commissioning. The application will be made in compliance with MGN654. This would to ensure navigational safety and minimise risk of snagging.	Safety Zone Statement DML 1 & 2 - Condition 18 DML 3 & 4 - Condition 16 DML 5 - Condition 12
Cable burial risk assessment	Final Cable Burial Risk Assessments and Cable Protection Plans will be produced in line with the detail provided in the **Cable Statement (application ref: 8.20)** that has been submitted with the DCO application, and in accordance with conditions attached to the DMLs in the **Draft DCO (application ref: 3.1**). Any damage, destruction or decay of cables must be notified to Maritime Coastguard Agency (MCA), Trinity House, Kingfisher and United Kingdom Hydrographic Office (UKHO) no later than 24 hours after discovered.	DML 1 & 2 - Condition 15 DML 3 & 4- Condition 13 DML 5 - Condition 11

Embedded Mitigation Measure	Details	Where commitment is secured
Charting of infrastructure	Aids to navigation (marking and lighting) will be deployed in accordance with the latest relevant available standard industry guidance. The United Kingdom Hydrographic Office (UKHO) will be notified of both the commencement, progress, and completion of offshore construction works, to allow marking of installed infrastructure on nautical charts.	DML 1 & 2 - Condition 10 DML 3 &4 - Condition 8 DML 5 - Condition 6
Compliance with MGN 654	The Projects will ensure compliance with MGN 654 and its annexes, where applicable, including completion of a SAR checklist.	DML 1 &2 - Condition 18 DML 3 & 4-Condition 16 DML 5 - Condition 12
Decommissioning Plan	One or more offshore Decommissioning Programme(s) would be submitted prior to commencement of the offshore works based on the relevant guidance and legislation.	Schedule 2 - Condition 7
Fishing liaison	Ongoing liaison with the fishing industry through the Fisheries Liaison Officer (FLO) and adhere to good practice guidance with regards to fisheries liaison. Advance warning and accurate location details will be provided to fishing fleets of construction, maintenance and decommissioning activities, associated safety zones and advisory passing distances; communication will be via timely and efficient Notices to Mariners (NtMs) and Kingfisher Bulletins. This is to ensure that the fishing industry is fully informed in advance of any offshore activities. This will be committed to within the **Fisheries Liaison and Coexistence Plan(s) (application ref: 8.28).**	Fisheries Liaison and Coexistence Plan DML 1 &2 - Condition 18 DML 3 & 4-Condition 20 DML 5 - Condition 14
Guard vessel(s)	Where appropriate, guard vessels will also be used to ensure navigational safety to mitigate impacts which pose a risk to surface navigation during construction and maintenance. This will be committed to within the **Fisheries Liaison and Coexistence Plan(s) (application ref: 8.28).**	DML 1 & 2 - Condition 15 DML 3 & 4- Condition 13 DML 5 - Condition 11
Layout plan	One or more Layout Plan(s) setting out the relevant proposed details of the Projects within the Offshore Development Area would be agreed with the MMO following appropriate consultation with Trinity House and the MCA.	Layout Plan DML 1 & 2 - Condition 15 DML 3 & 4- Condition 13 DML 5 - Condition 11
Lighting and marking	Lighting and marking of obstacles would be in accordance with the latest relevant industry guidance, as required by Trinity House, MCA, and Civil Aviation Authority (CAA). Final requirements will be detailed and agreed pre-construction in a Lighting and Marking Plan(s) produced as part of the Aids to Navigation Management Plan(s).	Aids to Navigation Management Plan DML 1 & 2 - Condition 10 DML 3 & 4 - Condition 8 DML 5 - Condition 6

Embedded Mitigation Measure	Details	Where commitment is secured
Marine coordination for project vessels	Marine coordination would be implemented to manage project vessels throughout construction and maintenance periods, and will be detailed in one or more Emergency Response Cooperation Plans (ERCoPs) produced in compliance with MGN654.	Emergency Response Cooperation Plans (ERCoPs) DML 1 & 2 - Condition 18 DML 3 & 4 - Condition 16 DML 5 - Condition 12
Minimum blade clearance	There would be a minimum blade tip clearance (air draft height) of at least 34m above MSL. Project parameters would be secured within the **Draft DCO (application ref: 3.1).**	DML 1 & 2 -Condition 2
Pollution prevention measures	Due to the presence and movements of construction and operation and maintenance vessels/equipment there is the potential for spills and leaks which could result in changes to water quality. All vessels involved will be required to comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78. The production of one or more Project Environmental Management Plans (PEMPs) is a Condition of the five Deemed Marine Licences (DMLs). The final PEMP(s) would be in accordance with the **Outline PEMP (application ref: 8.21**) and would detail all procedures and measures (in the form of a Marine Pollution Contingency Plan (MPCP)) to be followed during the different phases of the Projects to minimise the risk of, and effects in, the event of an accidental spill. The final PEMP will identify all potential sources and types of accidental pollution for the relevant project phase and set out the proposed mitigation measures and will be developed in consultation with key stakeholders for approval by the MMO. The individual Projects and phases may require separate final PEMP(s). In addition separate PEMPs may also be produced for individual packages.	Pollution Environmental Management Plan (PEMP) Marine Pollution Contingency Plan (MPCP) DML 1 & 2 - Condition 15 DML 3 & 4- Condition 13 DML 5 - Condition 11
Project vessel compliance with international marine regulations	Project vessels will ensure compliance with Flag State regulations including the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) (International Maritime Organization (IMO), 1972/77) and International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974). This is detailed within the **Outline PEMP (application ref: 8.21).**	Pollution Environmental Management Plan (PEMP) DML 1 & 2 - Conditions 15 & 21 DML 3 & 4 - Conditions 13 & 19 DML 5 - Conditions 11 & 15
Promulgation of information	The Projects will ensure that local Notifications to Mariners are updated and reissued at weekly intervals during construction activities and at least five days before any planned operation and maintenance works. Advance warning and accurate location details of construction, maintenance and decommissioning operations (including details of vessel routes, timings and	DML 1 & 2 - Condition 9 DML 3 & 4- Condition 7 DML 5 - Condition 5

Embedded Mitigation Measure	Details	Where commitment is secured
	locations), associated safety zones and advisory passing distances will be given via Kingfisher Bulletins at least 14 days prior where possible.	
Traffic monitoring	Monitoring of vessel traffic will be undertaken for the duration of the construction phase and during the first three years of the operation and maintenance phase. This would be secured through carrying out vessel traffic monitoring in accordance with the **Outline Marine Traffic Monitoring Plan (application ref: 8.30).**	Marine Traffic Monitoring Plan DML 1 & 2 - Conditions 19 & 20 DML 3 & 4 - Conditions 21 & 22 DML 5 - Conditions 15 &16
Under keel clearance	Where scour protection is required, MGN 654 will be adhered to with respect to changes greater than 5% to the charted water depth referenced to CD in consultation with the MCA and Trinity House. Compliance with MGN 654 would be secured within the **Draft DCO (application ref: 3.1).**	DML 1 & 2 - Condition 18 DML 3 & 4 - Condition 16 DML 5 - Condition 12

20.1 Marine Aids to Navigation

618. Throughout all phases, aids to navigation will be provided in accordance with Trinity House and MCA requirements, with consideration being given to IALA Guideline G1162 (IALA, 2021 (a)), IALA Recommendation O-139 (IALA, 2021 (b)), and MGN 654 (MCA, 2021).

20.1.1 Construction and Decommissioning Phases

619. During the construction and decommissioning phases, buoyed construction and decommissioning areas will be established and marked, where required, in accordance with Trinity House requirements based on the IALA Maritime Buoyage System.

20.1.2 Operations and Maintenance Phase

620. Marking during the operation and maintenance phase will be agreed in consultation with Trinity House once the final array layouts has been selected post consent; however, the following subsections summarise likely requirements.

20.1.2.1 Marking of Individual Array Structures

621. As per IALA Guideline G1162, each surface structure within the DBS Array Areas will be painted yellow from the level of Highest Astronomical Tide (HAT) to at least 15m above HAT. Each structure will also be clearly marked with a unique alphanumeric identifier which will be clearly visible from all directions. The MCA will advise post consent on the specific requirements for the identifiers, but a logical pattern with potential for additional visual marks may be considered by statutory stakeholders.

Each identifier will be illuminated by a low-intensity light such that the sign is available from a vessel thus enabling the structure to be identified at a suitable distance to avoid an allision incident.

622. The identifiers will be situated such that under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer (with the naked eye), stationed 3m above sea level and at a distance of at least 150m from the wind turbine. The light will be either hooded or baffled so as to avoid unnecessary light pollution or confusion with navigational marks.

20.1.2.2 Marking of Array as a Whole

623. The marking of the array(s) as a whole will be agreed with Trinity House once the final array layout has been selected and will be in line with IALA Guideline G1162 and Recommendation O-139. As per the IALA guidance, and in consultation with Trinity House, it will be ensured that:

- All corner structures will be marked as a Significant Peripheral Structure (SPS) and where necessary, to satisfy the spacing requirements between SPSs, additional periphery structures may also be marked as SPSs;
- Structures designated as an SPS will exhibit a flashing yellow five second (flash yellow every five seconds) light of at least 5nm nominal range and omnidirectional fog signals as appropriate and where prescribed by Trinity House, and will be sounded at least when the visibility is 2nm or less;
- Further periphery structures may be marked as Intermediate Peripheral Structures (IPS) including a flashing yellow light with a distinctly different flash character from those displayed on the SPSs and at least 2nm nominal range;
- All lights will be visible to shipping through 360˚ and if more than one lantern is required on a structure to meet the all-round visibility requirement, then all the lanterns on that structure will be synchronised;
- All lights will be exhibited at the same height at least 6m above HAT and below the arc of the lowest wind turbine blades;
- All lights will be exhibited at least at night;
- Remote monitoring sensors using Supervisory Control and Data Acquisition (SCADA) will be included as part of the lighting and marking scope to ensure a high level of availability for all aids to navigation;
- Aviation lighting will be as per CAA requirements; and
- All lighting will be considered cumulatively with existing aids to navigation to avoid the potential for light confusion to passing traffic.

624. Consideration will also be given to the use of marking via AIS, or other electronic means (such as Radar Beacons (Racon)) to assist safe navigation particularly in reduced visibility. AIS transmitters or virtual buoys could also be considered internally to assist with safe navigation within the DBS Array Areas.

625. Additionally, consideration will be given to the cumulative lighting and marking of the Projects alongside Dogger Bank A, again in consultation with Trinity House.

20.1.2.3 Marking of Offshore Export Cables

626. No lighting or physical marking will be required during the operation and maintenance phase for the offshore export cables.

20.2 Design Specifications Noted in Marine Guidance Note 654

627. The individual wind turbines and other structures will have functions and procedures in place for generator shut down in emergency situations, as per MGN 654 (MCA, 2021).

21 Summary

628. Using baseline data, quantitative modelling, outputs of the Hazard Workshops, expert opinion, stakeholder concerns, and lessons learnt from existing offshore developments, hazards relating to shipping and navigation have been identified due to the presence of the Projects for all phases of the development (construction, operation and maintenance, and decommissioning). This has been fed into the risk assessment – which follows the FSA approach – undertaken in section 17.

21.1 Consultation

629. Consultation has been undertaken with key shipping and navigation stakeholders, including dedicated meetings with:

- MCA;
- Trinity House;
- UK Chamber of Shipping;
- RYA;
- Cruising Association;
- UK Major Ports Group;
- Perenco;
- DEME Group;
- Neptune Energy; and
- Tidewater.

21.2 Baseline Characterisation

21.2.1 Navigational Features

630. The under-construction Dogger Bank A development is located approximately 4nm north-east of the DBS Array Areas. Construction buoyage related to Dogger Bank A is currently present but will be removed once construction is completed. The Dogger Bank B, Sofia, and Dogger Bank C developments are also under construction, and are located approximately 9nm, 18nm, and 30nm north of the DBS Array Areas respectively.

631. Various oil and gas infrastructure associated with nearby gas fields exists in proximity to the Array Areas, with the closest of these being the Cavendish platform, located 1.6nm to the south of the DBS East Array Area and directly south of the Offshore Export Cable Corridor.

632. Six sub-sea pipelines pass through the DBS Array Areas, although four are disused. Two of the disused sub-sea pipelines also intersect the Offshore Export Cable Corridor. Currently under installation sub-sea cables for Dogger Bank A are located north and north-west of the DBS Array Areas and pass alongside the Offshore Export

Cable Corridor for much of its length, including an intersection over a distance of approximately 6.2nm.

21.2.2 Maritime Incidents

633. From DfT SAR helicopter taskings data recorded between April 2015 and March 2022, there was an average of five SAR taskings per year within the DBS East study area, with most rescue/recovery incidents occurring in close proximity to the Cygnus gas field. There was an average of one SAR tasking every one to two years in the DBS West study area.

634. Within the Offshore Export Cable Corridor study area there was an average of three SAR taskings per year, consisting primarily of rescue/recovery incidents closer to shore.

635. From RNLI incident data recorded between 2013 and 2022, there was a single documented incident responded to by the RNLI within the DBS East study area – a sailing vessel experiencing machinery failure. No documented incidents were responded to within the DBS West study area.

636. Within the Offshore Export Cable Corridor study area there was an average of four to five unique RNLI incidents per year with machinery failure (63%) and person in danger (17%) the most frequently recorded incident types.

637. Within the offshore cable platform search area study area there was an average of one unique RNLI incident per year with machinery failure (four counts) and person in danger (two counts) the most frequently recorded incident types. One RNLI incident was recorded within the export cable platform search area itself.

638. From MAIB incident data recorded between 2012 and 2021, there were three recorded incidents within the DBS East study area and two incidents recorded within the DBS West study area.

639. Within the Offshore Export Cable Corridor study area there was an average of one to two unique MAIB incidents per year with "*machinery failure*" (46%) and "*damage/loss of equipment*" (14%) the most frequently recorded incident types. Two MAIB incidents occurred within the Offshore Export Cable Corridor itself.

640. Within the export cable platform search area study area there was an average of one unique MAIB incident per year with "*machinery failure*" (five counts) the most frequently recorded incident type. No MAIB incidents occurred within the export cable platform search area itself.

21.2.3 Vessel Traffic Movements

641. From 28 days of vessel traffic survey data recorded in July 2022 (summer) and October/November 2022 (winter) within the DBS East study area, there was an average of 14 unique vessels per day with an average of three unique vessels per day

within the DBS East Array Area itself. In the DBS West study area there was an average of ten unique vessels per day with an average of three unique vessels per day within the DBS West Array Area itself.

642. Throughout both survey periods, the main vessel types recorded within the DBS East study area were cargo vessels (40%), oil and gas vessels (30%), tankers (14%), and fishing vessels (14%). The main vessel types recorded within the DBS West study area were cargo vessels (46%), tankers (18%), oil and gas vessels (14%), and fishing vessels (10%).

643. A total of ten main commercial routes were identified within the array routeing study area from the vessel traffic survey data. The most heavily trafficked main commercial route – with an average of two unique vessels per day – was between Immingham and Gothenburg, featuring RoRo cargo services operated by DFDS Seaways and Finnlines.

644. From 28 days of vessel traffic data recorded in July 2022 (summer) and October/November 2022 (winter) within the Offshore Export Cable Corridor study area, there was an average of 50 unique vessels per day with an average of 47 unique vessels per day within the Offshore Export Cable Corridor itself.

645. Throughout both survey periods, the main vessel types recorded within the Offshore Export Cable Corridor study area were cargo vessels (42%), tankers (24%), and fishing vessels (13%).

646. From 28 days of vessel traffic data recorded in January 2023 (winter) and June/July 2022 (summer) within the export cable platform search area study area, there was an average of 17 unique vessels per day with an average of four unique vessels per day within the export cable platform search area itself.

647. Throughout both survey periods, the main vessel types recorded within the offshore export cable platform search area study area were tankers (33%), cargo vessels (32%), and oil and gas vessels (14%).

648. A total of 11 main commercial routes were identified within the export cable platform search area study area from the vessel traffic survey data. The most heavily trafficked main commercial route – with an average of one to two unique vessels per day – was between Newcastle and Ijmuiden, featuring RoPax services operated by DFDS Seaways.

21.3 Future Case Vessel Traffic

649. Indicative 10% and 20% increases in vessel traffic associated with commercial vessels, commercial fishing vessels, and recreational vessels has been considered for the future case scenario. Additionally, transits made by project vessels have been considered.

650. Deviations due to the presence of DBS would be required for five out of the ten main commercial routes identified with the level of deviation varying between a 0.1nm increase for routes between Tees and Gdynia/Grimsby and Thyborøn; and an increase of 6.8nm for a route between Rotterdam and Icelandic ports.

651. Deviations due to the presence of the ESP would be required for two out of the eleven main commercial routes identified, with these including a 0.2nm deviation for a route between Newcastle and Ijmuiden, and a deviation of 0.1nm between Grangemouth and Rotterdam.

21.4 Collision and Allision Risk Modelling

652. The NRA process included quantitative modelling of the change in allision and collision frequency as a result of the Projects and ESP, with consideration given to future cases in terms of potential future traffic increases.

653. It was estimated that the return period of a vessel being involved in a collision in proximity to the DBS Array Areas post wind farm was 5,593 years assuming base case traffic levels. This represents a 45% increase in collision frequency compared to the pre wind farm base case result.

654. The powered allision return period in proximity to the DBS Array Areas post wind farm was estimated at 24,315 years assuming base case traffic levels. The corresponding drifting allision return period post wind farm was estimated at 18,742 years. The fishing vessel allision return period was estimated at 15.3 years.

655. It was estimated that the return period of a vessel being involved in a collision in proximity to the ESP post wind farm was 1,693 years assuming base case traffic levels. This represents a 1% increase in collision frequency compared to the pre wind farm base case result.

656. The powered allision return period in proximity to the ESP post wind farm was estimated at 3,910 years assuming base case traffic levels. The corresponding drifting allision return period post wind farm was estimated at 104,738 years.

21.5 Risk Statement

657. Using the baseline data, quantitative modelling, expert opinion, outputs of the Hazard Workshops, and lessons learnt from existing offshore developments, shipping and navigation hazards have been identified and assessed in line with the FSA methodology. The full risk control log including details of hazards, embedded mitigation measures, and significant of risk is presented in section 19.

658. The significance of risk has been determined as either **Broadly Acceptable** or **Tolerable with Mitigation** for all shipping and navigation hazards assessed. No additional mitigation measures have been identified, and thus the residual risk is also

Broadly Acceptable or **Tolerable with Mitigation** for all shipping and navigation hazards.

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Appendix A Marine Guidance Note 654 Checklist

659. The MGN 654 Checklist may be divided into two distinct checklists, one considering the main MGN 654 guidance document (MCA, 2021) and one considering the *Methodology for Assessing Marine Navigational Safety and Emergency Response Risks of OREIs* which serves as Annex 1 to MGN 654.

660. The checklist for the main MGN 654 guidance document is presented in Table A.1. Following this, the checklist for the MCA's methodology annex is presented in Table A.2. For both checklists, references to where the relevant information and/or assessment is provided in the NRA is given.

Table A.1 MGN 654 Checklist for Main Document

Issue	Compliance	Comments
Site and Installation Coordinates. Developers are responsible for ensuring that formally agreed coordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (European Terrestrial Reference System 1989 (ETRS89)) datum.		
Traffic Survey. Includes:		
All vessel types.	✓	**Section 10: Vessel Traffic Movements** All vessel types are considered with specific breakdowns by vessel type given for the DBS Array Areas, Offshore Export Cable Corridor and export cable platform search area.
At least 28 days duration, within either 12 or 24 months prior to submission of the ES.	✓	**Section 5: Data Sources** A total of 28 full days of vessel traffic survey data from July and October/November 2022 has been assessed within the respective study areas for the DBS Array Areas. A total of 28 full days of vessel traffic survey data from January/February 2023 and June 2023 has been assessed within the export cable platform search area study area.
Multiple data sources.	✓	**Section 5: Data Sources** The vessel traffic survey data includes AIS, visual observations and Radar for the summer and winter periods to ensure maximal coverage of vessels not broadcasting on AIS.
Seasonal variations.	✓	**Section 5: Data Sources** A total of 28 full days of vessel traffic survey data from July and October/November 2022 has been assessed within the respective study areas for the DBS Array Areas. A total of 28 full days of vessel traffic survey data from January/February 2023 and June 2023 has been assessed within the export cable platform search area study area.

Issue	Compliance	Comments
MCA consultation.	✓	**Section 4: Consultation** The MCA have been consulted as part of the NRA process including through the Hazard Workshops.
General Lighthouse Authority (GLA) consultation.	✓	**Section 4: Consultation** Trinity House have been consulted as part of the NRA process.
UK Chamber of Shipping consultation.	✓	**Section 4: Consultation** The UK Chamber of Shipping have been consulted as part of the NRA process including through the Hazard Workshops.
Recreational and fishing vessel organisations consultation.	✓	**Section 4: Consultation** The CA and RYA have been consulted as part of the NRA process including through the Hazard Workshops.
Port and navigation authorities consultation, as appropriate.	✓	**Section 4: Consultation** The UK Major Ports Group have been consulted as part of the NRA process including through the Hazard Workshops.
Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Projects has been analysed. **Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase including for all relevant users.
ii. Numbers, types and sizes of vessels presently using such areas.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Projects has been analysed and includes breakdowns of daily vessel count, vessel type and vessel size.
iii. Non-transit uses of the areas, e.g., fishing, day cruising of leisure craft, racing, aggregate dredging, personal watercraft, etc.	✓	**Section 10: Vessel Traffic Movements** Non-transit users were identified in the vessel traffic survey data and included fishing vessels engaged in fishing activities, support for oil and gas activities, and anchoring.
iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓	**Section 10: Vessel Traffic Movements** Main commercial routes have been identified using the principles set out in MGN 654 in proximity to the DBS Array Areas and export cable platform search area, with these routes accounting for coastal, deep draught and internationally scheduled vessels.
v. Alignment and proximity of the site relative to adjacent shipping lanes.	✓	**Section 7: Navigational Features** There are no IMO routeing measures in proximity to the Projects.
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓	**Section 7: Navigational Features** There are no IMO routeing measures or precautionary areas in proximity to the Projects.

Issue	Compliance	Comments
vii. Proximity of the site to areas used for anchorage (charted or uncharted), safe haven, port approaches and pilot boarding or landing areas.	✓	**Section 7: Navigational Features** There are no designated anchorage areas or ports/harbours in proximity to the Projects.
viii. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	**Section: Navigational Features** There are no ports/harbours in proximity to the Projects.
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	**Section 10: Vessel Traffic Movements** Commercial fishing vessel movements are considered within the respective study areas for the DBS Array Areas, Offshore Export Cable Corridor, and export cable platform search area.
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	**Section 7: Navigational Features** Military practice and exercise areas in proximity to the Projects have been identified.
xi. Proximity of the site to existing or proposed submarine cables or pipelines, offshore oil/gas platforms, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Areas or other exploration/exploitation sites.	✓	**Section 7: Navigational Features** Sub-sea cables and pipelines, oil and gas infrastructure, and charted wrecks and obstructions in proximity to the Projects have been identified. There are no marine aggregate dredging areas in proximity to the Projects.
xii. Proximity of the site to existing or proposed OREI developments, in cooperation with other relevant developers, within each round of lease awards.	✓	**Section 7: Navigational Features** Other offshore wind farm developments in proximity to the Projects have been identified.
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground.	✓	**Section 7: Navigational Features** There are no spoil grounds or other dumping grounds in proximity to the Projects.
xiv. Proximity of the site to aids to navigation and/or VTS in or adjacent to the area and any impact thereon.	✓	**Section 7: Navigational Features** Key aids to navigation in proximity to the Projects have been identified.

Issue	Compliance	Comments
xv. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of 'choke points' in areas of high traffic density and nearby or consented OREI sites not yet constructed.	✓	**Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Projects including the array infrastructure and ESP (within the export cable platform search area).
xvi. With reference to xv. above, the number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation.	✓	**Section 8: Emergency Response and Incident Overview** Historical vessel incident data published by the MAIB, RNLI and DfT in proximity to the Projects has been considered alongside historical offshore wind farm incident data throughout the UK.
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area.	✓	**Section 10: Vessel Traffic Movements** Recreational vessel movements are considered within the respective study areas for the DBS Array Areas, Offshore Export Cable Corridor, and export cable platform search area.
Predicted effect of OREI on traffic and interactive boundaries. Where appropriate, the following should be determined:		
a. The safe distance between a shipping route and OREI boundaries.	✓	**Section 15: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes a minimum distance of 1nm from offshore installations and existing offshore wind farm boundaries.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	No corridors with regular routeing by commercial vessels have been identified between offshore wind farm developments.
OREI Structures. The following should be determined:		
a. Whether any feature of the OREI, including auxiliary platforms outside the main generator site, mooring and anchoring systems, inter-device and export cabling could pose any type of difficulty or danger to vessels underway, performing normal operations, including fishing, anchoring and emergency response.	✓	**Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of anchoring and emergency response.

Issue	Compliance	Comments
b. Clearances of fixed or floating wind turbine blades above the sea surface are not less than 22m (above MHWS for fixed). Floating wind turbines allow for degrees of motion.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including a minimum blade tip clearance of at least 34m above MSL.
c. Underwater devices: i. Changes to charted depth; ii. Maximum height above seabed; and iii. Under keel clearance.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** Array and export cable specifications relevant to the MDS for shipping and navigation are provided.
d. Whether structures block or hinder the view of other vessels or other navigational features.	✓	**Section 13: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the use of existing aids to navigation are considered. **Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of visual hindrance to navigation.
The effect of tides, tidal streams and weather. It should be determined whether:		
a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide, i.e., whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** The range of water depths within the DBS Array Areas and Offshore Export Cable Corridor are provided. **Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Projects has been analysed.
b. The set and rate of the tidal stream, at any state of the tide, has a significant effect on vessels in the area of the OREI site.	✓	**Section 8: Meteorological Ocean Data** Section 8.4 provides meteorological data in proximity to the Projects relating to various states of the tide. **Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Projects including the array infrastructure and ESP (within the export cable platform search area).
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	
d. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓	

Issue	Compliance	Comments
e. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream, including unpowered vessels and small, low speed craft.	✓	**Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of drifting allision risk.
f. The structures themselves could cause changes in the set and rate of the tidal stream.	✓	**Section 8: Meteorological Ocean Data** Section 8.4 provides meteorological data in proximity to the DBS Array Areas and export cable platform search area.
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the wind farm area or adjacent to the area.	✓	**Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of reduction in under keel clearance.
h. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Projects has been analysed including recreational vessels. **Section 12: Adverse Weather Routeing** Alternative routeing used during periods of adverse weather has been identified. **Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of adverse weather routeing.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	**Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of vessels under sail.
j. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above.	✓	**Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of drifting allision risk.
Assessment of access to and navigation within, or close to, an OREI. To determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:		
a. Navigation within or close to the site would be safe:		
i. For all vessels.	✓	

Issue	Compliance	Comments
ii. For specified vessel types, operations and/or sizes.		**Section 4: Consultation** Consultation with Regular Operators has been undertaken as part of the Hazard Workshop process. **Section 12: Adverse Weather Routeing** Alternative routeing used during periods of adverse weather has been identified. **Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of internal navigation.
iii. In all directions or areas.		
iv. In specified directions or areas.		
v. In specified tidal, weather or other conditions.		
b. Navigation in and/or near the site should be prohibited or restricted:		
i. For specified vessel types, operations and/or sizes.	✓	**Section 13: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the use of navigation, communication, and position fixing devices used in and around offshore wind farms are assessed. **Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of internal navigation. **Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including an application for safety zones.
ii. In respect of specific activities.	✓	
iii. In all areas or directions.	✓	
iv. In specified areas or directions.	✓	
v. In specified tidal or weather conditions.	✓	
c. Where it is not feasible for vessels to access or navigate through the site it could cause navigational, safety or routeing problems for vessels operating in the area, e.g., by preventing vessels from responding to calls for assistance from persons in distress.	✓	**Section 17: Risk Assessment** The hazards due to the Projects have been assessed for each phase and include consideration of emergency response capability.
d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered.	✓	**Section 15: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes consideration of the Shipping Route Template.
SAR, maritime assistance service, counter pollution and salvage incident response.		
The MCA, through HM Coastguard, is required to provide SAR and emergency response within the sea area occupied by all OREIs in UK waters. To ensure that such operations can be safely and effectively conducted, certain requirements must be met by developers and operators.		

Issue	Compliance	Comments
a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires the creation of an ERCoP.
b. The MCA's guidance document *Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response* (MCA, 2021) for the design, equipment and operation requirements will be followed.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires fulfilment of requirements in the stated guidance document.
c. A SAR checklist will be completed to record discussions regarding the requirements, recommendations and considerations outlined in Annex 5 (to be agreed with MCA).	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires the completion of the SAR checklist.
6. Hydrography. In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
i. Pre construction: The proposed generating assets area and proposed cable route.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires the specified hydrographic surveys to be completed.
ii. On a pre-established periodicity during the life of the development.	✓	
iii. Post construction: Cable route(s).	✓	
iv. Post decommissioning of all or part of the development: the installed generating assets area and cable route.	✓	
Communications, Radar and positioning systems. To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:		
a. The structures could produce radio interference such as shadowing, reflections or phase changes, and emissions with respect to any frequencies used for marine positioning, navigation, and timing (PNT) or communications, including GMDSS and AIS, whether ship borne, ashore, or fitted to any of the proposed structures, to:		
i. Vessels operating at a safe navigational distance.	✓	**Section 13: Navigation, Communication, and Position Fixing Equipment**

Issue	Compliance	Comments
ii. Vessels by the nature of their work necessarily operating at less than the safe navigational distance to the OREI, e.g., support vessels, survey vessels, SAR assets.	✓	Hazards relating to the use of navigation, communication, and position fixing devices used in and around offshore wind farms are assessed.
iii. Vessels by the nature of their work necessarily operating within the OREI.	✓	
b. The structures could produce Radar reflections, blind spots, shadow areas or other adverse effects:		
i. Vessel to vessel.	✓	**Section 13: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the use of navigation, communication, and position fixing devices used in and around offshore wind farms are assessed.
ii. Vessel to shore.	✓	
iii. VTS Radar to vessel.	✓	
iv. Racon to/from vessel.	✓	
c. The structures and generators might produce SONAR interference affecting fishing, industrial or military systems used in the area.	✓	**Section 13: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the risk of SONAR interference due to the Projects are assessed.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	**Section 13: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the risk of noise due to the Projects are assessed.
e. Generators and the seabed cabling within the site and onshore might produce EMFs affecting compasses and other navigation systems.	✓	**Section 13: Navigation, Communication, and Position Fixing Equipment** Hazards relating to the risk of electromagnetic interference due to the Projects are assessed.
Risk mitigation measures recommended for OREI during construction, operation and decommissioning.		
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the EIA. The specific measures to be employed will be selected in consultation with the MCA and will be listed in the developer's ES. These will be consistent with international standards contained in, for example, SOLAS Chapter V (IMO, 1974), and could include any or all of the following:		
i. Promulgation of information and warnings through notices to mariners and other appropriate MSI dissemination methods.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including the promulgation of information.
ii. Continuous watch by multi-channel VHF, including DSC.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including marine coordination for project vessels.

Issue	Compliance	Comments
iii. Safety zones of appropriate configuration, extent and application to specified vessels[9].	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including an application for safety zones.
iv. Designation of the site as an Area to be Avoided (ATBA).	✓	**Section 6: Project Description Relevant to Shipping and Navigation** It is not planned to designate the DBS Array Areas as an ATBA.
v. Provision of aids to navigation as determined by the GLA.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including lighting and marking as required by Trinity House, MCA and CAA.
vi. Implementation of routeing measures within or near to the development.	✓	**Section 7: Navigational Features** There are no IMO routeing measures in proximity to the Projects.
vii. Monitoring by Radar, AIS, Closed Circuit Television (CCTV) or other agreed means.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires discussions with the MCA regarding monitoring as part of the SAR checklist.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including an application for safety zones. The means for notifying and providing evidence of the infringement of safety zones will be provided in the safety zone application, submitted post consent.
ix. Creation of an ERCoP with the MCA's SAR Branch for the construction phase onwards.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including compliance with MGN 654, which requires the creation of an ERCoP.
x. Use of guard vessels, where appropriate.	✓	**Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including the use of guard vessels.
xi. Update NRAs every two years, e.g., at testing sites.	✓	Not applicable to the Projects.

[9] As per SI 2007 No 1948 "The Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007.

Issue	Compliance	Comments
xii. Device-specific or array-specific NRAs.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** All offshore elements of the Projects are considered in this NRA including within the DBS Array Areas, Offshore Export Cable Corridor, and export cable platform search area. **Section 20: Mitigation Measures** Embedded mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined including a cable burial risk assessment which will serve as additional assessment relating to shipping and navigation.
xiii. Design of OREI structures to minimise risk to contacting vessels or craft.	✓	There is no additional risk posed to craft compared to previous offshore wind farms and so no additional measures are identified.
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	**Section 20: Mitigation Measures** Additional mitigation measures to be implemented to reduce the significance of risk associated with shipping and navigation hazards are outlined and informed by consultation.

Table A.2 MGN 654 Annex 1 Checklist

Item	Compliance	Comments
A risk claim is included that is supported by a reasoned argument and evidence.	✓	**Section 17: Risk Assessment** The risk assessment provides a risk claim for a range of hazards based on a number of inputs including baseline data, quantitative modelling, expert opinion, outputs of the Hazard Workshops and lessons learnt from existing offshore developments.
Description of the marine environment.	✓	**Section 7: Navigational Features** Navigational features in proximity to the Projects have been described including (but not limited to) other offshore wind farm developments, key aids to navigation, oil and gas infrastructure, sub-sea cables and pipelines, and charted wrecks and obstructions. **Section 14: Cumulative and Transboundary Overview** Potential future offshore developments have been screened into the cumulative risk assessment where a cumulative or in combination activity has been identified based upon the location and distance from the Projects. Developments screened include other offshore wind farms, oil and gas infrastructure, marine aggregate dredging areas, and sub-sea cables.
SAR overview and assessment.	✓	**Section 8: Emergency Response and Incident Overview** Existing SAR resources in proximity to the Projects are summarised including the UK SAR operations contract, RNLI stations, and HMCG stations.

Item	Compliance	Comments
		Section 17: Risk Assessment The risk assessment includes consideration of how activities associated with the Projects may restrict emergency response capability.
Description of the OREI development and how it changes the marine environment.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** The maximum extent of the Projects for which any shipping and navigation hazards are assessed is provided including a description of the Projects, associated infrastructure, construction phase programme, and indicative vessel and helicopter numbers during the construction and operation and maintenance phases.
Analysis of the vessel traffic, including base case and future traffic densities and types.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Projects has been analysed and includes vessel density and breakdowns of vessel type. **Section 15: Future Case Vessel Traffic** Future vessel traffic levels have been considered, with consideration of increases in commercial vessel activity, commercial fishing vessel and recreational vessel activity, and traffic associated with the Projects operations. Additionally, worst case alternative routeing for commercial traffic has been considered.
Status of the hazard log: ▪ Hazard identification; ▪ Risk assessment; ▪ Influences on level of risk; ▪ Tolerability of risk; and ▪ Risk matrix.	✓	**Section 3: Navigational Risk Assessment Methodology** A tolerability matrix has been defined to determine the tolerability (significance) of risks.
NRA: ▪ Appropriate risk assessment; ▪ MCA acceptance for assessment techniques and tools; ▪ Demonstration of results; and ▪ Limitations.	✓	**Section 2: Guidance and Legislation** MGN 654 and the IMOs FSA guidelines are the primary guidance documents used for the assessment. **Appendix B: Hazard Log** The complete hazard log is presented and includes a description of the hazards considered, possible causes, consequences (most likely and worst case) and relevant embedded mitigation measures. Using this information, each hazard is then ranked in terms of frequency of occurrence and severity of consequence to give a tolerability (significance) level.
Risk control log	✓	**Section 18: Risk Control Log** Provides the risk control log which summarises the assessment of shipping and navigation hazards scoped into the risk

Item	Compliance	Comments
		assessment. This includes the embedded mitigation measures, frequency of occurrence, severity of consequence, and significance of risk, per hazard.

Appendix B Hazard Log

661. The complete hazard log, created following the first Hazard Workshop and updated following the second Hazard Workshop, is presented in Table B.1.

Table B.1 Hazard Log

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences								Consequences						
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk	
Vessel Displacement for Third-Party Vessels (Including Adverse Weather Routeing)																						
Commercial vessels (including oil and gas, marine aggregate dredger, wind farm)	Isolation	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	5	1	1	1	2	1.3	Tolerable with Mitigation	Displacement with effects on schedule and vessel stability in adverse weather	3	3	2	3	3	2.8	Broadly Acceptable	Neptune Energy noted no concerns and oil and gas routeing between the DBS Array Areas and Dogger Bank A will be maintained.
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		5	1	1	1	2	1.3	Tolerable with Mitigation		3	3	2	3	3	2.8	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Installation vessel which is RAM	Displacement with manageable effects on schedule but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	N/A
			O		▪ Maintenance vessel which is RAM		2	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	4	1	1	1	2	1.3	Broadly Acceptable	Displacement with effects on schedule	3	1	1	1	2	1.3	Broadly Acceptable	Neptune Energy noted no vessel concerns.
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		3	1	1	1	2	1.3	Broadly Acceptable		3	1	1	1	2	1.3	Broadly Acceptable	
	Cumulative	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Simultaneous buoyed construction/ decommissioning areas for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Adverse weather ▪ Construction vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	5	1	1	1	2	1.3	Tolerable with Mitigation	Displacement with effects on schedule and vessel stability in adverse weather	4	3	2	3	4	3.0	Tolerable with Mitigation	Number of affected routes likely to be lower than in isolation due to the assumed deviations caused by cumulative projects steering traffic away from the DBS Array Areas. These cumulative projects include, most notably, Hornsea Four.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		5	1	1	1	2	1.3	Tolerable with Mitigation		4	3	2	3	4	3.0	Tolerable with Mitigation	Neptune Energy noted no concerns and oil and gas routeing between the DBS Array Areas and Dogger Bank A will be maintained.
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Installation vessel which is RAM ▪ Simultaneous installation of the Projects, Hornsea Four, and Eastern Green Link 2 is not likely in the same location	Displacement with manageable effects on schedule but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	2	1	1	1	2	1.3	Broadly Acceptable	N/A
			O		▪ Maintenance vessel which is RAM ▪ Simultaneous maintenance of the Projects, Hornsea Four, and Eastern Green Link 2 is not likely in the same location		2	1	1	1	1	1.0	Broadly Acceptable		2	1	1	1	2	1.3	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences								Consequences						
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk	
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Adverse weather ▪ Construction vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	4	1	1	1	22	1.3	Broadly Acceptable	Displacement with effects on schedule	3	1	1	1	2	1.3	Broadly Acceptable	Neptune Energy noted no vessel concerns.
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		3	1	1	1	2	1.3	Broadly Acceptable		3	1	1	1	2	1.3	Broadly Acceptable	
Commercial fishing vessels in transit	Isolation	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	3	1	2	1	3	1.8	Broadly Acceptable	It is assumed that the SAC will remain in place during the life of the Projects. MCA emphasise the importance of cooperation with the commercial fisheries chapter and relevant parties.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		3	1	1	1	1	1.0	Broadly Acceptable		2	1	2	1	3	1.8	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Installation vessel which is RAM	Displacement with manageable effects on schedule but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	
			O		▪ Maintenance vessel which is RAM		3	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		1	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	
	Cumulative	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Simultaneous buoyed construction/ decommissioning areas for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Adverse weather ▪ Construction vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	3	1	2	1	4	2.0	Broadly Acceptable	MCA emphasise the importance of cooperation with the commercial fisheries chapter and relevant parties.
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		4	1	1	1	1	1.0	Broadly Acceptable		4	1	2	1	4	2.0	Tolerable with Mitigation	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required and Additional Comments
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Installation vessel which is RAM ▪ Simultaneous installation of the Projects, Hornsea Four, and Eastern Green Link 2 is not likely in the same location	Displacement with manageable effects on schedule but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	2	1	1	1	2	1.3	Broadly Acceptable	
			O		▪ Maintenance vessel which is RAM ▪ Simultaneous maintenance of the Projects, Hornsea Four, and Eastern Green Link 2 is not likely in the same location		3	1	1	1	1	1.0	Broadly Acceptable		2	1	1	1	2	1.3	Broadly Acceptable	
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Adverse weather ▪ Construction vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences								Consequences						
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk	
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		1	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	
Recreational vessels (2.5 to 24m length)	Isolation	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	Cruising Association noted no concerns although it is important that the arrays are well marked and larger spacing between turbines would be beneficial.
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		2	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure	▪ Installation vessel which is RAM	Displacement with manageable	4	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	Cruising Association noted no concerns with

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
			O	▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Maintenance vessel which is RAM	effects on schedule but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	the Offshore Export Cable Corridor assuming appropriate marking of the ESP.
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		1	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
	Cumulative	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Simultaneous buoyed construction/ decommissioning areas for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Adverse weather ▪ Construction vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	N/A
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		2	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Installation vessel which is RAM ▪ Simultaneous installation of the Projects, Hornsea Four, and Eastern Green Link 2 is not likely in the same location	Displacement with manageable effects on schedule but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	Cruising Association noted no concerns with the Offshore Export Cable Corridor assuming appropriate marking of the ESP.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required and Additional Comments
			O		▪ Maintenance vessel which is RAM ▪ Simultaneous maintenance of the Projects, Hornsea Four, and Eastern Green Link 2 is not likely in the same location		3	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information ▪ Traffic monitoring	▪ Adverse weather ▪ Construction vessels which are RAM	Displacement with manageable effects on schedule but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on schedule	1	1	1	1	2	1.3	Broadly Acceptable	
			O	▪ Application for safety zones (major maintenance) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		1	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences								Consequences						
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk	
Increased Vessel to Vessel Collision Risk Between Third-Party Vessels																						
Commercial vessels (including oil and gas, marine aggregate dredger, wind farm)	Isolation	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM ▪ Reduction of navigable sea room between DBS Array Areas or between DBS West and Dogger Bank A	Displacement results in increased encounters and potential for low impact collision to occur	2	2	2	3	3	2.5	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	3	3	4	4	3.5	Broadly Acceptable	UKMPG noted no immediate concerns.
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM ▪ Reduction of navigable sea room between DBS Array Areas or between DBS West and Dogger Bank A		2	2	2	3	3	2.5	Broadly Acceptable		1	3	3	4	4	3.5	Broadly Acceptable	N/A
		Offshore export cable corridor	C/D	▪ Charting of infrastructure	▪ Installation vessel which RAM	Displacement results in	2	2	2	3	2	2.3	Broadly Acceptable	Displacement results in	1	3	3	4	3	3.3	Broadly Acceptable	Cruising Association noted no concerns

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
			O	▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Maintenance vessel which is RAM	increased encounters and potential for low impact collision to occur	1	2	2	3	2	2.3	Broadly Acceptable	increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	3	3	4	3	3.3	Broadly Acceptable	assuming appropriate marking of the ESP.
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement results in increased encounters and potential for low impact collision to occur	2	2	2	3	3	2.5	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	3	3	4	4	3.5	Broadly Acceptable	Neptune Energy noted no vessel concerns.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required and Additional Comments
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		2	2	2	3	3	2.5	Broadly Acceptable		1	3	3	4	4	3.5	Broadly Acceptable	
	Cumulative	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Simultaneous buoyed construction/ decommissioning areas for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM ▪ Reduction of navigable sea room between DBS Array Areas or between DBS West and Dogger Bank A	Displacement results in increased encounters and potential for low impact collision to occur	3	2	2	3	3	2.5	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable	UKMPG noted no immediate concerns.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required and Additional Comments
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM ▪ Reduction of navigable sea room between DBS Array Areas or between DBS West and Dogger Bank A		3	2	2	3	3	2.5	Broadly Acceptable		1	3	3	4	4	3.5	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Installation vessel which RAM ▪ Simultaneous installation of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location	Displacement results in increased encounters and potential for low impact collision to occur	2	2	2	3	2	2.3	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	3	3	4	3	3.3	Broadly Acceptable	N/A
			O		▪ Maintenance vessel which is RAM ▪ Simultaneous maintenance of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location		1	2	2	3	2	2.3	Broadly Acceptable		1	3	3	4	3	3.3	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required and Additional Comments
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Simultaneous buoyed construction/ decommissioning areas for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement results in increased encounters and potential for low impact collision to occur	2	2	2	3	3	2.5	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	3	3	4	4	3.5	Broadly Acceptable	Neptune Energy noted no vessel concerns.
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		2	2	2	3	3	2.5	Broadly Acceptable		1	3	3	4	4	3.5	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	
Commercial fishing vessels in transit	Isolation	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement results in increased encounters and potential for low impact collision to occur	2	3	2	3	2	2.5	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	3	4	3	3.5	Broadly Acceptable	It is assumed that the SAC will remain in place during the life of the Projects. MCA emphasise the importance of cooperation with the commercial fisheries chapter and relevant parties.
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		1	3	2	3	2	2.5	Broadly Acceptable		1	4	3	4	3	3.5	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure	▪ Installation vessel which RAM	Displacement results in	2	3	2	3	2	2.5	Broadly Acceptable	Displacement results in	1	4	3	4	3	3.5	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required and Additional Comments
			O	▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Maintenance vessel which is RAM	increased encounters and potential for low impact collision to occur	1	3	2	3	2	2.5	Broadly Acceptable	increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	3	4	3	3.5	Broadly Acceptable	
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement results in increased encounters and potential for low impact collision to occur	1	2	2	3	2	2.5	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	3	4	3	3.5	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		1	2	2	3	2	2.5	Broadly Acceptable		1	4	3	4	3	3.5	Broadly Acceptable	
	Cumulative	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Simultaneous buoyed construction/ decommissioning areas for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement results in increased encounters and potential for low impact collision to occur	3	3	2	3	2	2.5	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	3	4	3	3.5	Broadly Acceptable	MCA emphasise the importance of cooperation with the commercial fisheries chapter and relevant parties.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		2	3	2	3	2	2.5	Broadly Acceptable		1	4	3	4	3	3.5	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Installation vessel which RAM ▪ Simultaneous installation of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location	Displacement results in increased encounters and potential for low impact collision to occur	2	3	2	3	2	2.5	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	3	4	3	3.5	Broadly Acceptable	
			O		▪ Maintenance vessel which is RAM ▪ Simultaneous maintenance of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location		1	3	2	3	2	2.5	Broadly Acceptable		1	4	3	4	3	3.5	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required and Additional Comments
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Simultaneous buoyed construction/ decommissioning areas for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement results in increased encounters and potential for low impact collision to occur	2	3	2	3	2	2.5	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	3	4	3	3.5	Broadly Acceptable	
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		2	3	2	3	2	2.5	Broadly Acceptable		1	4	3	4	3	3.5	Broadly Acceptable	

<table>
<tr><th rowspan="3">User</th><th rowspan="3">Isolation/ Cumulative</th><th rowspan="3">Project Component(s)</th><th rowspan="3">Phase (C/O/D)</th><th rowspan="3">Embedded Mitigation Measures (Full Descriptions Provided in Section 20)</th><th rowspan="3">Possible Causes</th><th rowspan="3">Most Likely Consequences</th><th colspan="7">Realistic Most Likely Consequences</th><th rowspan="3">Worst Case Consequences</th><th colspan="7">Realistic Worst Case Consequences</th><th rowspan="3">Further Mitigation Required and Additional Comments</th></tr>
<tr><th rowspan="2">Frequency</th><th colspan="5">Consequences</th><th rowspan="2">Risk</th><th rowspan="2">Frequency</th><th colspan="5">Consequences</th><th rowspan="2">Risk</th></tr>
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<tr><td rowspan="3">Recreational vessels (2.5 to 24m length)</td><td rowspan="3">Isolation</td><td rowspan="2">DBS Array Areas</td><td>C/D</td><td>▪ Application for safety zones
▪ Buoyed construction/ decommissioning area
▪ Charting of infrastructure
▪ Compliance with MGN 654
▪ Guard vessels
▪ Pollution prevention measures
▪ Promulgation of information
▪ Traffic monitoring</td><td>▪ Presence of buoyed construction/ decommissioning area
▪ Adverse weather
▪ Construction/ decommissioning vessels which are RAM</td><td rowspan="2">Displacement results in increased encounters and potential for low impact collision to occur</td><td>2</td><td>3</td><td>1</td><td>3</td><td>2</td><td>2.3</td><td>Broadly Acceptable</td><td rowspan="2">Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution</td><td>1</td><td>4</td><td>2</td><td>4</td><td>2</td><td>3.0</td><td>Broadly Acceptable</td><td rowspan="2">Cruising Association noted no concerns although it is important that the arrays are well-marked and larger spacing between turbines would be beneficial.</td></tr>
<tr><td>O</td><td>▪ Application for safety zones (major maintenance only)
▪ Charting of infrastructure
▪ Compliance with MGN 654
▪ Guard vessels
▪ Pollution prevention measures
▪ Promulgation of information</td><td>▪ Presence of surface structures
▪ Adverse weather
▪ Maintenance vessels which are RAM</td><td>1</td><td>3</td><td>1</td><td>3</td><td>2</td><td>2.3</td><td>Broadly Acceptable</td><td>1</td><td>4</td><td>2</td><td>4</td><td>2</td><td>3.0</td><td>Broadly Acceptable</td></tr>
<tr><td>Offshore export cable corridor</td><td>C/D</td><td>▪ Charting of infrastructure</td><td>▪ Installation vessel which RAM</td><td>Displacement results in</td><td>2</td><td>3</td><td>1</td><td>3</td><td>2</td><td>2.3</td><td>Broadly Acceptable</td><td>Displacement results in</td><td>1</td><td>4</td><td>2</td><td>4</td><td>2</td><td>3.0</td><td>Broadly Acceptable</td><td>Cruising Association noted no concerns with</td></tr>
</table>

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
			O	▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Maintenance vessel which is RAM	increased encounters and potential for low impact collision to occur	1	3	1	3	2	2.3	Broadly Acceptable	increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	the Offshore Export Cable Corridor assuming appropriate marking of the ESP.
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Presence of buoyed construction/ decommissioning area ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement results in increased encounters and potential for low impact collision to occur	1	3	1	3	2	2.3	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures ▪ Adverse weather ▪ Maintenance vessels which are RAM		1	3	1	3	2	2.3	Broadly Acceptable		1	4	2	4	2	3.0	Broadly Acceptable	
	Cumulative	DBS Array Areas	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Simultaneous buoyed construction/ decommissioning areas for the Projects, Dogger Bank C, Hornsea Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement results in increased encounters and potential for low impact collision to occur	3	3	1	3	2	2.3	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences					Risk			Consequences					Risk	
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence		
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		2	3	1	3	2	2.3	Broadly Acceptable		1	4	2	4	2	3.0	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Installation vessel which RAM ▪ Simultaneous installation of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location	Displacement results in increased encounters and potential for low impact collision to occur	2	3	1	3	2	2.3	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	Cruising Association noted no concerns with the Offshore Export Cable Corridor assuming appropriate marking of the ESP.
			O		▪ Maintenance vessel which is RAM ▪ Simultaneous maintenance of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location		1	3	1	3	2	2.3	Broadly Acceptable		1	4	2	4	2	3.0	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Realistic Most Likely Consequences: Consequences: People	Realistic Most Likely Consequences: Consequences: Environment	Realistic Most Likely Consequences: Consequences: Property	Realistic Most Likely Consequences: Consequences: Business	Realistic Most Likely Consequences: Consequences: Average Consequence	Realistic Most Likely Consequences: Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Realistic Worst Case Consequences: Consequences: People	Realistic Worst Case Consequences: Consequences: Environment	Realistic Worst Case Consequences: Consequences: Property	Realistic Worst Case Consequences: Consequences: Business	Realistic Worst Case Consequences: Consequences: Average Consequence	Realistic Worst Case Consequences: Risk	Further Mitigation Required and Additional Comments
		ESP	C/D	▪ Application for safety zones ▪ Buoyed construction/ decommissioning area ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information ▪ Traffic monitoring	▪ Simultaneous buoyed construction/ decommissioning areas for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Adverse weather ▪ Construction/ decommissioning vessels which are RAM	Displacement results in increased encounters and potential for low impact collision to occur	1	3	1	3	2	2.3	Broadly Acceptable	Displacement results in increased encounters and high impact collision occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	
			O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Guard vessels ▪ Pollution prevention measures ▪ Promulgation of information	▪ Presence of surface structures for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Maintenance vessels which are RAM		1	3	1	3	2	2.3	Broadly Acceptable		1	4	2	4	2	3.0	Broadly Acceptable	
Increased Vessel to Vessel Collision Risk Between a Third-Party Vessel and a Project Vessel																						
Commercial vessels	Isolation	DBS Array Areas	C/D			Increased encounters	4	1	1	1	2	1.3	Broadly Acceptable	Collision event occurs involving	1	3	3	4	4	3.5	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences								Consequences						
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk	
(including oil and gas, marine aggregate dredger, wind farm)			O	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	resulting in increased alertness but no safety risks	3	1	1	1	2	1.3	Broadly Acceptable	vessel damage, PLL, and/or pollution	1	3	3	4	4	3.5	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	2	3	3	4	3	3.3		N/A
			O				2	1	1	1	1	1.0	Broadly Acceptable		2	3	3	4	3	3.3	Broadly Acceptable	
		ESP	C/D			Increased encounters	3	1	1	1	2	1.3	Broadly Acceptable	Collision event occurs involving	2	3	3	4	4	3.5	Broadly Acceptable	Neptune Energy noted no vessel concerns.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences								Consequences						
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk	
			O	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	resulting in increased alertness but no safety risks	2	1	1	1	2	1.3	Broadly Acceptable	vessel damage, PLL, and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable	
	Cumulative	DBS Array Areas	C/D	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures	▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous installation of the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing is not likely in the same location	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	2	1.3	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	3	3	4	4	3.5	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk			Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence					People	Environment	Property	Business	Average Consequence		
			O	▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous maintenance of the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing is not likely in the same location		2	1	1	1	2	1.3	Broadly Acceptable		1	3	3	4	4	3.5	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous installation of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	2	3	3	4	3	3.3	Broadly Acceptable	N/A
			O		▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous maintenance of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location		2	1	1	1	1	1.0	Broadly Acceptable		2	3	3	4	3	3.3	Broadly Acceptable	
		ESP	C/D			Increased encounters	3	1	1	1	2	1.3	Broadly Acceptable	Collision event occurs involving	2	3	3	4	4	3.5	Broadly Acceptable	Neptune Energy noted no vessel concerns.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
			O	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	resulting in increased alertness but no safety risks	2	1	1	1	2	1.3	Broadly Acceptable	vessel damage, PLL, and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable	
Commercial fishing vessels in transit	Isolation	DBS Array Areas	C/D	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	3	3.3	Broadly Acceptable	N/A
			O				3	1	1	1	1	1.0	Broadly Acceptable		2	4	2	4	3	3.3	Broadly Acceptable	

<table>
<tr><th rowspan="3">User</th><th rowspan="3">Isolation/ Cumulative</th><th rowspan="3">Project Component(s)</th><th rowspan="3">Phase (C/O/ D)</th><th rowspan="3">Embedded Mitigation Measures (Full Descriptions Provided in Section 20)</th><th rowspan="3">Possible Causes</th><th rowspan="3">Most Likely Consequences</th><th colspan="7">Realistic Most Likely Consequences</th><th rowspan="3">Worst Case Consequences</th><th colspan="7">Realistic Worst Case Consequences</th><th rowspan="3">Further Mitigation Required and Additional Comments</th></tr>
<tr><th rowspan="2">Frequency</th><th colspan="5">Consequences</th><th rowspan="2">Risk</th><th rowspan="2">Frequency</th><th colspan="5">Consequences</th><th rowspan="2">Risk</th></tr>
<tr><th>People</th><th>Environment</th><th>Property</th><th>Business</th><th>Average Consequence</th><th>People</th><th>Environment</th><th>Property</th><th>Business</th><th>Average Consequence</th></tr>
<tr><td rowspan="4"></td><td rowspan="4"></td><td rowspan="2">Offshore export cable corridor</td><td>C/D</td><td rowspan="2">▪ Charting of infrastructure
▪ Guard vessels
▪ Marine coordination for Project vessels
▪ Pollution prevention measures
▪ Project vessel compliance with international marine regulations (COLREGs)
▪ Promulgation of information</td><td rowspan="2">▪ Project vessels in transit
▪ Lack of third-party awareness</td><td rowspan="2">Increased encounters resulting in increased alertness but no safety risks</td><td>4</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1.0</td><td>Broadly Acceptable</td><td rowspan="2">Collision event occurs involving vessel damage, PLL, and/or pollution</td><td>2</td><td>4</td><td>2</td><td>4</td><td>3</td><td>3.3</td><td>Broadly Acceptable</td><td rowspan="2">N/A</td></tr>
<tr><td>O</td><td>3</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1.0</td><td>Broadly Acceptable</td><td>2</td><td>4</td><td>2</td><td>4</td><td>3</td><td>3.3</td><td>Broadly Acceptable</td></tr>
<tr><td rowspan="2">ESP</td><td>C/D</td><td rowspan="2">▪ Application for safety zones
▪ Charting of infrastructure
▪ Guard vessels
▪ Marine coordination for Project vessels
▪ Pollution prevention measures
▪ Project vessel compliance with international marine regulations (COLREGs)
▪ Promulgation of information</td><td rowspan="2">▪ Project vessels in transit
▪ Lack of third-party awareness</td><td rowspan="2">Increased encounters resulting in increased alertness but no safety risks</td><td>3</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1.0</td><td>Broadly Acceptable</td><td rowspan="2">Collision event occurs involving vessel damage, PLL, and/or pollution</td><td>1</td><td>4</td><td>2</td><td>4</td><td>3</td><td>3.3</td><td>Broadly Acceptable</td><td rowspan="2">N/A</td></tr>
<tr><td>O</td><td>2</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1.0</td><td>Broadly Acceptable</td><td>2</td><td>4</td><td>2</td><td>4</td><td>3</td><td>3.3</td><td>Broadly Acceptable</td></tr>
</table>

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	
	Cumulative	DBS Array Areas	C/D	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous installation of the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing is not likely in the same location	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	3	3.3	Broadly Acceptable	N/A
			O		▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous maintenance of the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing is not likely in the same location		3	1	1	1	1	1.0	Broadly Acceptable		2	4	2	4	3	3.3	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures	▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous installation of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location	Increased encounters resulting in increased alertness but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	2	4	2	4	3	3.3	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk			Frequency	Consequences					Risk		
								People	Environment	Property	Business	Average Consequence					People	Environment	Property	Business	Average Consequence			
			O	▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous maintenance of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location		3	1	1	1	1	1.0	Broadly Acceptable			2	4	2	4	3	3.3	Broadly Acceptable		
		ESP	C/D	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable		Collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	3	3.3	Broadly Acceptable		N/A
		ESP	O				2	1	1	1	1	1.0	Broadly Acceptable			2	4	2	4	2	3.0	Broadly Acceptable		
	Isolation	DBS Array Areas	C/D			Increased encounters	2	1	1	1	1	1.0	Broadly Acceptable		Collision event occurs involving	1	4	2	4	2	3.0	Broadly Acceptable		N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required and Additional Comments
			O	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	resulting in increased alertness but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	
Recreational vessels (2.4 to 24m length)		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable	Cruising Association noted no concerns with the Offshore Export Cable Corridor assuming appropriate marking of the ESP.
			O				3	1	1	1	1	1.0	Broadly Acceptable		2	4	2	4	2	3.0	Broadly Acceptable	
		ESP	C/D			Increased encounters	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving	1	4	2	4	2	3.0	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation Required and Additional Comments
								Consequences									Consequences							
							Frequency	People	Environment	Property	Business	Average Consequence	Risk			Frequency	People	Environment	Property	Business	Average Consequence	Risk	
			O	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	resulting in increased alertness but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable	
	Cumulative	DBS Array Areas	C/D	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures	▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous installation of the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing from same or similar ports	Increased encounters resulting in increased alertness but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation Required and Additional Comments
			O	▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous maintenance of the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing from same or similar ports		2	1	1	1	1	1.0	Broadly Acceptable		1	4	2	4	2	3.0	Broadly Acceptable	
		Offshore export cable corridor	C/D	▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous installation of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location	Increased encounters resulting in increased alertness but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable	Cruising Association noted no concerns with the Offshore Export Cable Corridor assuming appropriate marking of the ESP.
			O		▪ Project vessels in transit ▪ Lack of third-party awareness ▪ Simultaneous maintenance of the Projects, Hornsea Four, and Eastern Green Link is not likely in the same location		3	1	1	1	1	1.0	Broadly Acceptable		2	4	2	4	2	3.0	Broadly Acceptable	
		ESP	C/D			Increased encounters	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving	1	4	2	4	2	3.0	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
			O	▪ Application for safety zones ▪ Charting of infrastructure ▪ Guard vessels ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (COLREGs) ▪ Promulgation of information	▪ Project vessels in transit ▪ Lack of third-party awareness	resulting in increased alertness but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable	

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
Creation of Vessel to Structure Allision Risk (Including Powered, Drifting and Internal)																						
Commercial vessels (including oil and gas, marine aggregate dredger, wind farm)	Isolation	DBS Array Areas	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure ▪ Reduction of navigable sea room between the DBS Array Areas or between DBS West and Dogger Bank A	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with a platform involving vessel damage, PLL, and/or pollution	1	4	3	5	5	4.3	Broadly Acceptable	MCA noted the worst case array layout does not raise any concerns including placement of platforms on periphery. UK Chamber of Shipping noted previous allision concerns for the southwest corner of DBS West have now been alleviated with the site refinement.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
		ESP	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with ESP involving vessel damage, PLL, and/or pollution	2	4	3	5	5	4.3	Tolerable with Mitigation	Neptune Energy noted no vessel concerns.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation Required and Additional Comments
								Consequences									Consequences							
							Frequency	People	Environment	Property	Business	Average Consequence	Risk			Frequency	People	Environment	Property	Business	Average Consequence	Risk		
	Cumulative	DBS Array Areas	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures associated with the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure ▪ Reduction of navigable sea room between the DBS Array Areas or between DBS West and Dogger Bank A	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with a platform involving vessel damage, PLL, and/or pollution	1	4	3	5	5	4.3	Broadly Acceptable	MCA noted the worst case array layout does not raise any concerns including placement of platforms on periphery.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation Required and Additional Comments
								Consequences					Risk				Consequences					Risk	
							Frequency	People	Environment	Property	Business	Average Consequence				Frequency	People	Environment	Property	Business	Average Consequence		
		ESP	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures associated with the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with ESP involving vessel damage, PLL, and/or pollution	2	4	3	5	5	4.3	Tolerable with Mitigation	Neptune Energy noted no vessel concerns.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	
Commercial fishing vessels in transit	Isolation	DBS Array Areas	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with a platform involving vessel damage, PLL, and/or pollution	1	5	2	5	4	4.0	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences								Consequences						
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk	
		ESP	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	2	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with ESP involving vessel damage, PLL, and/or pollution	1	5	2	5	4	4.0	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	
	Cumulative	DBS Array Areas	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures associated with the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with a platform involving vessel damage, PLL, and/or pollution	1	5	2	5	4	4.0	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences					Risk			Consequences					Risk	
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence		
		ESP	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures associated with the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	2	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with ESP involving vessel damage, PLL, and/or pollution	1	5	2	5	4	4.0	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	
Recreational vessels (2.5 to 24m length)	Isolation	DBS Array Areas	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Minimum blade tip clearance ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	2	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with a platform involving vessel damage, PLL, and/or pollution	1	4	3	5	2	3.5	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
		ESP	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with ESP involving vessel damage, PLL, and/or pollution	1	5	2	5	2	3.5	Broadly Acceptable	Cruising Association noted no concerns assuming appropriate marking of the ESP.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences					Risk			Consequences					Risk	
							Frequency	People	Environment	Property	Business	Average Consequence			Frequency	People	Environment	Property	Business	Average Consequence		
	Cumulative	DBS Array Areas	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Minimum blade tip clearance ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures associated with the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	2	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with a platform involving vessel damage, PLL, and/or pollution	1	5	2	5	2	3.5	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
		ESP	O	▪ Application for safety zones (major maintenance only) ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS) ▪ Promulgation of information	▪ Presence of surface structures associated with the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather ▪ Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	2	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with ESP involving vessel damage, PLL, and/or pollution	1	4	3	5	2	3.5	Broadly Acceptable	Cruising Association noted no concerns assuming appropriate marking of the ESP.
Reduction of Under-Keel Clearance Due to Cable Protection																							
All vessels	Isolation	Sub-sea cables	O	▪ Cable burial risk assessment ▪ Guard vessels ▪ Pollution prevention measures	▪ Reduced depth due to cable protection	Vessel transits over an area of reduced clearance but does not make contact	4	1	1	1	1	1.0	Broadly Acceptable	Grounding on cable protection resulting in vessel damage, pollution (including spillage of potential hazardous cargo)	2	3	3	4	4	3.5	Broadly Acceptable	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/ D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	
Anchor Interaction with Sub-Sea Cables																						
All vessels	Isolation	Sub-sea cables	O	▪ Cable burial risk assessment ▪ Charting of infrastructure ▪ Compliance with MGN 654 ▪ Promulgation of information	▪ Presence of sub-sea cables ▪ Human/navigation error ▪ Mechanical/ technical failure ▪ Adverse weather	Commercial vessel drops or drag anchor in vicinity of an installed cable but no interaction occurs	1	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over a cable/protection resulting in damage to the cable/protection and/or anchor	1	1	1	2	2	1.5	Broadly Acceptable	N/A
Interference with Marine Navigation, Communication and Position Fixing Equipment																						
All vessels	Isolation	DBS Array Areas	O	▪ Cable burial risk assessment	▪ Human error relating to adjustment of Radar controls ▪ Presence of surface structures	Structures have no material effect upon the Radar, communications and navigation equipment on a vessel	4	1	1	1	1	1.0	Broadly Acceptable	Minor level of Radar interference due to the structures	3	1	1	1	1	1.0	Broadly Acceptable	N/A
		Offshore export cable corridor	O	▪ Cable burial risk assessment	▪ EMF from cables	Cables have no material effect upon the Radar, communications and navigation equipment on a vessel	4	1	1	1	1	1.0	Broadly Acceptable	Minor level of EMF interference due to the wind farm infrastructure	3	1	1	1	1	1.0	Broadly Acceptable	N/A
		ESP	O	▪ Cable burial risk assessment	▪ Human error relating to adjustment of Radar controls ▪ Presence of surface structure	Structures have no material effect upon the Radar, communications and navigation equipment on a vessel	4	1	1	1	1	1.0	Broadly Acceptable	Minor level of Radar interference due to the structures	3	1	1	1	1	1.0	Broadly Acceptable	Neptune Energy noted no vessel concerns. Cruising Association noted no concerns assuming appropriate marking of the ECR platforms.

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk	
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
Reduction in Emergency Response Capability (Including SAR Access)																						
Emergency responders	Isolation	DBS Array Areas	O	▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS)	▪ Array does not facilitate responder access ▪ Limited resource capability ▪ Adverse weather	Delay to response request	4	1	1	1	2	1.3	Broadly Acceptable	Delay to response request leading to vessel damage, injury to person, PLL, and/or pollution	2	4	4	5	5	4.5	Tolerable with Mitigation	N/A
		Offshore export cable corridor	O	▪ Cable burial risk assessment ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS)	▪ Limited resource capability	Delay to response request	2	1	1	1	2	1.3	Broadly Acceptable	Delay to response request leading to vessel damage, injury to person, PLL, and/or pollution	2	4	4	5	5	4.5	Tolerable with Mitigation	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required and Additional Comments
								Consequences								Consequences						
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk	
		ESP	O	▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS)	▪ Array does not facilitate responder access ▪ Limited resource capability ▪ Adverse weather	Delay to response request	3	1	1	1	2	1.3	Broadly Acceptable	Delay to response request leading to vessel damage, injury to person, PLL, and/or pollution	1	4	4	5	5	4.5	Broadly Acceptable	N/A
	Cumulative	DBS Array Areas	O	▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS)	▪ Simultaneous operation for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Array does not facilitate responder access ▪ Adverse weather	Delay to response request	5	1	1	1	2	1.3	Tolerable with Mitigation	Delay to response request leading to vessel damage, injury to person, PLL, and/or pollution	3	4	4	5	5	4.5	Tolerable with Mitigation	N/A

User	Isolation/ Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Section 20)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation Required and Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk			Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		
		Offshore export cable corridor	O	▪ Cable burial risk assessment ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS)	▪ Limited resource capability	Delay to response request	3	1	1	1	2	1.3	Broadly Acceptable		Delay to response request leading to vessel damage, injury to person, PLL, and/or pollution	3	4	4	5	5	4.5	Tolerable with Mitigation		N/A
		ESP	O	▪ Compliance with MGN 654 ▪ Lighting and marking ▪ Marine coordination for Project vessels ▪ Pollution prevention measures ▪ Project vessel compliance with international marine regulations (SOLAS)	▪ Simultaneous operation for the Projects, Dogger Bank C, Hornsea Three, Hornsea Four, and Outer Dowsing ▪ Array does not facilitate responder access ▪ Adverse weather	Delay to response request	4	1	1	1	2	1.3	Broadly Acceptable		Delay to response request leading to vessel damage, injury to person, PLL, and/or pollution	2	4	4	5	5	4.5	Tolerable with Mitigation		N/A

Appendix C Consequences Assessment

662. This appendix presents an assessment of the consequences of collision and allision incidents, in terms of people and the environment, due to the presence of the wind farm structures.

663. The significance of risk of the hazards due to the presence of the Projects are also assessed based upon risk evaluation criteria and comparison with historical accident data in UK waters[10].

C.1 Risk Evaluation Criteria

C.1.1 Risk to People

664. With regard to the assessment of risk to people two measures are considered, namely:

- Individual risk; and
- Societal risk.

C.1.2 Annual Individual Risk

665. Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of the Projects. Individual risk considers not only the frequency of the accident and the consequences (e.g., likelihood of death), but also the individual's fractional exposure to that risk, i.e., the probability of the individual being in the given location at the time of the incident.

666. The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the Projects are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of the Projects relative to the background individual risk levels.

667. Annual risk levels to crew (the annual risk to an average crew member) for different vessel types are presented in Figure C.1, which also includes the upper and lower bounds for risk acceptance criteria as suggested in IMO MSC 72/16 (IMO, 2001). The annual individual risk to crew falls within the ALARP region for each of the vessel types presented.

[10] For the purposes of this assessment, UK waters is defined as the UK EEZ and UK territorial waters refers to the 12nm limit from the British Isles, excluding the Republic of Ireland.

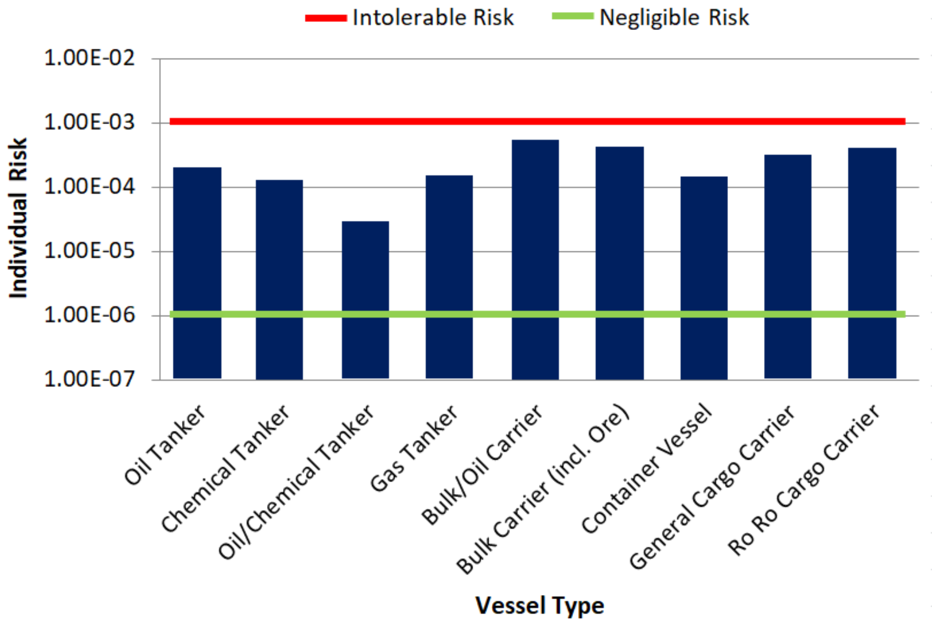

Figure C.1 Individual Risk Levels and Acceptance Criteria per Vessel Type

668. Typical bounds defining the ALARP regions for decision making within shipping are presented in Table C.1. It can be seen that for a new vessel the target upper bound for ALARP is set lower since new vessels are expected to be safer.

Table C.1 Individual Risk ALARP Criteria

Individual	Lower Bound for ALARP	Upper Bound for ALARP
To crew member	10^{-6}	10^{-3}
To passenger	10^{-6}	10^{-4}
Third party	10^{-6}	10^{-4}
New vessel target	10^{-6}	Above values reduced by one order of magnitude

669. On a UK basis, the MCA website presents individual risks for various UK industries based upon Health, Safety, and Environment (HSE) data from 1987 to 1991. The risks for different industries are presented in Figure C.2.

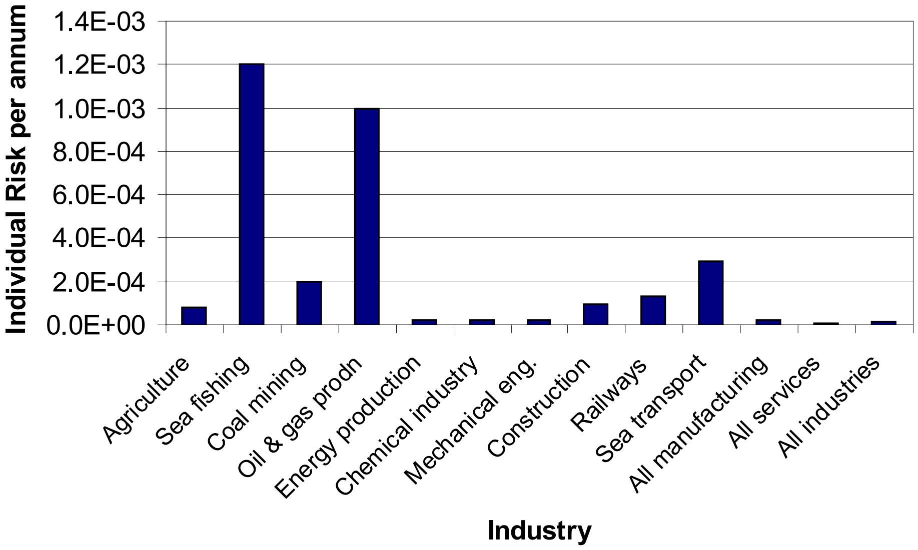

Figure C.2 Individual Risk per Year for Various UK Industries

670. The individual risk for sea transport of 2.9×10^{-4} per year is consistent with the worldwide data presented in Figure C.2, whilst the individual risk for sea fishing of 1.2×10^{-3} per year is the highest across all of the industries included.

C.1.3 Societal Risk

671. Societal risk is used to estimate risks of accidents affecting many persons (catastrophes) and acknowledging risk adverse or neutral attitudes. Societal risk includes the risk to every person, even if a person is only exposed to risk on one brief occasion. For assessing the risk to a large number of affected people societal risk is desirable because individual risk is insufficient in evaluating risks imposed on large numbers of people.

672. Within this assessment, societal (navigation-based) risk can be assessed for the Projects, giving account to the change in risk associated with each accident scenario caused by the introduction of the wind farm structures. Societal risk may be expressed as:

- Annual fatality rate where frequency and fatality are combined into a convenient one-dimensional measure of societal risk (also known as PLL); and
- F-N diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

673. When assessing societal risk this study focuses on PLL, which takes into account the number of people likely to be involved in an incident (which is higher for certain vessel types) and assesses the significance of the change in risk compared to the background risk levels.

C.1.4 Risk to Environment

674. For risk to the environment the key criteria considered in terms of the risk due to the Projects is the potential quantity of oil spilled from a vessel involved in an incident.

675. It is recognised that there will be other potential pollution, e.g., hazardous containerised cargoes; however, oil is considered the most likely pollutant and the extent of predicted oil spills will provide an indication of the significance of pollution risk due to the Projects to background pollution risk levels for the UK.

C.2 Marine Accident Investigation Branch Incident Analysis

C.2.1 All UK Waters Incidents

676. All British flagged commercial vessels are required to report accidents to the MAIB. Non-UK flagged vessels do not have to report unless they are at a UK port or within 12nm territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report accidents to the MAIB; however, a significant proportion of these incidents are reported to and investigated by the MAIB.

677. Only incidents occurring in UK waters have been considered within this assessment for which the MAIB data is most comprehensive. It is also noted that incidents occurring in ports/harbours and rivers/canals have been excluded since the causes and consequences may differ considerably from an accident occurring offshore, which is the location of most relevance to the Projects.

678. Taking into account these criteria, a total of 12,093 accidents, injuries and hazardous incidents were reported to the MAIB between 2000 and 2019 involving 13,965 vessels (some incidents, such as collisions, involved more than one vessel).

679. The locations of all incidents reported in proximity to the UK are presented in Figure C.3, colour-coded by incident type. The distribution of unique incidents by year in UK waters is presented in Figure C.4.

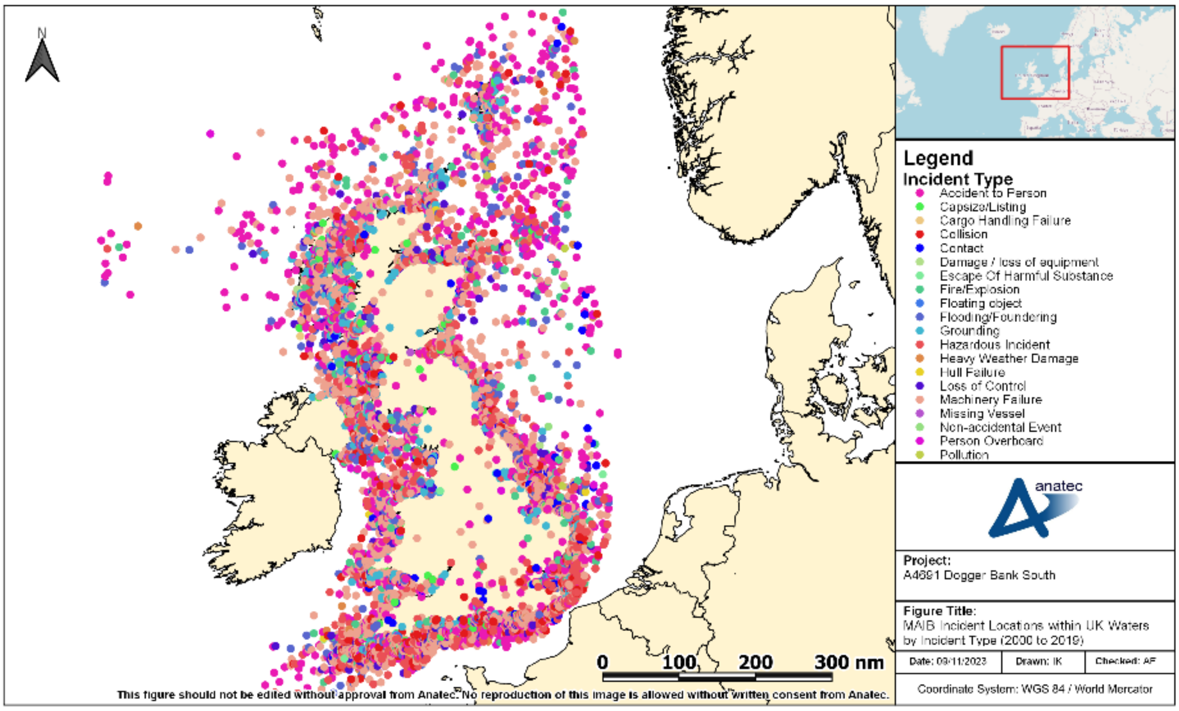

Figure C.3 MAIB Incident Locations within UK Waters by Incident Type (2000 to 2019)

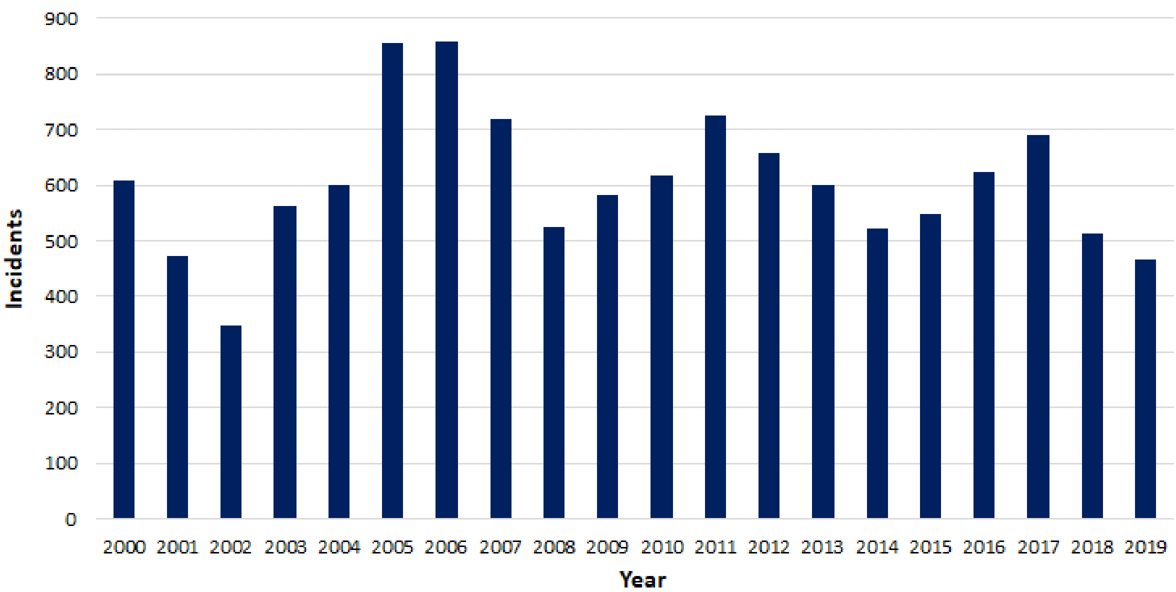

Figure C.4 MAIB Unique Incidents per Year within UK Waters (2000 to 2019)

680. The average number of unique incidents per year was 605. There has generally been a fluctuating trend in incidents over the 20-year period.

681. The distribution of incidents in UK waters by incident type is presented in Figure C.5.

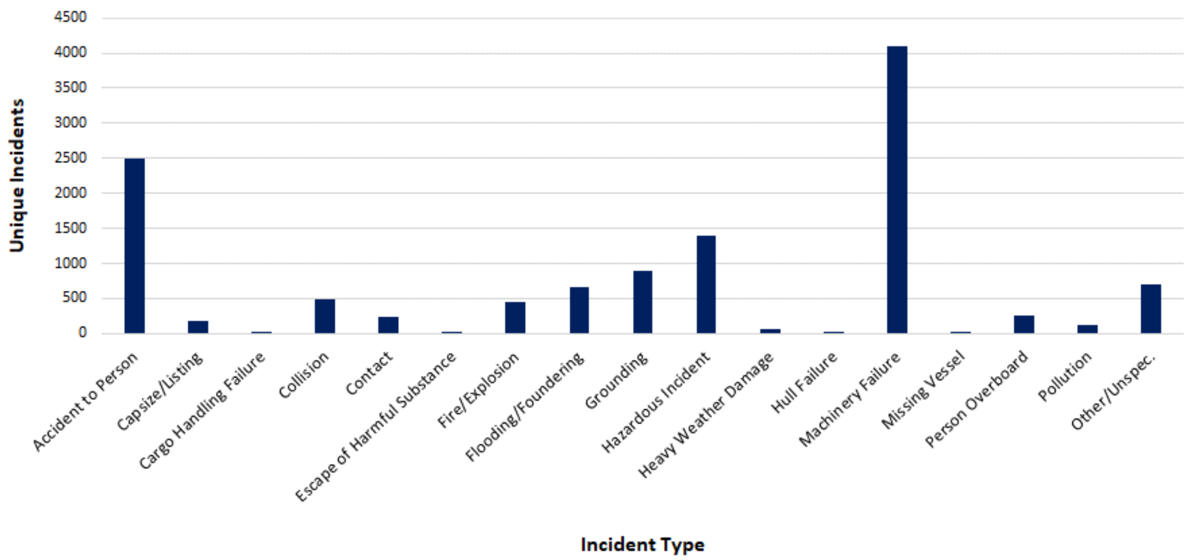

Figure C.5 MAIB Incident Types Breakdown within UK Waters (2000 to 2019)

682. The most frequent incident types were *"machinery failure"* (34%), *"accident to person"* (21%) and *"hazardous incident"* (12%). *"Collision"* and *"contact"* incidents represented 4% and 2% of total incidents, respectively.

683. The distribution of incidents in UK waters by vessel type is presented in Figure C.6.

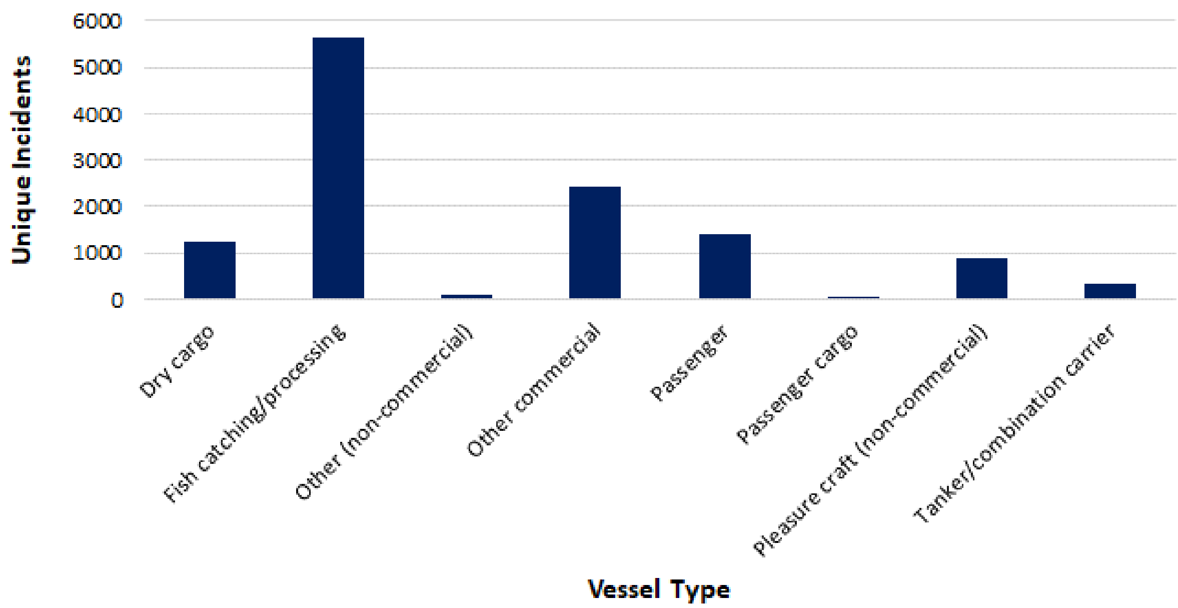

Figure C.6 MAIB Incident Types Breakdown within UK Waters (2000 to 2019)

684. The vessel types most frequently involved in incidents were fishing vessels (46%), other commercial vessels (20%) (including offshore industry vessels, tugs, workboats and pilot vessels) and dry cargo vessels (10%).

685. The total of 373 fatalities were reported in the MAIB incidents within UK waters from 2000 to 2019, averaging 19 fatalities per year.

686. The distribution of fatalities in UK waters by vessel type and person category (namely crew, passenger and other) is presented in Figure C.7.

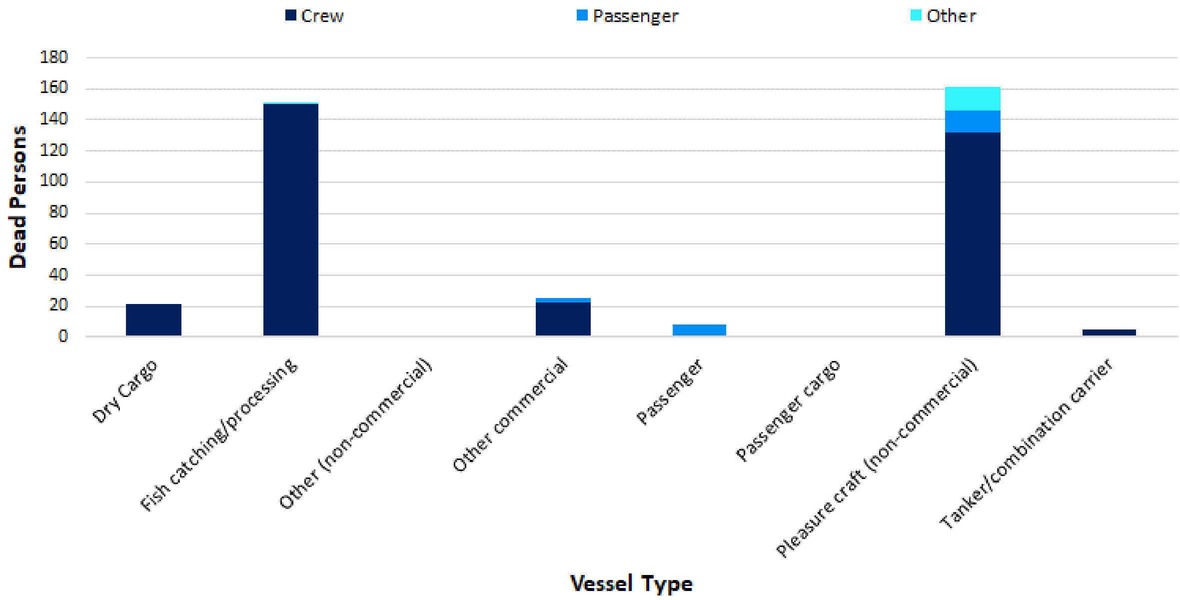

Figure C.7 MAIB Fatalities by Vessel Type within UK Waters (2000 to 2019)

687. The majority of fatalities occurred to pleasure craft (43%) and fishing vessels (40%), with crew members the main people involved (89%).

C.2.2 Collision Incidents

688. The MAIB define a collision incident as "ships striking or being struck by another ship, regardless of whether the ships are underway, anchored or moored" (MAIB, 2013).

689. A total of 481 collision incidents were reported to the MAIB in UK waters between 2000 and 2019 involving 1,090 vessels (in a small number of cases the other vessel involved was not logged).

690. The locations of collision incidents reported in proximity to the UK are presented in Figure C.8. The distribution of collision incidents per year is presented in Figure C.9.

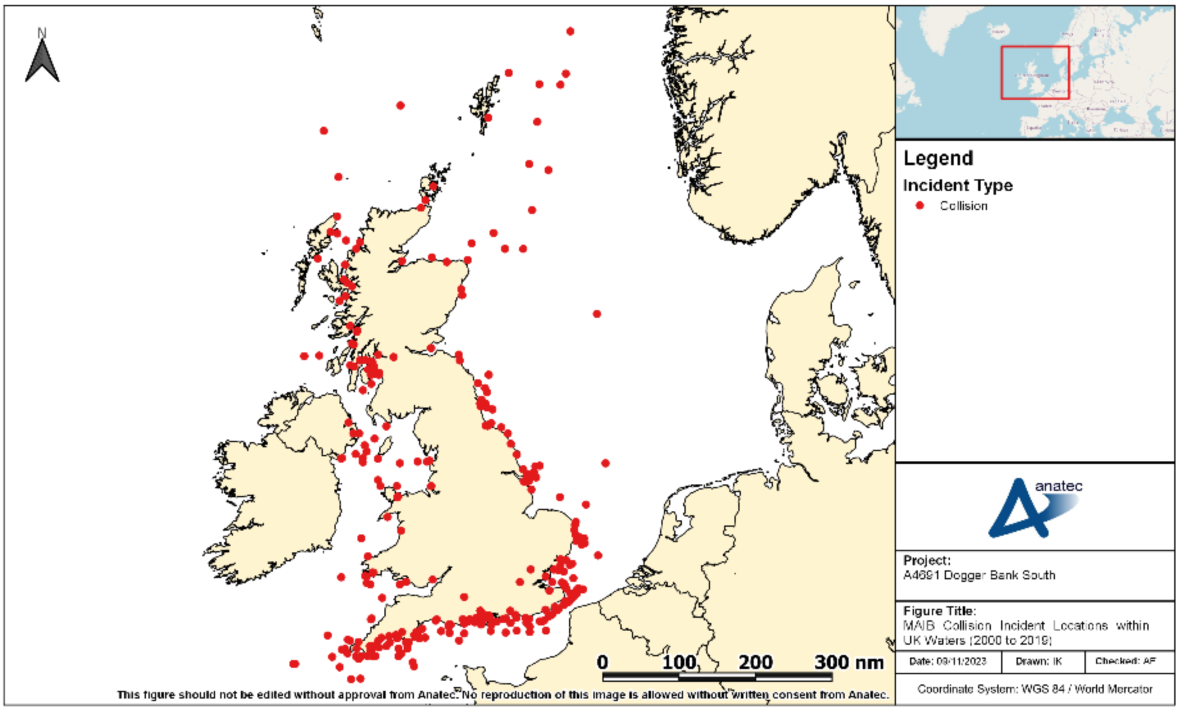

Figure C.8 MAIB Collision Incident Locations within UK Waters (2000 to 2019)

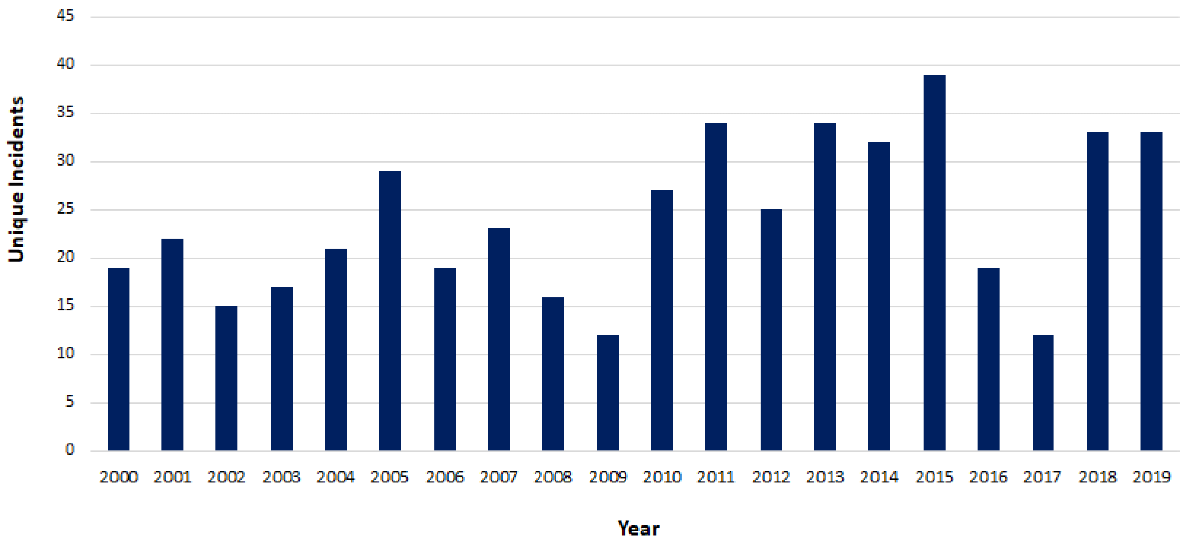

Figure C.9 MAIB Annual Collision Incidents within UK Water (2000 to 2019)

691. The average number of unique collision incidents per year was 14. There has been an overall slight increasing trend in collision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

692. The most common vessel types involved in collision incidents were other commercial vessels (29%), fishing vessels (24%), non-commercial pleasure craft (23%), and dry cargo vessels (12%).

693. The total of six fatalities were reported in MAIB collision incidents within UK waters between 2000 and 2019. Details of each of these fatal incidents reported by the MAIB are presented in Table C.2.

Table C.2 Description of Fatal MAIB Collision Incidents (2000 to 2019)

Date	Description	Fatalities
October 2001	Collision between dry cargo vessel and chemical tanker following lateness by watchkeepers in taking effective action. Dry cargo vessel sank with five of the six crew members rescued.	1
July 2005	Collision between two powerboats at night. Both vessels were unlit and both helmsmen had consumed alcohol. One of the helmsmen died.	1
October 2007	Collision between fishing vessel and coastal general cargo vessel following failure to keep an effective lookout. Fishing vessel sank with three of the four crew members abandoning ship into a life raft but the fourth crew member was not recovered.	1
August 2010	Collision between passenger ferry and fishing vessel. Fishing vessel sank with one of the two crew members recovered from the sea but the other member was not recovered despite an extensive search.	1
June 2015	Collision between Rigid-hulled Inflatable Boat (RIB) and yacht. Believed that around a dozen persons were onboard the motorboat with the majority taken ashore by lifeboat. One person seriously injured and airlifted to hospital before being pronounced dead later.	1
June 2018	Collision between power boats during a race. One of the vessels overturned with the pilot pronounced dead at the scene.	1

C.2.3 Contact Incidents

694. The MAIB define a contact incident as “ships striking or being struck by an external object. The objects can be: floating object (cargo, ice, other or unknown); fixed object, but not the sea bottom; or flying object” (MAIB, 2013).

695. A total of 235 contact incidents were reported to the MAIB within UK waters between 2000 and 2019 involving 270 vessels (in a small number of cases the contact involved a moving vessel and a stationary vessel).

696. The locations of contact incidents reported in proximity to the UK are presented in Figure C.10. The distribution of contact incidents is presented in Figure C.11.

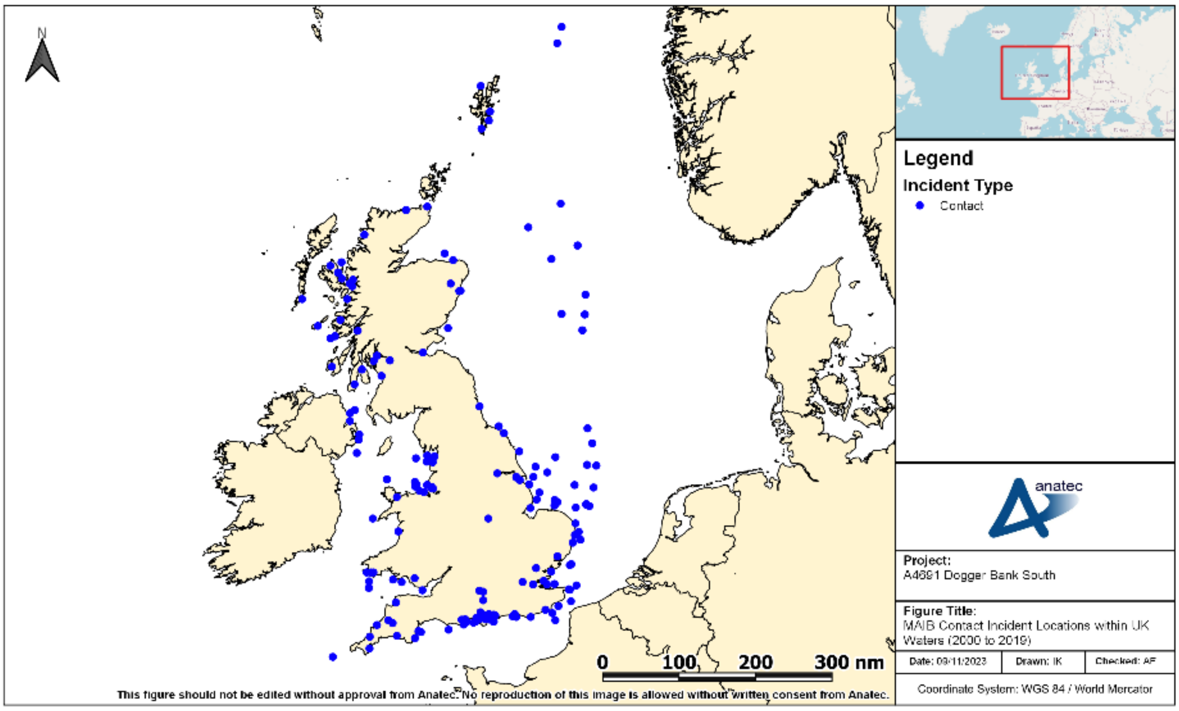

Figure C.10 MAIB Contact Incident Locations within UK Waters (2000 to 2019)

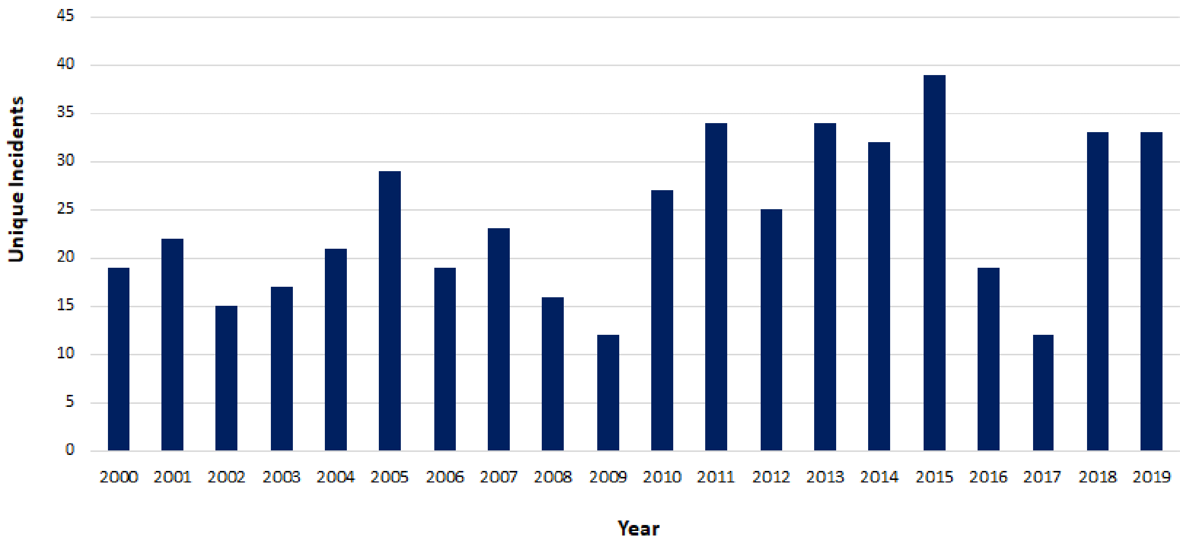

Figure C.11 MAIB Contact Incidents per Year within UK Waters (2000 to 2019)

697. The average number of contact incidents per year was 12. As with collision incidents, there has been an overall slight increasing trend over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

698. The distribution of vessel types involved in contact incidents is presented in Figure C.12.

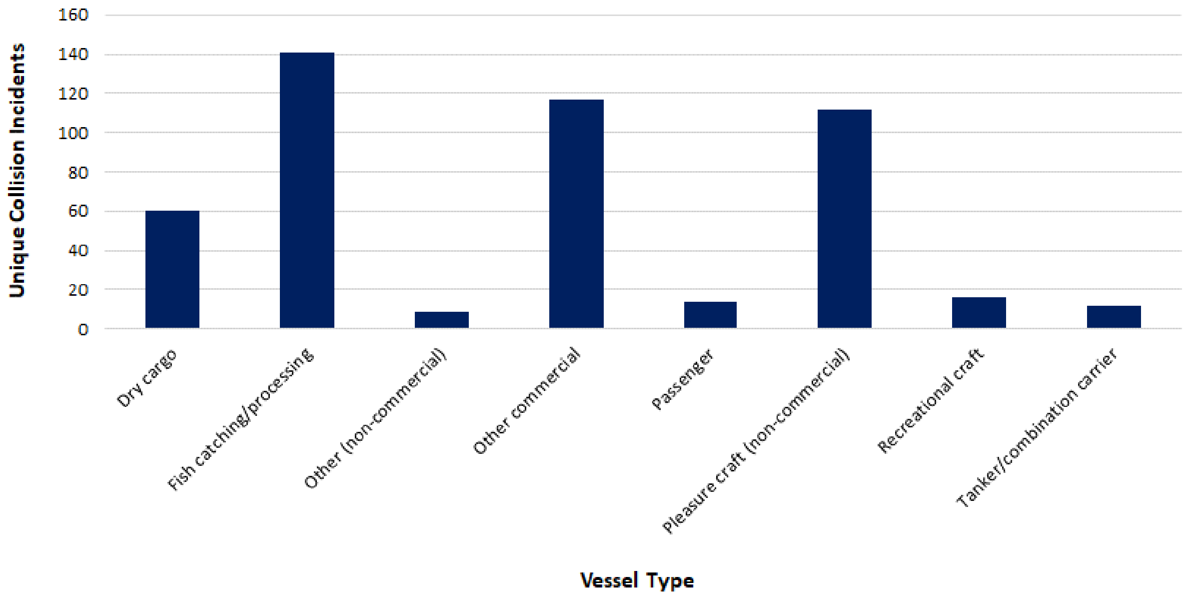

Figure C.12 MAIB Contact Incidents by Vessel Type within UK Waters (2000 to 2019)

699. The most commonly involved vessel types in contact incidents were other commercial vessels (43%), fishing vessels (15%), and non-commercial pleasure craft (13%).

700. One fatality was reported in MAIB contact incidents within UK waters between 2000 and 2019. Details of this fatal incident reported by the MAIB are presented in Table C.3.

Table C.3 Description of Fatal MAIB Contact Incidents (2000 to 2019)

Date	Description	Fatalities
June 2012	Contact between RIB and jetty. RIB badly damaged around the bow and fenders on the jetty also damaged. The RIB owner had consumed alcohol and suffered fatal injuries following the impact.	1

C.3 Fatality Risk

C.3.1 Incident Data

701. This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of a fatality in a marine incident associated with the Projects.

702. The wind farm structures are assessed to have the potential to affect the following incidents:

- Vessel to vessel collision;
- Powered vessel to structure allision;

- Drifting vessel to structure allision; and
- Fishing vessel to structure allision.

703. Of these incident types, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in Section C.2.2 is considered to be directly applicable to these types of incidents.

704. The other scenarios of powered vessel to structure allision, drifting vessel to structure allision and fishing vessel to structure allision are technically contacts since they would involve a vessel striking an immobile object in the form of a wind turbine or OCP. From Section C.2.3, it can be seen that only one of the 235 contact incidents reported by the MAIB between 2000 and 2019 resulted in a fatality, with the contact occurring with a jetty in the approaches to a harbour.

705. As the mechanics involved in a vessel contacting a wind turbine may differ in severity from hitting, for example, a buoy, quayside, or moored vessel, the MAIB collision fatality risk rate has also been conservatively applied for the allision incident types.

C.3.2 Fatality Probability

706. Six of the 481 collision incidents reported by the MAIB within UK waters between 2000 and 2019 resulted in one or more fatalities. This gives a 1.2% probability that a collision incident will lead to a fatal accident.

707. To assess the fatality risk for personnel on-board a vessel (crew, passenger or other) the number of persons involved in the incidents needs to be estimated. From analysis of the long-term AIS data, the average commercial passenger vessel had approximately 2,263 people on board (POB) (total of crew and passengers). For commercial cargo/freight vessels there was an average of 13 POB. For fishing vessels and recreational vessels, the average POB was 3.1 and 2.8, respectively, based on analysis of the MAIB incident data.

Table C.4 Estimated Average POB by Vessel Category

Vessel Category	Sub Categories	Source of Estimated Average POB	Estimated Average POB
Cargo/freight	Dry cargo, other commercial, service ship, etc.	MAIB incident data	15
Tanker	Tanker/combination carrier	MAIB incident data	22
Passenger	RoPax, cruise liner, etc.	Vessel traffic survey data/online information	203
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3

Vessel Category	Sub Categories	Source of Estimated Average POB	Estimated Average POB
Recreational	Yacht, small commercial motor yacht, etc.	MAIB incident data	3.3

708. It is recognised that these numbers can be substantially higher or lower on an individual vessel basis depending upon the size, subtype, etc. but applying reasonable averages is considered sufficient for this analysis.

709. Using the average number of POB, along with the vessel type information involved in collision incidents reported by the MAIB, there were an estimated 10,533 POB the vessels involved in the collision incidents.

710. Based upon six fatalities, the overall fatality probability in a collision for any individual on board is approximately 5.7×10^{-4} (0.057%) per collision.

711. It is considered inappropriate to apply this rate uniformly as the statistics indicate that the fatality probability associated with smaller craft, such as fishing vessels and recreational vessels, is higher. Therefore, the fatality probability has been subdivided into five categories of vessel as presented in Table C.5.

Table C.5 Collision Incident Fatality Probability by Vessel Category (2000 to 2019)

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability
Commercial	Dry cargo, passenger, tanker, etc.	1	16,256	6.2×10^{-5}
Fishing	Trawler, potter, dredger, etc.	2	880	2.3×10^{-3}
Recreational	Yacht, small commercial motor yacht, etc.	3	713	4.2×10^{-3}

712. The risk is higher by up to two orders of magnitude for POB small craft compared to larger commercial vessels.

C.3.3 Fatality Risk due to the Projects

713. The base case and future case annual collision and allision frequency levels pre and post wind farm for the DBS Array Areas are summarised in Table C.6, where change refers to the increase in collision and allision frequency due to the presence of the Projects (estimated at overall 6.57×10^{-2}, equating to an additional collision or allision every 15.2 years) for the base case.

714. The base case and future case annual collision and allision frequency levels pre and post wind farm for the export cable platform search area are summarised in Table

C.7, with increase in collision and allision frequency due to the presence of the Projects estimated at overall 1.02×10^{-1}, equating to an additional collision or allision every 9.8 years for the base case.

Table C.6 Summary of Annual Collision and Allision Risk Results (DBS Array Areas)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.23×10^{-4} (1 in 8,104 years)	1.79×10^{-4} (1 in 5,593 years)	5.60×10^{-5} (1 in 17,857 years)
	Future case (10%)	1.49×10^{-4} (1 in 6,722 years)	2.16×10^{-4} (1 in 4,628 years)	6.70×10^{-5} (1 in 14,925 years)
	Future case (20%)	1.78×10^{-4} (1 in 5,617 years)	2.57×10^{-4} (1 in 3,887 years)	7.90×10^{-5} (1 in 12,658 years)
Powered vessel to structure allision	Base case	-	4.11×10^{-5} (1 in 24,315 years)	4.11×10^{-5} (1 in 24,315 years)
	Future case (10%)	-	4.58×10^{-5} (1 in 21,842 years)	4.58×10^{-5} (1 in 21,842 years)
	Future case (20%)	-	4.88×10^{-5} (1 in 20,471 years)	4.88×10^{-5} (1 in 20,471 years)
Drifting vessel to structure allision	Base case	-	5.34×10^{-5} (1 in 18,742 years)	5.34×10^{-5} (1 in 18,742 years)
	Future case (10%)	-	5.89×10^{-5} (1 in 16,972 years)	5.89×10^{-5} (1 in 16,972 years)
	Future case (20%)	-	6.39×10^{-5} (1 in 15,658 years)	6.39×10^{-5} (1 in 15,658 years)
Fishing vessel to structure allision	Base case	-	6.55×10^{-2} (1 in 15.3 years)	6.55×10^{-2} (1 in 15.3 years)
	Future case (10%)	-	7.21×10^{-2} (1 in 13.9 years)	7.21×10^{-2} (1 in 13.9 years)
	Future case (20%)	-	7.86×10^{-2} (1 in 12.7 years)	7.86×10^{-2} (1 in 12.7 years)
Total	**Base case**	**1.23×10^{-4} (1 in 8,104 years)**	**6.58×10^{-2} (1 in 15.2 years)**	**6.57×10^{-2} (1 in 15.2 years)**
	Future case (10%)	**1.49×10^{-4} (1 in 6,722 years)**	**7.24×10^{-2} (1 in 13.8 years)**	**7.23×10^{-2} (1 in 13.8 years)**
	Future case (20%)	**1.78×10^{-4} (1 in 5,617 years)**	**7.90×10^{-2} (1 in 12.7 years)**	**7.88×10^{-2} (1 in 12.7 years)**

Table C.7 Summary of Annual Collision and Allision Risk Results (Export Cable Platform Search Area)

Risk	Traffic Level Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	5.84×10^{-4} (1 in 1,713 years)	5.91×10^{-4} (1 in 1,693 years)	7.00×10^{-6} (1 in 142,857 years)
	Future case (10%)	6.52×10^{-4} (1 in 1,534 years)	6.60×10^{-4} (1 in 1,516 years)	8.00×10^{-6} (1 in 125,000 years)
	Future case (20%)	7.87×10^{-4} (1 in 1,271 years)	7.96×10^{-4} (1 in 1,256 years)	9.00×10^{-6} (1 in 111,111 years)
Powered vessel to structure allision	Base case	-	2.56×10^{-4} (1 in 3,910 years)	2.56×10^{-4} (1 in 3,910 years)
	Future case (10%)	-	2.82×10^{-4} (1 in 3,541 years)	2.82×10^{-4} (1 in 3,541 years)
	Future case (20%)	-	3.08×10^{-4} (1 in 3,246 years)	3.08×10^{-4} (1 in 3,246 years)
Drifting vessel to structure allision	Base case	-	9.55×10^{-6} (1 in 104,738 years)	9.55×10^{-6} (1 in 104,738 years)
	Future case (10%)	-	1.05×10^{-5} (1 in 94,863 years)	1.05×10^{-5} (1 in 94,863 years)
	Future case (20%)	-	1.15×10^{-5} (1 in 86,977 years	1.15×10^{-5} (1 in 86,977 years
Total	**Base case**	**5.84×10^{-4} (1 in 1,713 years)**	**8.56×10^{-4} (1 in 1,168 years)**	**2.72×10^{-4} (1 in 3,672 years)**
	Future case (10%)	**6.52×10^{-4} (1 in 1,534 years)**	**9.53×10^{-4} (1 in 1,049 years)**	**3.01×10^{-4} (1 in 3,323 years)**
	Future case (20%)	**7.87×10^{-4} (1 in 1,271 years)**	**1.12×10^{-3} (1 in 896 years)**	**3.29×10^{-4} (1 in 3,044 years)**

715. From the detailed results of the collision and allision risk modelling, the distribution of the predicted change in annual collision and allision frequency by vessel type due to the DBS Array Areas for the base case and future cases are presented in 308. This figure for the export cable platform search area is presented in Figure C.14.

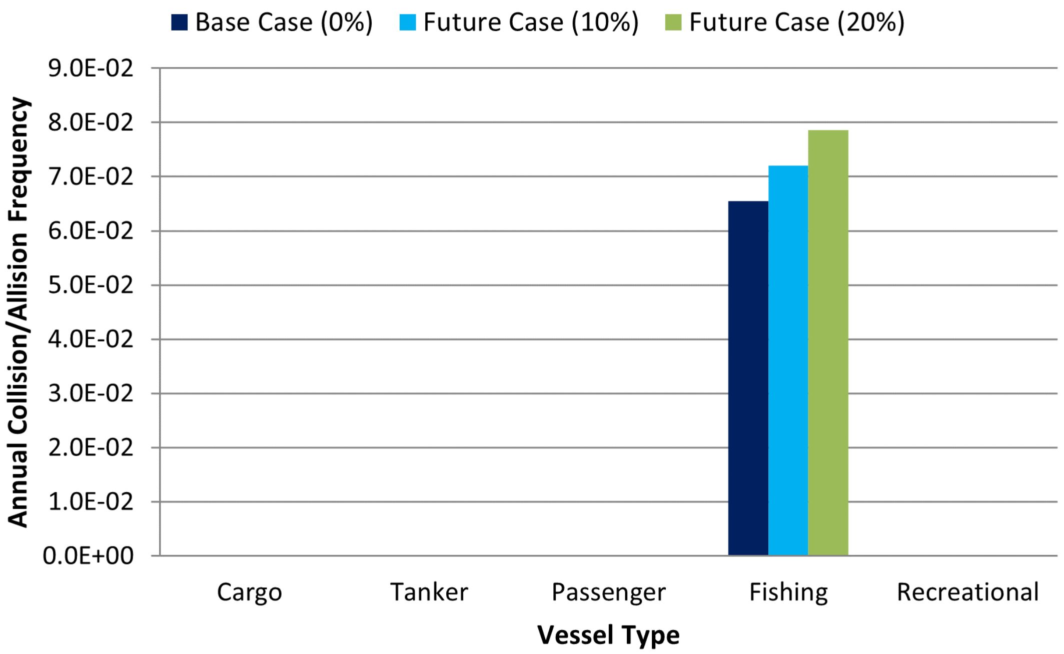

Figure C.13 Estimated Change in Annual Collision and Allision Frequency by Vessel Type (DBS Array Areas)

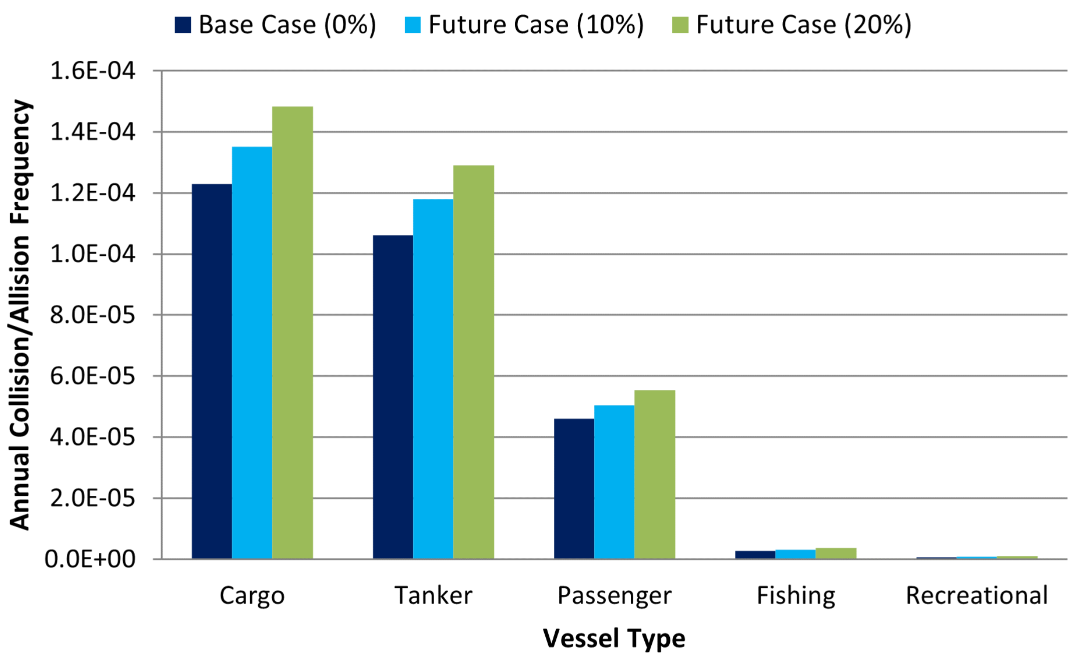

Figure C.14 Estimated Change in Annual Collision and Allision Frequency by Vessel Type (Export Cable Platform Search Area)

716. It can be seen that for the DBS Array Areas the majority of change in collision and allision frequency is associated with fishing vessels, due to the level of internal fishing activity. For the export cable platform search area this was cargo vessels and tankers, owing to the greater duration spent in proximity to the export cable platform search area.

717. Combining the annual collision and allision frequency, estimated number of POB for each vessel type, and estimated fatality probability for each vessel category, the total annual increase in PLL due to the presence of the DBS Array Areas for the base case is estimated to be 4.40×10^{-4}, equating to one additional fatality every 2,274 years.

718. Combining the annual collision and allision frequency, estimated number of POB for each vessel type, and estimated fatality probability for each vessel category, the total annual increase in PLL due to the presence of the export cable platform search area for the base case is estimated to be 1.16×10^{-6}, equating to one additional fatality every 859,351 years.

719. The estimated incremental increases in PLL due to the export cable platform search area, distributed by vessel type for the base and future cases, are presented in Figure C.15. These values for the export cable platform search area are presented in Figure C.16.

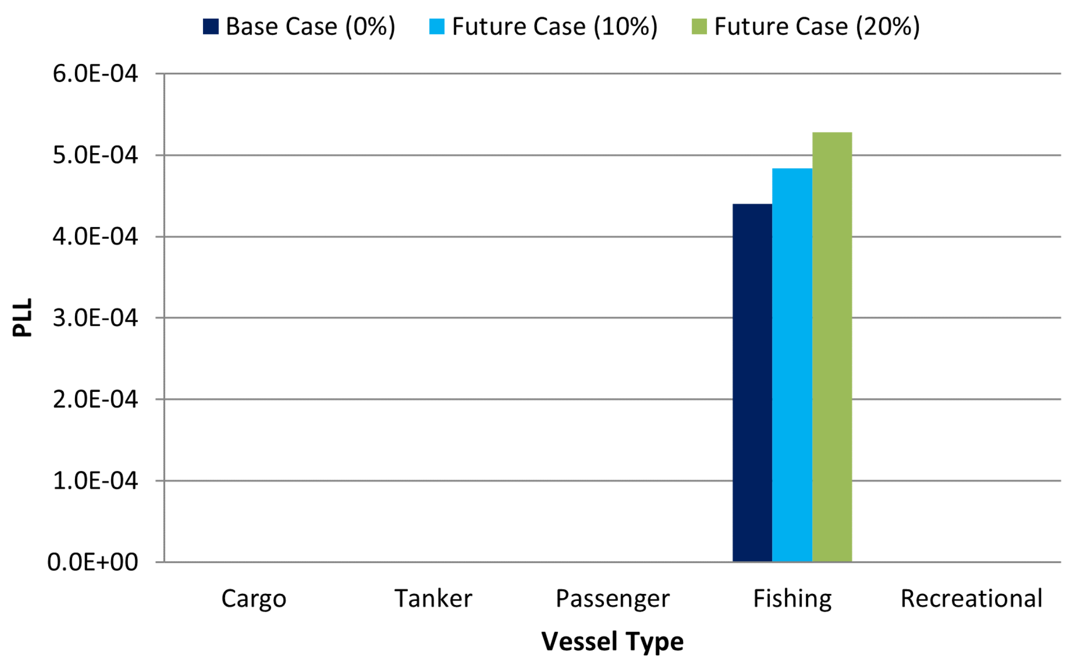

Figure C.15 Estimated Change in Annual PLL by Vessel Type (DBS Array Areas)

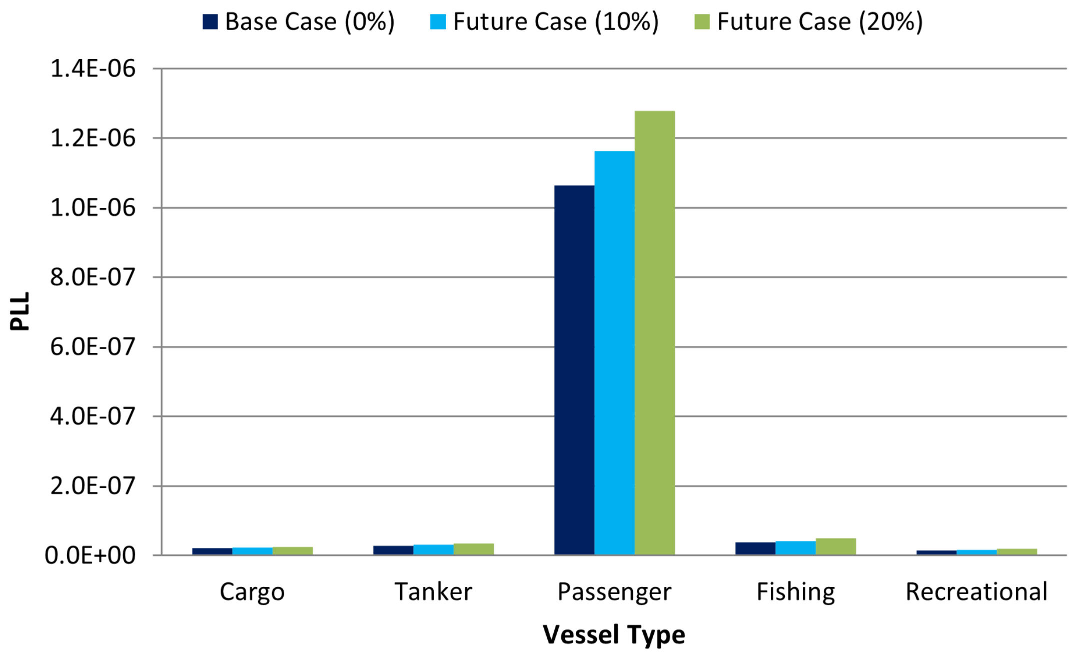

Figure C.16 Estimated Change in Annual PLL by Vessel Type (Export Cable Platform Search Area)

720. It can be seen that the majority of the change in annual PLL is associated with fishing vessels for the DBS Array Areas, and passenger vessels for the export cable platform search area.

721. Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results for the DBS Array Areas are presented in Figure C.17, and for the export cable platform search area are presented in Figure C.18.

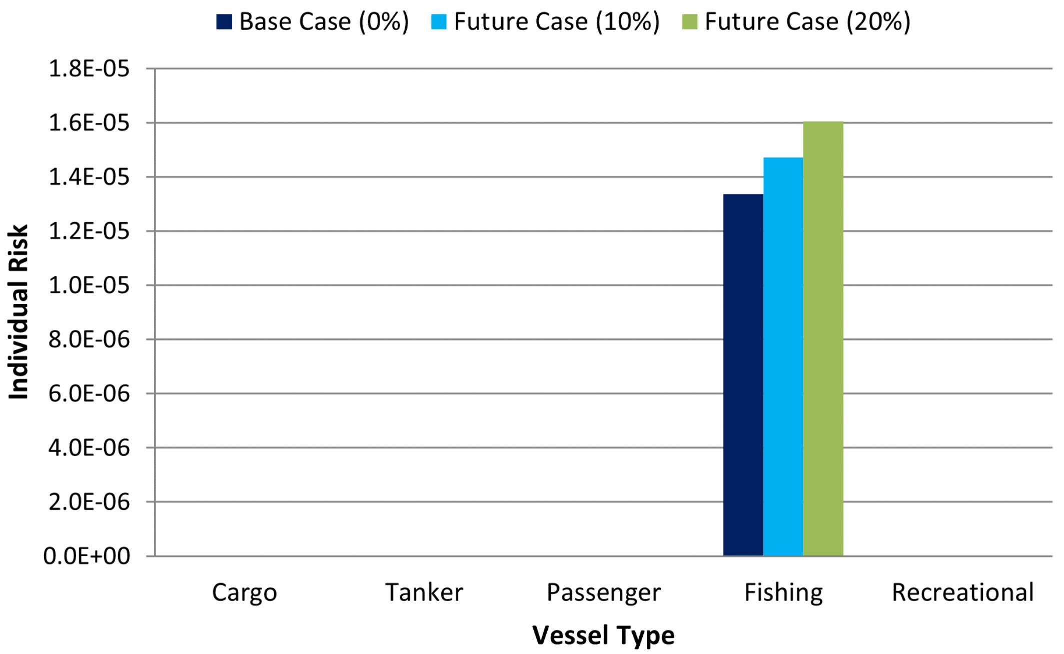

Figure C.17 Estimated Change in Individual Risk by Vessel Type (DBS Array Areas)

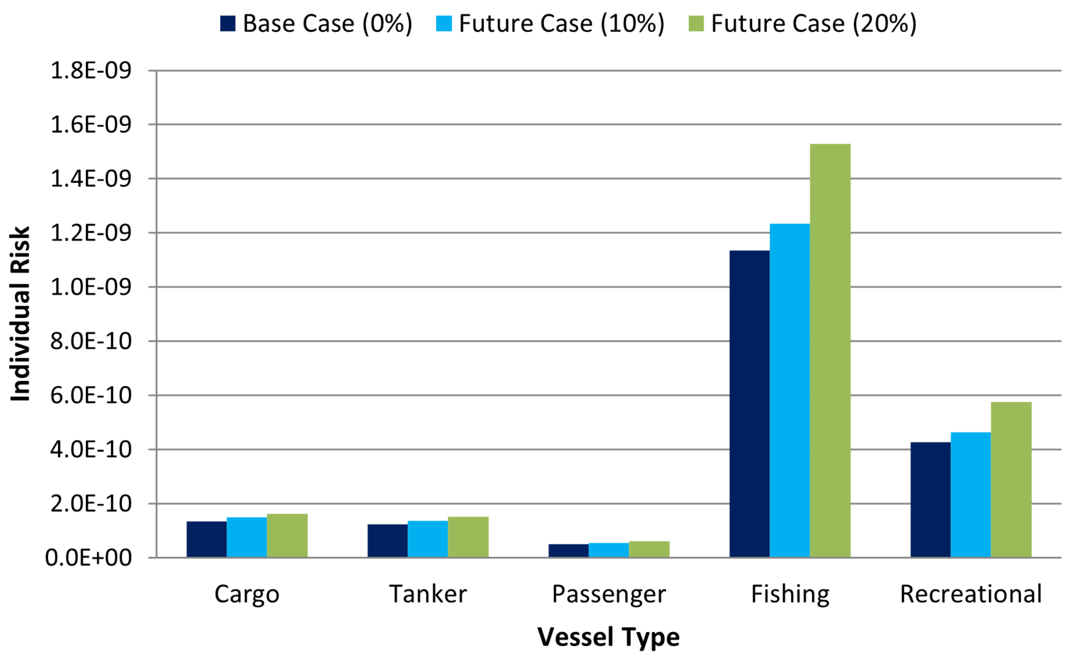

Figure C.18 Estimated Change in Individual Risk by Vessel Type (Export Cable Platform Search Area)

722. It can be seen that the individual risk is highest for people on fishing vessels in both the DBS Array Areas and export cable platform search area, which reflects the higher probability of a fatality occurring in the event of an incident involving a fishing vessel.

C.3.4 Significance of Increase in Fatality Risk

723. In comparison to MAIB statistics, which indicate an average of 20 fatalities per year in UK territorial waters, the overall increase for the base case in PLL of one additional fatality per 2,274 years for the DBS Array Areas and one per 859,351 years for the export cable platform search area represents a small change.

724. In terms of individual risk to people, the change for commercial vessels attributed to the Projects (approximately 1.95×10^{-10} for the DBS Array Areas for the base case and 3.08×10^{-10} for the export cable platform search area) is very low compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

725. For fishing vessels, the change in individual risk attributed to the Projects (approximately 1.34×10^{-5} for the DBS Array Areas for base case and 1.13×10^{-9} for the export cable platform search area) is low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

C.4 Pollution Risk

C.4.1 Historical Analysis

726. The pollution consequences of a collision in terms of oil spill depend upon the following criteria:

- Spill probability (i.e., the likelihood of outflow following an incident); and
- Spill size (quantity of oil).

727. Two types of oil spill are considered within this assessment:

- Fuel oil spills from bunkers (all vessel types); and
- Cargo oil spills (laden tankers).

728. Research undertaken as part of the UK's DfT Marine Environmental High Risk Area (MEHRA) project (DfT, 2001) has been used as it was comprehensive and based upon worldwide marine oil spill data analysis. From this research, the overall probability of a spill incident per accident was calculated based upon historical accident data for each accident type as presented in Figure C.19.

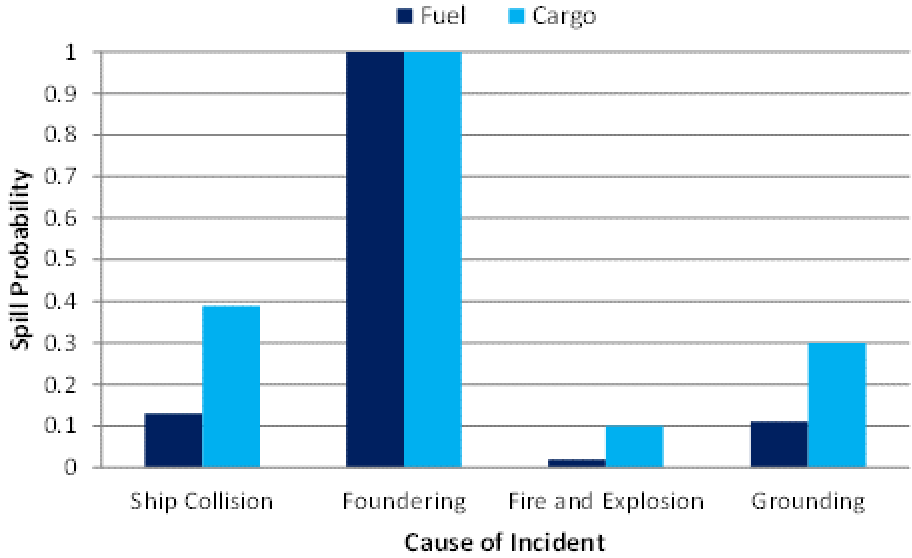

Figure C.19 Probability of an Oil Spill Resulting from an Accident

729. Therefore, it was estimated that 13% of vessel collisions result in a fuel oil spill and 39% of collisions involving a laden tanker result in a cargo oil spill.

730. In the event of a bunker spill, the potential outflow of oil depends upon the bunker capacity of the vessel. Historical bunker spills from vessels have generally been limited to a size below 50% of bunker capacity, and in most incidents much lower.

731. For the types and sizes of vessels exposed to the Projects, an average spill size of 100 tonnes of fuel oil is considered to be a conservative assumption.

732. For oil spills from laden tankers, the spill size can vary significantly. The International Tanker Owners Pollution Federation (ITOPF) reported the following spill size distribution for tanker collisions between 1974 and 2004:

- 31% of spills below seven tonnes;
- 52% of spills between seven and 700 tonnes; and
- 17% of spills greater than 700 tonnes.

733. Based upon this data and the tankers transiting in proximity to the export cable platform search area, an average spill size of 400 tonnes is considered conservative.

734. For fishing vessel collisions comprehensive statistical data is not available. Consequently, it is conservatively assumed that 50% of all collisions involving fishing vessels will lead to oil spill with the quantity spilled being on average five tonnes. Similarly, for recreational vessels, owing to a lack of data 50% of collisions are assumed to lead to a spill with an average size of one tonne.

C.4.2 Pollution Risk due to the Projects

735. Applying the above probabilities to the annual collision and allision frequency by vessel type and the average spill size per vessel, the estimated amount of oil spilled per year due to the presence of the Projects would equate to 0.018 tonnes of oil per year for the base case. For the future case scenarios, this estimate increases to 0.020 tonnes and 0.023 tonnes for traffic increases of 10% and 20%, respectively.

736. The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base and future cases for the DBS Array Areas are presented in Figure C.20. These values for the export cable platform search area are presented in Figure C.21.

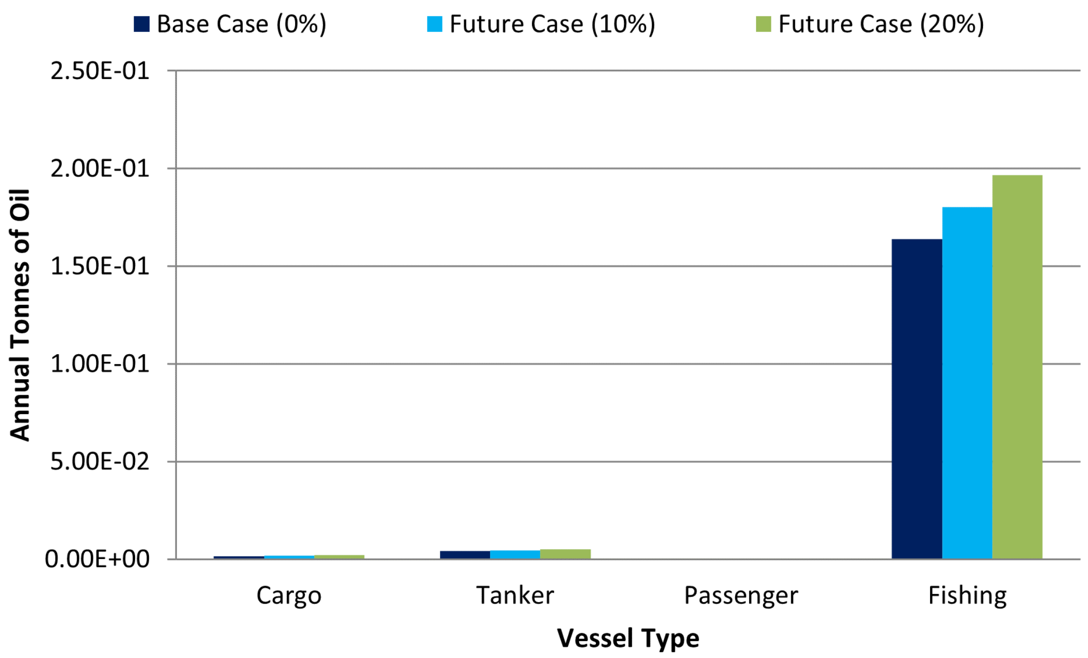

Figure C.20 Estimated Change in Pollution by Vessel Type (DBS Array Areas)

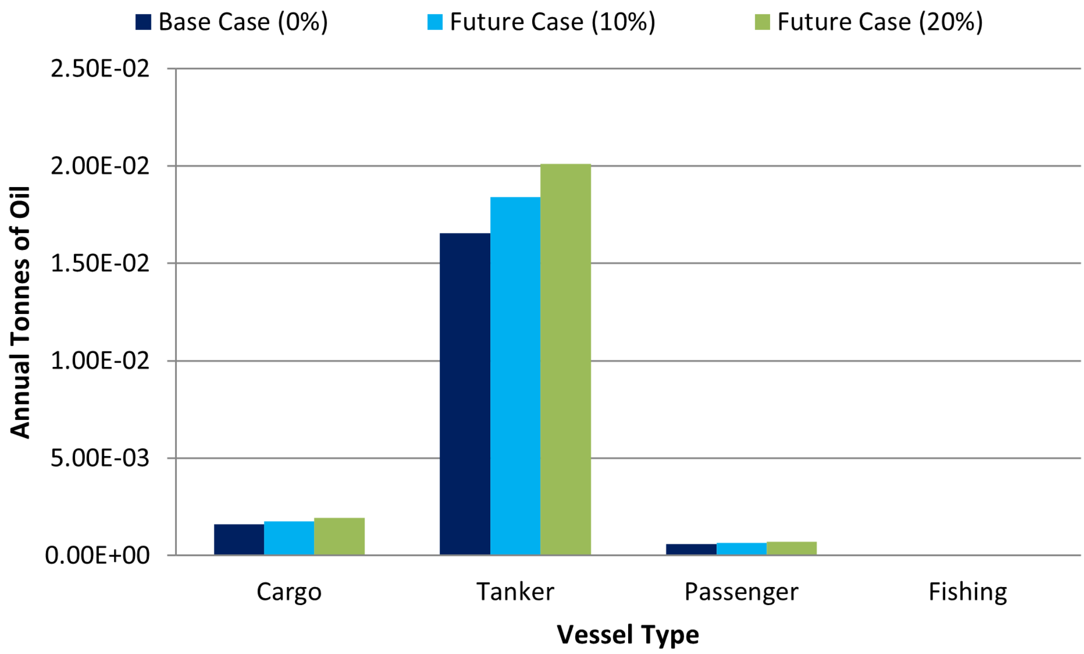

Figure C.21 Estimated Change in Pollution by Vessel Type (Export Cable Platform Search Area)

737. The majority of annual oil spill results are associated with fishing vessels in the DBS Array Areas, and tankers near the export cable platform search area, due to the high annual allision frequency associated.

C.4.3 Significance of Increase in Pollution Risk

738. To assess the significance of the increased pollution risk from vessels caused by the Projects, historical oil spill data for the UK has been used as a benchmark.

739. From the MEHRAs research, the annual average tonnes of oil spilled in UK waters due to maritime incidents in the 10-year period from 1989 to 1998 was 16,111 tonnes. This is based upon a total of 146 reported oil pollution incidents of greater than one tonne (smaller spills are excluded as are incidents which occurred within port or harbour areas or as a result of operational errors or equipment failure). Commercial vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

740. The overall increase in pollution estimated due to the Projects of 0.1 tonnes for the base case for the DBS Array Areas and 0.018 tonnes for the base case for the export cable platform search area represents a 0.00105% and 0.00012% increase compared to the historical average pollution quantities from marine incidents in UK waters for the DBS Array Areas and export cable platform search area respectively.

C.5 Conclusion

741. This appendix has quantitatively assessed the fatality and pollution risk associated with the Projects in the case of a collision or allision incident occurring. It is concluded, based upon the results, that the collision and allision risk of the Projects on people and the environments is very low compared to the existing background risk levels.

Appendix D Regular Operator Consultation

742. As part of the consultation process for the Projects, Regular Operators identified from the vessel traffic survey data were consulted via electronic mail. An example of the correspondence sent to the Regular Operators is presented below.

Anatec Ltd.
Cain House
10 Exchange Street
Aberdeen AB11 6PH
Tel: 01224 253700
Email: aberdeen@anatec.com
Web: www.anatec.com

Date: 28th March 2023

Stakeholder Consultation on Impacts Relating to Shipping and Navigation for the Proposed Dogger Bank South Offshore Wind Farms

Dear Stakeholder,

As you may be aware, RWE Renewables is the developer of the Dogger Bank South (DBS) Offshore Wind Farms, two Projects known as DBS East and DBS West, located off the Yorkshire coast. The DBS Projects will consist of offshore wind turbines and associated infrastructure, as well as export cables to shore, associated infrastructure, and an onshore grid connection.

The DBS array areas are located approximately 55 nautical miles (nm) (102 kilometres (km)) east of the Yorkshire coast and each covers an area of approximately 144 square nautical miles (nm^2) (494 square kilometres (km^2)). Between 95 and 200 wind turbines may be installed across the DBS array areas alongside up to nine platforms. The location of the DBS Offshore Wind Farms, including the DBS array areas and potential offshore export cable corridor(s), is presented in Figure 1.2.

Further information relating to DBS is available here.

Other offshore wind farms in the area include the under-construction Dogger Bank A and Dogger Bank B located approximately 4nm and 9nm to the northeast, respectively, as well as Dogger Bank C and Sofia (both consented). The Hornsea developments are located further south. An overview of nearby offshore wind farm developments is presented in Figure 1.2.

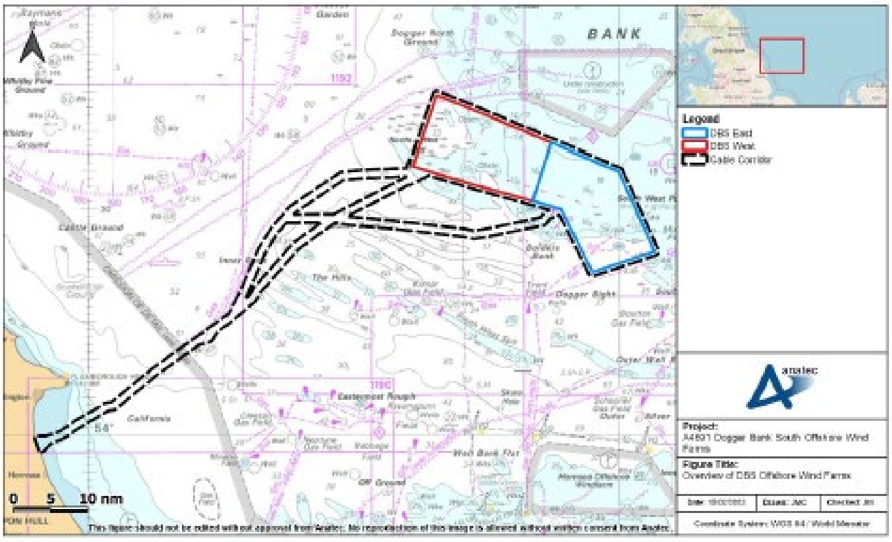

Figure 1.1: Overview of DBS Offshore Wind Farms

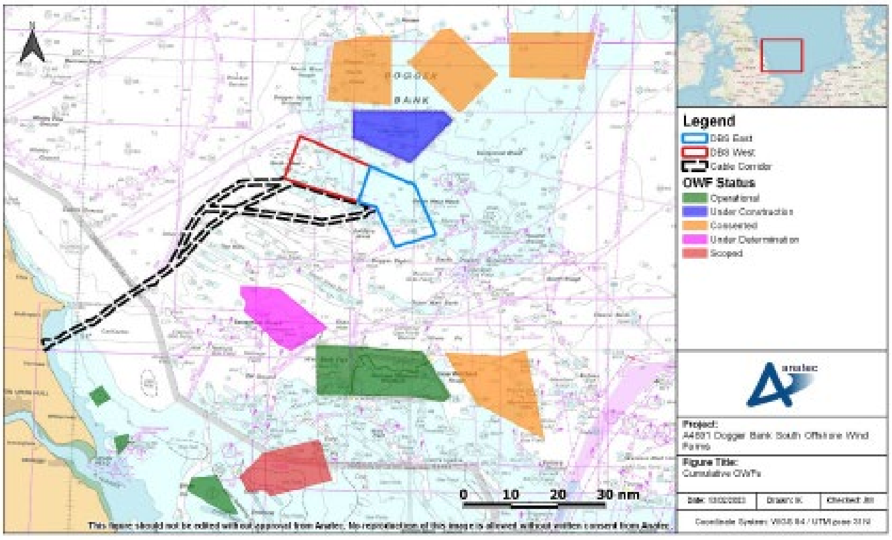

Figure 1.2: Overview of Nearby Wind Farm Developments

Anatec has been contracted to provide technical support on shipping and navigation during the consenting process, and to co-ordinate consultation with stakeholders. Therefore, we are writing to you on behalf of the Projects to inform you of our relationship with DBS and to kindly request your comments, which will help inform the proposed development.

The Environmental Impact Assessment (EIA) process requires RWE Renewables to identify impacts that the DBS Offshore Wind Farms may potentially have upon shipping and navigation, and to ensure comprehensive consultation is undertaken. To analyse shipping movements within, and in the vicinity of, the DBS array areas, Automatic Identification System (AIS), Radar data, and visual observations obtained from vessel-based surveys in 2022 has been collected and assessed and will feed into the Navigational Risk Assessment (NRA) required by the Maritime and Coastguard Agency (MCA).

According to the assessment of the available datasets, your company's vessel(s) regularly navigates within, and/or in the vicinity of, the DBS array areas. Consequently, your company has been identified as a potential marine stakeholder for DBS. We therefore invite your feedback on the potential development including any impact it may have upon the navigation of vessels.

We would be grateful if you could provide us with any comments or feedback that you may have by Friday 21st April. This will allow us to assess your feedback as part of the NRA submitted as part of the Development Consent Order (DCO) application. We would also be grateful if you could forward a copy of this information to any vessel operators/owners you feel may be interested in commenting.

In particular, we are keen to receive comments relating to the following:

1. Whether the proposal to construct DBS is likely to impact the routeing of any specific vessels, including the nature of any change in regular passage;
2. Whether any aspect of DBS poses any safety concerns to your vessels, including any adverse weather routeing;
3. Whether your responses to questions 1 and 2 above change when considering the cumulative scenario with the other Southern North Sea developments;
4. Whether you would choose to make passage internally through the array; and
5. Whether you wish to be retained on our list of marine stakeholders and be invited to a shipping and navigation Hazard Workshop planned to take place in London on Tuesday 25th April.

Responses should be sent via email to [redacted] Should you have any queries about the published information or require any further information to support your review, please do not hesitate to contact us.

Yours sincerely,

[redacted]

Anatec Ltd.

Appendix E Supplementary AIS Vessel Traffic Survey Data

743. This appendix assesses additional AIS vessel traffic data for the Projects. As required under MGN 654 (MCA, 2021), the NRA and **Volume 7, Chapter 14: Shipping and Navigation (application ref: 7.14)** consider 28 days of AIS, Radar and visual observation data as the primary vessel traffic data source. However, it should be considered that studying a 28-day period in isolation may exclude certain activities or periods of pertinence to shipping and navigation and may not be fully comprehensive. Therefore, in line with good practice assessment procedures, this NRA has also considered an additional dataset covering approximately three months in 2022 to help validate the characterisation of vessel traffic movements within proximity to the Projects.

744. The key aims of this appendix are to validate vessel traffic movements represented by the vessel traffic survey data.

E.1 Methodology

E.1.1 Study Area

745. This appendix has assessed the supplementary AIS survey data within one study area surrounding the Projects, the 'DBS combined study area'. This study area used is the combined 10nm buffer study areas used for both DBS East and DBS West introduced in Section 3.4. Where necessary, for a comparative analysis, the individual 10nm study areas have been also used.

E.1.2 Data Period and Temporary Vessel Traffic

746. The additional AIS vessel traffic survey data was collected via two dedicated survey vessels onsite within the DBS Array Areas over the course of approximately three months within 2022. These vessels were the *Mainport Geo* and *Fugro Frontier*. Noting that this data is AIS only, those vessels not required to carry AIS may be underrepresented due to the lack of Radar or visual observation data which was available for the vessel traffic survey data introduced in Section 5.2 and analysed in Section 10.

747. As the survey vessels were off-site for periods of time during the survey period, only days where the survey vessel was on-site have been included in the analysis. Days in which the survey vessel was on-site for a partial day have been taken into consideration where necessary within the analysis and where information is based solely on full days of data, this has been highlighted within the analysis.

748. A total of 79 days between 15th April 2022 and 24th July 2022 have been included.

749. As per the vessel traffic surveys, a number of vessel tracks recorded during the data period were classified as temporary (non-routine) and have been excluded from the characterisation of the vessel traffic.

E.1.3 AIS Carriage

750. General limitations associated with the use of AIS data (for example, carriage requirements) are discussed in full within Section 5.3.1.

E.2 Vessel Traffic Movements

751. A plot of the vessel tracks recorded within the DBS combined study area during the supplementary survey period, colour-coded by vessel type and excluding temporary traffic, is presented in Figure E.1. Following this, the same data is illustrated in a density heat map[11] in Figure E.2.

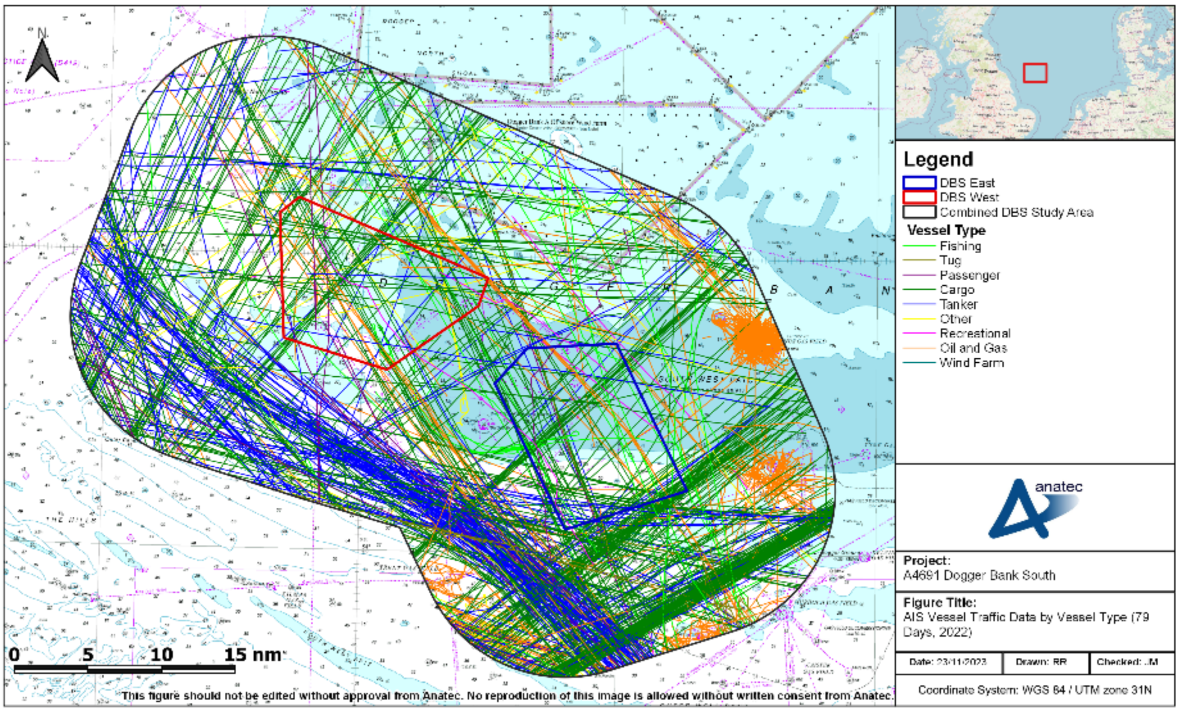

Figure E.1 Vessel Traffic Data by Vessel Type (79 Days, 2022)

[11] To ensure contrasts in vessel density are suitably illustrated, the scale used for the vessel density heat map for the additional vessel traffic data is not the same as used for the DBS East and DBS West vessel traffic survey in earlier sections.

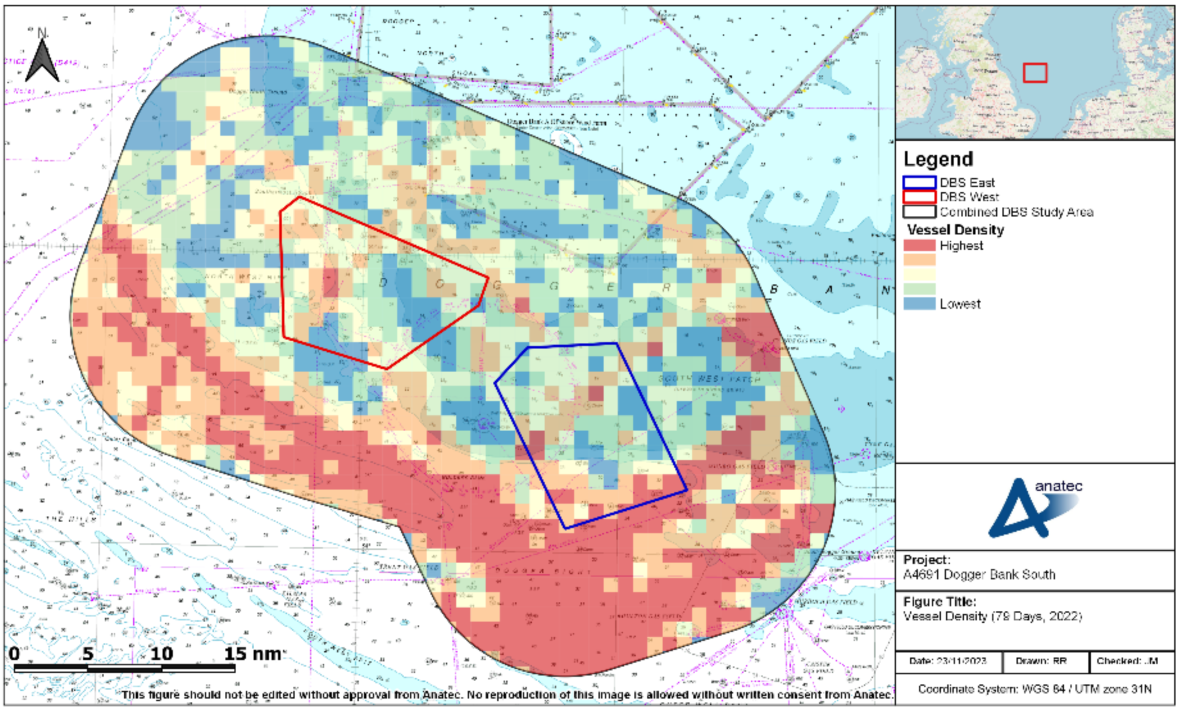

Figure E.2 Density Heat Map of Vessel Traffic Data (79 Days, 2022)

E.2.2 Vessel Count

752. The unique daily number of vessels within the DBS combined study area and intersecting each of the DBS Array Areas are presented in Figure E.3, noting this only illustrates those days during the survey period where the survey vessels were on-site for the full day; partial survey days have been excluded.

753. During the supplementary survey period within the DBS combined study area, there was an average of 12 unique vessels recorded per day. The busiest full day was 8th May 2022 when 26 unique vessels were recorded. The quietest full day was 23rd May 2022 when only four unique vessels were recorded.

754. Within the DBS East study area alone, there was an average of 11 unique vessels recorded per day. The busiest full day was 8th May 2022 when 23 unique vessels were recorded. The quietest full days recorded only four unique vessels; this occurred on three separate days.

755. Within the DBS West study area alone, there was an average of six unique vessels recorded per day. The busiest full day was 8th May 2022 when 16 unique vessels were recorded. The quietest full day was 4th June 2022 when no vessels were recorded.

756. Approximately 28% of all vessel traffic within the DBS combined study area intersected the DBS arrays during the additional survey period with a maximum of nine unique vessels intersecting DBS East on one day and seven intersecting DBS West.

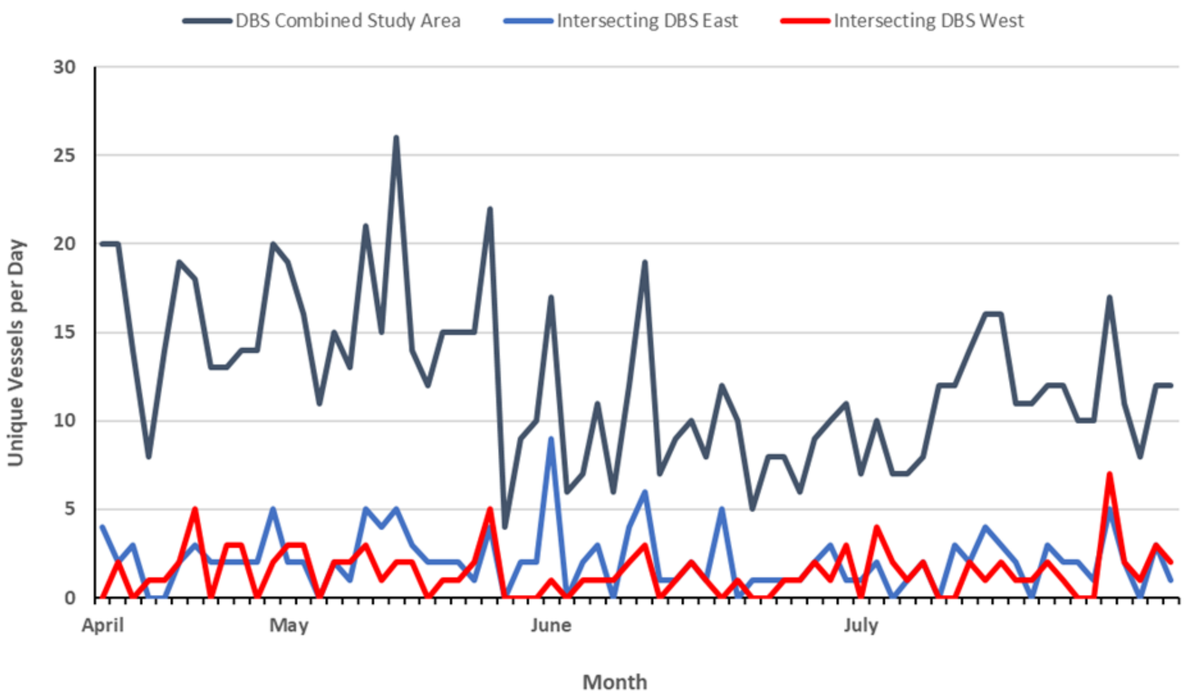

Figure E.3 Unique Vessel Counts per Day (Full Survey Days Only) (2022)

E.2.3 Vessel Type

757. The distribution of the main vessel types recorded during the supplementary survey period are presented in Figure E.4. The other vessel type category consisted of mainly cable laying vessels and heavy lift vessels on transit.

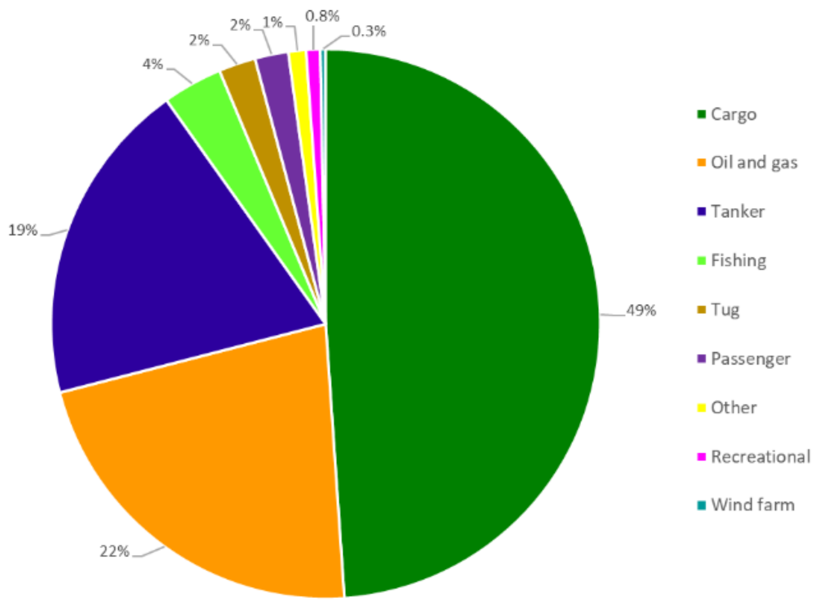

Figure E.4 Distribution of the Main Vessel Types (79 Days, 2022)

758. The most common vessel type recorded within the DBS combined study area was cargo vessels, accounting for nearly half (49%) of all vessels recorded. Other common vessel types were oil and gas vessels (22%) and tankers (19%). No other vessel type equated to more than 5% off all traffic recorded.

759. There was a similar trend of vessel types in the dedicated vessel traffic survey data, although within the DBS West study area there were considerably less oil and gas vessels (9% off all vessels recorded within the DBS West study area). This trend was also noted in the original vessel traffic survey data and is due to the greater volume of oil and gas infrastructure in proximity to the DBS East Array Area (see Section 10.1.5).

760. For vessel traffic intersecting the DBS Array Areas, cargo vessels were the main vessel type to intersect both Array Areas during the survey period, accounting for 64% of all vessel traffic intersecting DBS East, and 58% of all vessel traffic intersecting DBS West.

E.2.4 Commercial Vessels

761. Figure E.5 presents the commercial vessels recorded within the DBS combined study area during the supplementary survey period, colour-coded by vessel type.

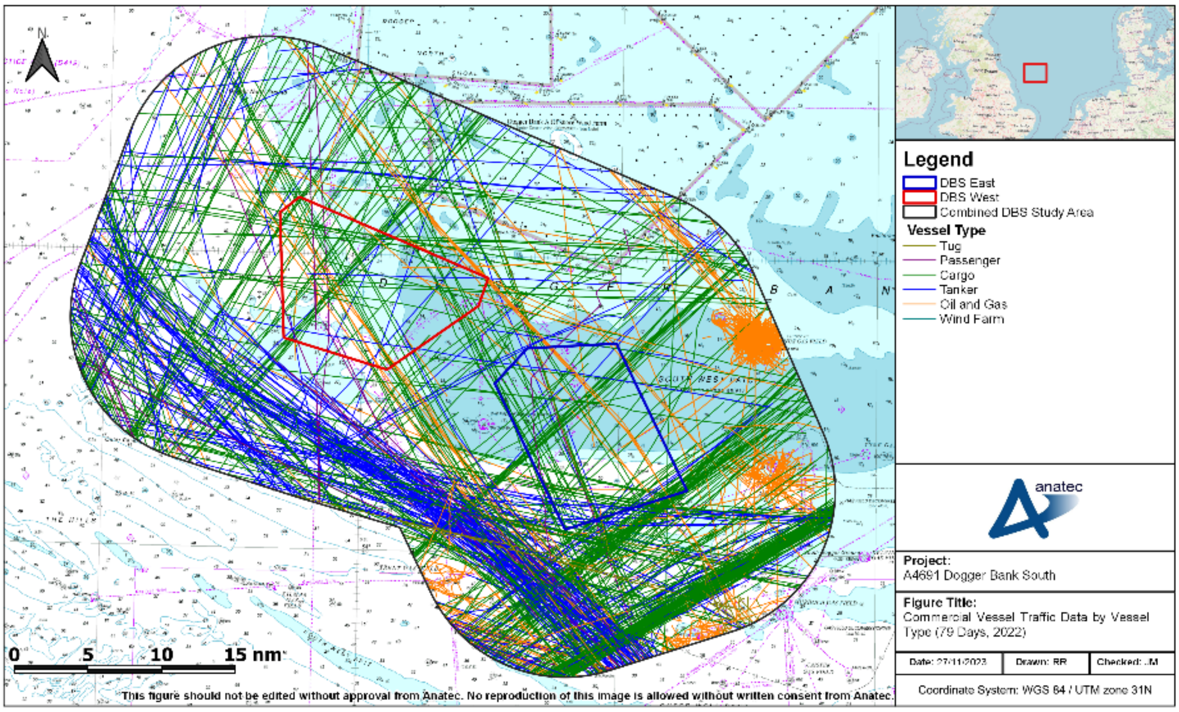

Figure E.5 Commercial Vessel Traffic by Vessel Type (79 Days, 2022)

762. The majority of the commercial traffic within the DBS combined study area is on defined routes with these comprising the main commercial routes that have been identified from the dedicated vessel traffic survey data (see Section 11.2). Notably

there was significant north-west south-east tanker transits and north-east south-west cargo vessels transits.

763. Oil and gas vessel activity was recorded at multiple offshore sites located within the DBS combined study area. All activity was in the DBS East area of the DBS combined study area, in particular at the Cygnus gas field. The Munro field, Boulton field, and Trent field also noted levels of oil and gas vessel activity. This activity and trend was also noted from the dedicated vessel traffic surveys in Section 10.1.5. The only difference in oil and gas activity was the absence of such activity at the Cavendish field during the supplementary survey period.

764. A breakdown of the average number of unique vessels per day for each commercial vessel type recorded within the DBS combined study area, as well as within the individual DBS array study areas, is presented in Figure E.6. Wind farm vessels have been excluded due to the low numbers of vessels recorded (only three unique vessels over the 79 days).

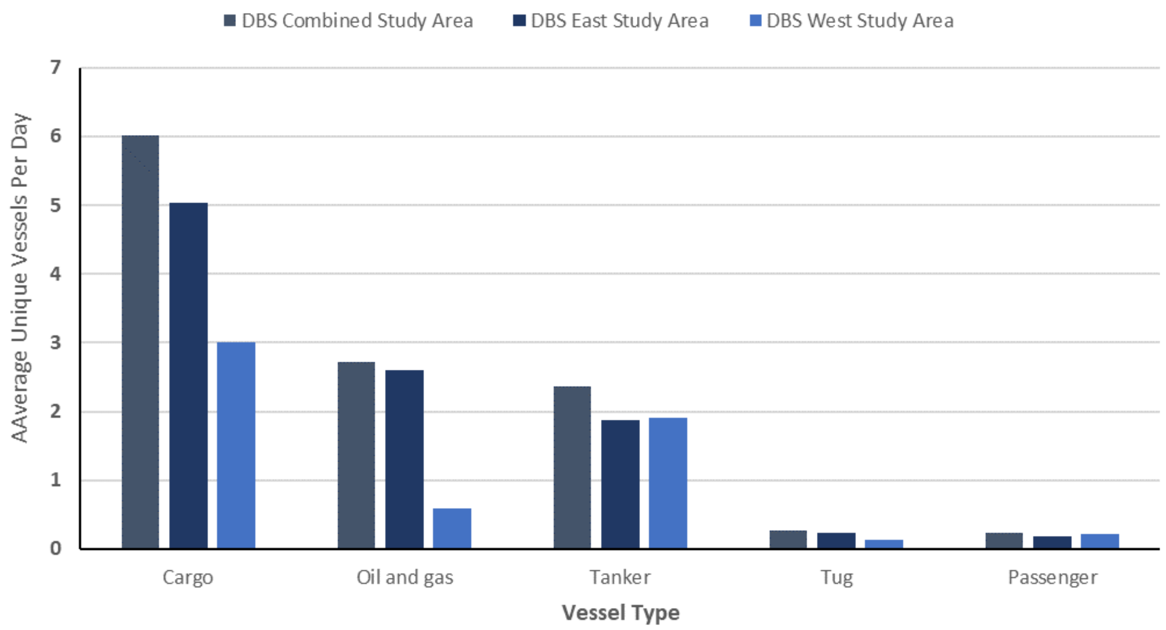

Figure E.6 Commercial Vessel Average Daily Counts per Vessel Type (79 Days, 2022)

765. On average throughout the survey period, there was an average of six unique cargo vessels per day, three unique oil and gas vessels per day, and between two and three unique tankers recorded per day within the DBS combined study area. For tugs, one unique vessel was recorded on average every three days, and one unique passenger vessel was recorded on average every five days within the DBS combined study area. Approximately 19% of all commercial vessels recorded within the DBS combined study area intersected the DBS Array Areas, the majority being cargo vessels.

E.2.5 Commercial Ferries

766. Figure E.7 presents the commercial ferries recorded within the DBS combined study area during the survey period, colour-coded by vessel operator.

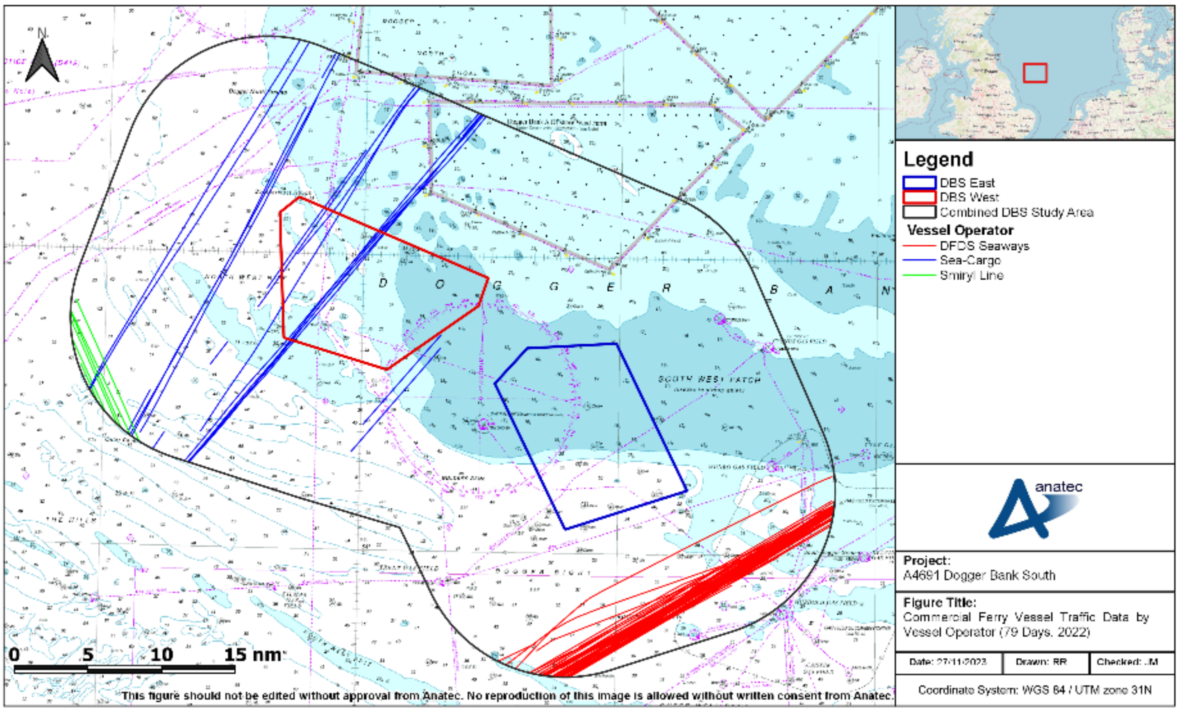

Figure E.7 Commercial Vessel Traffic by Vessel Type (79 Days, 2022)

767. As with the dedicated vessel traffic survey data, only RoRo vessels were recorded (no RoPax) within the DBS combined study area during the survey period. The most frequently recorded ferries were the three DFDS Seaways vessels at the south of the DBS combined study area, all on routes between Immingham and Gothenburg, with an average of one to two vessels recorded on this route every day during the supplementary survey period. This route was highlighted in the dedicated vessel traffic survey data in Section 10.1.3.

768. Several RoRo operated by Sea-Cargo were noted routeing towards the western extent of the DBS combined study area. These vessels were mainly on route to Immingham with one vessel, routeing through the DBS West array, only routeing south-west. Two other vessels were routeing to the north-east to ports in Norway. This routeing was identified in Section 11.2 although with less presence intersecting the DBS West Array Area, noting that this supplementary data does not fully account for the offshore construction of Dogger Bank A and Dogger Bank B.

769. The Finnlines route between Hull and Helsinki identified in Section 10.1.3 was not recorded within this data. However, the commercial ferry operators and their relative prominence within the study area is comparable with that observed during the dedicated vessel traffic surveys.

E.2.6 Fishing Vessels

770. Figure E.8 presents the fishing vessels recorded within the DBS combined study area during the survey period.

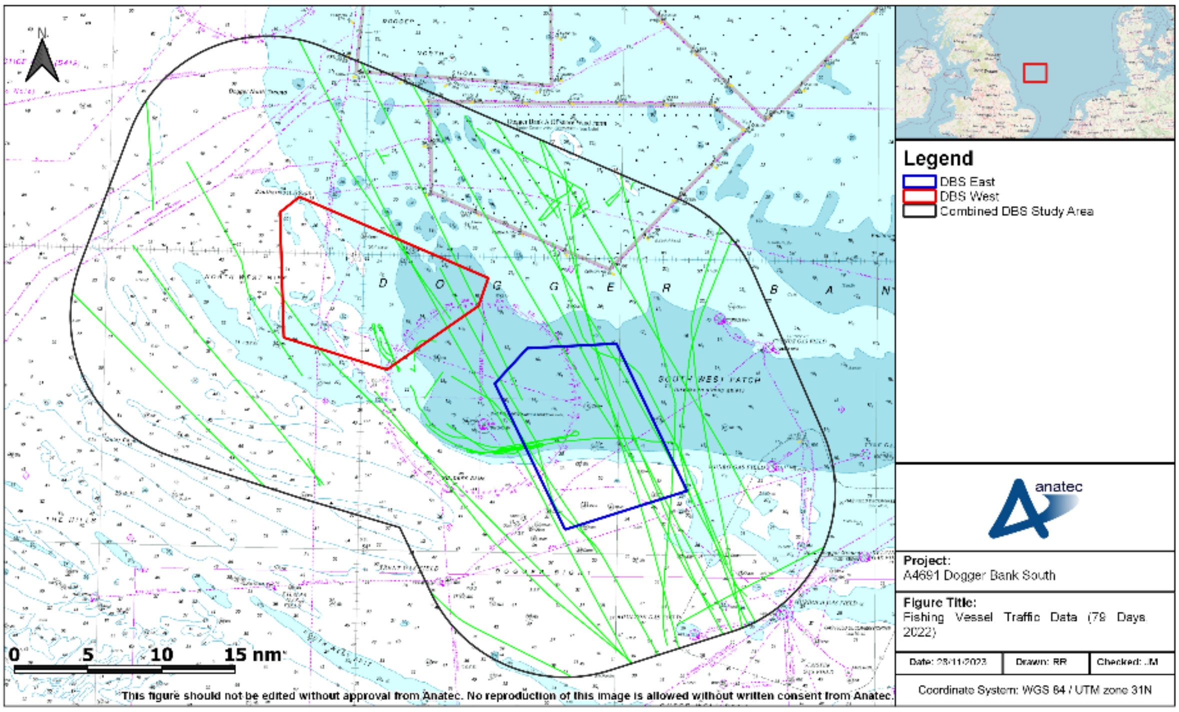

Figure E.8 Commercial Vessel Traffic by Vessel Type (79 Days, 2022)

771. The average daily unique vessel count for fishing vessels recorded within the DBS combined study area during the survey period was one unique fishing vessel every two to three days. The maximum number of unique fishing vessels recorded in one day was three on 8th May 2022, with many days during the survey period recording no fishing vessels at all. Approximately 44% of all fishing vessels recorded intersected the DBS Array Areas with a higher volume intersecting the DBS East Array Area.

772. Fishing vessels were primarily on transit with sparse tracks present within Dogger Bank A which suggests likely fishing activity, this is also supported by vessel speed and information broadcast via AIS. This activity was from one vessel, a vivier-crabber. Another vessel was also noted actively fishing within and to the immediate west of the DBS East Array Area. This vessel was a large pelagic fishing vessel with both pelagic trawling and purse seining gear onboard. As noted in Section 10.1.6, the DBS Array Areas are overlapped by an SAC which prohibits bottom-trawling fishing gear and has been in operation since June 2022.

E.2.7 Anchored Vessels

773. The same criteria for identifying anchored vessels as detailed in Section 10.1.9 was applied to the data gathered during the survey period. After applying the criteria, no

vessels were deemed to be at anchor within the DBS combined study area during the survey period.

E.3 Survey Data Comparison

774. The routeing of vessels during the dedicated vessel traffic surveys was similar overall to the supplementary vessel traffic survey data and comparable to the routes defined in the NRA (see Section 11.2). Table E.1 compares traffic volumes by vessel type between the supplementary vessel traffic data and vessel traffic survey data.

Table E.1 Comparison of Vessel Type Counts Between Supplementary Vessel Traffic Data and Dedicated Vessel Traffic Survey Data

Vessel Type	Average Vessels Per Week					
	DBS East Study Area			DBS West Study Area		
	Supplementary AIS Data	Summer Survey	Winter Survey	Supplementary AIS Data	Summer Survey	Winter Survey
Cargo vessels	35	41	37	21	34	31
Oil and gas vessels	18	20	38	4	7-8	12
Tankers	13	17	10	13	15	11
Tugs	1-2	7	0-1	1	2	0
Passenger vessels	1-2	2-3	0	1-2	1	0
Fishing vessels	2-3	7	1	2-3	6-7	12
Recreational vessels	0-1	2-3	0	0-1	6	0

775. Apart from tankers and passenger vessels, the weekly average of all vessel types was lower during the supplementary vessel traffic data in comparison to the vessel traffic surveys. As previously noted in Section E.1.3, those vessel types that are not required to carry AIS (including smaller fishing vessels and recreational vessels) may be underrepresented in the supplementary survey data.

776. For commercial vessel types, although vessel numbers are lower for cargo vessels, oil and gas vessels, and tugs, the numbers closely correlate for tankers and passenger vessels. For oil and gas vessels this difference may be attributed to lack of activity at the Cavendish field compared to during the dedicated vessel traffic surveys. All main commercial routes identified from the dedicated vessel traffic survey data in Section 11.2 were represented within the supplementary data, highlighting the consistency and habitual nature of these routes.

777. Although some vessel numbers differ between the supplementary data and the dedicated vessel traffic survey data, the greater numbers gathered in the vessel traffic surveys ensure that the baseline characterisation of vessel traffic movements established in Section 10 is conservative and suitably informs the subsequent risk assessment.

E.4 Conclusion

778. Supplementary AIS data was gathered for 79 days in 2022 for the combined DBS East and DBS West study areas. This data was used to validate the summer and winter vessel traffic surveys recorded for each of the DBS array study areas.

779. The main vessel types detected within the DBS combined study area during the 79-day survey period were cargo vessels (49%), oil and gas vessels (22%), and tankers (19%). The main vessel types recorded during the dedicated vessel traffic surveys for the DBS East study area were cargo (40%), oil and gas (30%), and tankers (14%) and for the DBS West study area they were cargo vessels (47%), tankers (18%), and oil and gas vessels (14%).

780. Overall, the vessel types detected within the study area were similar between the dedicated and supplementary vessel traffic survey data and all main routes identified were comparable between both datasets.