GREEN VOLT

Technical Appendix 14.1

Navigational Risk Assessment

Offshore EIA Report: Volume 2

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Green Volt Offshore Windfarm Navigational Risk Assessment

Prepared by	Anatec Limited
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Revision Number	Date	Summary of Change
00	30th September 2022	Initial Draft
01	15th November 2022	Client comment updates
02	7th December 2022	Minor Updates

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Abbreviations Table

Abbreviation	Definition
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ARPA	Automatic Radar Plotting Aid
AtoN	Aids to Navigation
BEWA	British Wind Energy Association
CBA	Cost Benefit Analysis
CBRA	Cable Burial Risk Assessment
CCS	Carbon Capture Storage
CD	Chart Datum
COLREGs	Convention on International Regulations for Preventing Collisions at Sea
CoS	Chamber of Shipping
DF	Direction Finding
DSC	Digital Selective Calling
DSLP	Development Specification and Layout Plan
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
ERCoP	Emergency Response Co-operation Plans
ERRV	Emergency, Response, and Rescue Vessel
ESRI	Environmental Systems Research Institute
ETRS89	European Terrestrial Reference System 1989
FLO	Fisheries Liaison Officer
FSA	Formal Safety Assessment
GIS	Geographical Information System
GMDSS	Global Maritime Distress and Safety System

Abbreviation	Definition
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
GT	Gross Tonnage
HDD	Horizontal Directional Drilling
HMCG	His Majesty’s Coastguard
HSE	Health and Safety Executive
HVDC	High Voltage Direct Current
IHO	International Hydrographic Organisation
IMO	International Maritime Organization
kHz	Kilohertz
km	Kilometres
LAT	Lowest Astronomical Tide
LOA	Length Overall
m	Metres
MAIB	Maritime Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MEHRAs	Marine Environmental High Risk Areas
MEPC	Marine Environment Protection Committee
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MSL	Mean Sea Level
MSC	Maritime Safety Committee
MSI	Maritime Safety Information
MS-LOT	Marine Scotland Licensing Operations Team
N	North
NAVTEX	Navigational Telex
NLB	Northern Lighthouse Board
nm	Nautical Mile

Abbreviation	Definition
nm^2	Square Nautical Miles
NRA	Navigational Risk Assessment
OSP	Offshore Substation Platform
OREIs	Offshore Renewable Energy Installations
PDE	Project Design Envelope
PLL	Potential Loss of Life
PNT	Positioning, Navigation and Timing
POB	Personnel on Board
HSEQ	Health, Safety, Environment and Quality
Radar	Radio Detecting and Ranging
RAM	Restricted in Ability to Manoeuvre
REZ	Renewable Energy Zones
RIB	Rigid-hulled Inflatable Boat
RNLI	Royal National Lifeboat Institution
RYA	Royal Yachting Association
SAR	Search and Rescue
SMS	Safety Management System
SONAR	Sound Navigation Ranging
SOV	Service Operation Vessel
SW	Southwest
TLPs	Tension Leg Platforms
TPV	Third Party Verification
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UTM	Universal Transverse Mercator
VHF	Very High Frequency
VMS	Vessel Monitoring System
VTS	Vessel Traffic Service

Abbreviation	Definition
W	West
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator

1 Introduction

1.1 Background

Anatec was commissioned by Green Volt Offshore Windfarm Ltd (hereafter referred to as 'the Applicant') to undertake a Navigational Risk Assessment (NRA) for the proposed Green Volt Offshore Windfarm (hereafter 'the Project'). The NRA has been undertaken with respect to the offshore components of the Project comprising the Windfarm Site and Offshore Export Cable Corridor. This NRA presents information on the Project relative to the existing and estimated future navigational activity and forms the technical appendix to **Chapter 16: Shipping and Navigation** of the offshore Environmental Impact Assessment Report (EIAR).

1.2 Navigational Risk Assessment

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

- Outline of methodology applied in the NRA including relevant guidance;
- Summary of consultation undertaken with shipping and navigation stakeholders;
- Lessons learnt from previous offshore wind farm developments;
- Summary of Project Design Envelope (PDE) relevant to shipping and navigation;
- Overview of existing environment including:
  - Navigational features;
  - Meteorological and oceanographic conditions;
  - Emergency response resources;
  - Historical maritime incidents; and
  - Vessel traffic movements.
- Implications for marine navigation and communication equipment;
- Cumulative and transboundary overview;
- Overview of anticipated future case vessel traffic;
- Assessment of navigational risk pre and post construction of the Project including collision and allision risk modelling;
- Hazard identification for assessment in Chapter 16: Shipping and Navigation;
- Identification of embedded mitigation measures; and
- Completion of the MGN 654 Checklist (see **Appendix A**).

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

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

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

2 Guidance and Legislation

2.1 Legislation and Policy

As part of the EIA Directive (2011/92/European Union (EU), as amended by Directive 2014/52/EU) (which remains applicable following EU Exit), an EIAR is required to support the application for the Section 36 consent for the Project. The MCA require that, as part of the EIAR, an NRA is undertaken to "*inform the shipping and navigation chapter of the EIA Report*" (MCA, 2021).

2.2 Primary Guidance

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* and its annexes (MCA, 2021); and
- *Revised Guidelines for FSA for Use in the Rule-Making Process* (International Maritime Organization (IMO), 2018).

MGN 654 highlights issues that shall be considered when assessing the potential effect on navigational safety from offshore renewable energy developments proposed in United Kingdom (UK) internal waters, territorial sea or Renewable Energy Zones (REZ).

MGN 654 includes several annexes including the *Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI)* which the MCA require to be used as a template for preparing NRAs. The methodology 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). In both Chapter 16: Shipping and Navigation and the NRA, the base and future case levels of risk have been identified as well as the mitigation measures required to ensure the future case remains broadly acceptable, or tolerable with mitigation.

2.3 Other Guidance

Other guidance documents used during the assessment include:

- *MGN 372 (Merchant and Fishing) Offshore Renewable Energy Installations (OREI): Guidance to Mariners Operating in the Vicinity of UK OREIs* (MCA, 2008);
- *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Guidance G1162 on the Marking of Offshore Man-Made Structures* (IALA, 2021);
- *IALA Recommendations R139 on the Marking of Offshore Man-Made Structures* (IALA, 2021);
- *The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy* (RYA, 2019); and

- *Regulatory Expectations on Moorings for Floating Wind and Marine Devices* – (MCA and Health and Safety Executive (HSE), 2017).

2.4 Lessons Learnt

There is considerable benefit for the Applicant in the sharing of lessons learnt within the offshore industry. The NRA, and in particular the risk assessment undertaken in **Chapter 16: Shipping and Navigation**, includes general consideration for lessons learnt and expert opinion from previous offshore wind farm developments and other sea users – especially from other floating projects such as Kincardine and Hywind offshore wind farms - capitalising upon the UK's position as a leading generator of offshore wind power.

It is noted that that are also applicable lessons learnt from the Oil and Gas industry in relation to use of floating infrastructure.

3 Navigation Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

A shipping and navigation user can only be affected by a hazard if there is a pathway through which a hazard can be transmitted between the source activity (cause) and the user. In cases where a user is exposed to a hazard, the overall severity of consequence to the user is determined. This process incorporates a degree of subjectivity. The assessments presented within the NRA for shipping and navigation users have considered the following criteria:

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

With regards to commercial fishing vessels, the methodology and assessment in the NRA considers hazards to commercial fishing vessels in transit. A separate methodology and assessment have been applied in **Chapter 16: Shipping and Navigation** to consider hazards to commercial fishing vessels related to commercial fishing activity (rather than commercial fishing vessels in transit).

3.2 Formal Safety Assessment Process

The IMO Formal Safety Assessment (FSA) process (IMO, 2018) (the FSA process) as approved by the IMO in 2018 under Maritime Safety Committee (MSC) – Marine Environment Protection Committee (MEPC).2/circ. 12/Rev.2 has been applied to the risk assessment in **Chapter 16: Shipping and Navigation** and is considered in this NRA.

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

- **Step 1** – identification of hazards (a list is produced of hazards prioritised by risk level specific to the problem under review);
- **Step 2** – risk analysis (investigation of the causes and initiating events and consequences of the more important hazards identified in Step 1);
- **Step 3** – risk control options (identification of measures to control and reduce the identified hazards);
- **Step 4** – CBA (identification and comparison of the benefits and costs associated with the risk control options identified in Step 3); and
- **Step 5** – recommendations for decision-making (defining of recommendations based upon the outputs of Steps 1 to 4).

Figure 3.1: Flow Chart of FSA Methodology

3.2.1 Hazard Workshop Methodology

A key tool used when undertaking an NRA is the Hazard Workshop which ensures that all risks are identified and qualified in agreement with relevant consultees prior to assessment within the EIAR. Risks (and the determined qualification) are recorded via the hazard log which is presented in full in **Appendix B.**

Table 3.1 and **Table 3.2** identify how the severity of consequence and the frequency of occurrence have been defined within the hazard log.

Table 3.1: Severity of Consequence Ranking Definitions

Rank	Description	Definition			
		People	Property	Environment	Business
1	Negligible	No perceptible risk	No perceptible risk	No perceptible risk	No perceptible risk
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

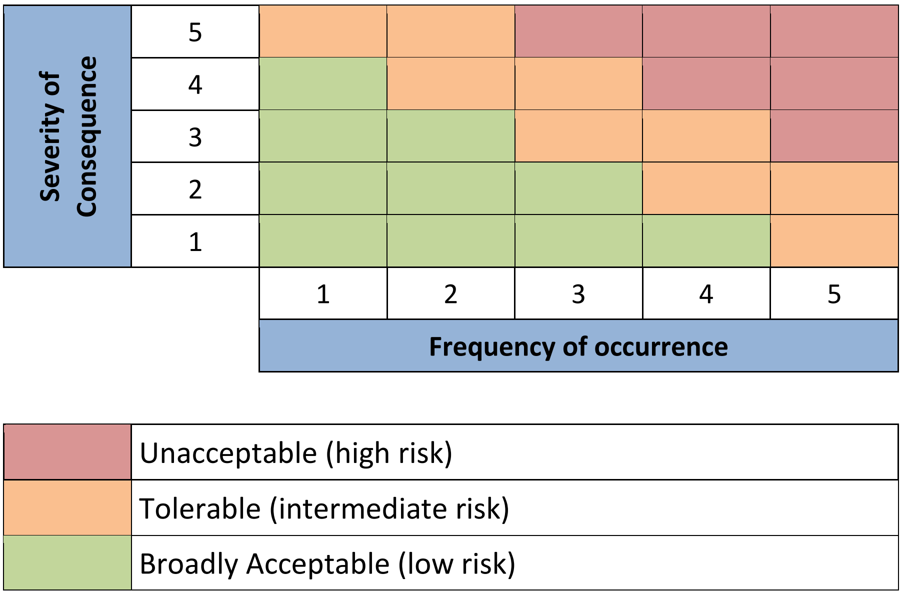
Rank	Description	Definition			
		People	Property	Environment	Business
4	Serious	Multiple serious injuries or single fatality	Damage resulting in critical risk to operations	Tier 2 regional assistance required	National reputational risks
5	Major	More than one fatality	Total loss of property	Tier 3 national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

Table 3.2: Frequency of Occurrence Ranking Definitions

Rank	Description	Definition
1	Negligible	Fewer than 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

An aggregate of the severity of consequence (**Table 3.1**) and frequency of occurrence (**Table 3.2**) provide the level of risk for each hazard. The method for undertaking this aggregation is through use of a tolerability matrix, as presented in **Table 3.3**. The risk of a hazard is defined as Broadly Acceptable (low risk), Tolerable (intermediate risk), or Unacceptable (high risk).

Table 3.3: Tolerability Matrix and Risk Rankings



Once identified, the risk of a hazard is assessed to ensure it is ALARP. Further risk control measures may be required to further mitigate a hazard in accordance with the ALARP principle. Unacceptable risks are not considered to be ALARP.

Outputs of the hazard log have been used as evidence to support and refine the assessment undertaken in **Chapter 16: Shipping and Navigation**.

3.3 Methodology for Assessing Cumulative Effects

The hazards identified in the FSA are also 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 undertaken, which splits developments into tiers depending upon project status, proximity to the Windfarm Site and the level to which they are anticipated to cumulatively impact relevant users. It also considers data confidence, most notably in terms of the level of certainty over the location and timescales for a development.

The tiers are summarised in **Table 3.4**, with the level of assessment undertaken for each tier included.

Table 3.4: Cumulative Development Screening Summary

Tier	Development Status	Distance from the Windfarm Site	Minimum Data Confidence	Level of Cumulative Risk Assessment
N/A	Operational or under construction	N/A	N/A	None – considered as part of the baseline assessment.
1	Pre-construction	Up to 50 nautical miles (nm)	High	Detailed qualitative and quantitative assessment of re-routeing of main commercial vessels.
2	Consented	Up to 50nm	Medium	Detailed qualitative and quantitative assessment of re-routeing of main commercial vessels.
3	Under determination, scoped or not yet scoped	Up to 50nm	Low	High level qualitative assumptions of re-routeing of main commercial vessels only.

Tier	Development Status	Distance from the Windfarm Site	Minimum Data Confidence	Level of Cumulative Risk Assessment
4	Any	Greater than 50nm	Any	None – screened out of cumulative risk assessment.

3.4 Study Area

The study area used within the NRA has been defined as a minimum[1] 10nm buffer of the Windfarm Site as shown in **Figure 3.2**. The study area has 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 Windfarm Site. Navigational features wholly or partially outside the study area are considered where appropriate.

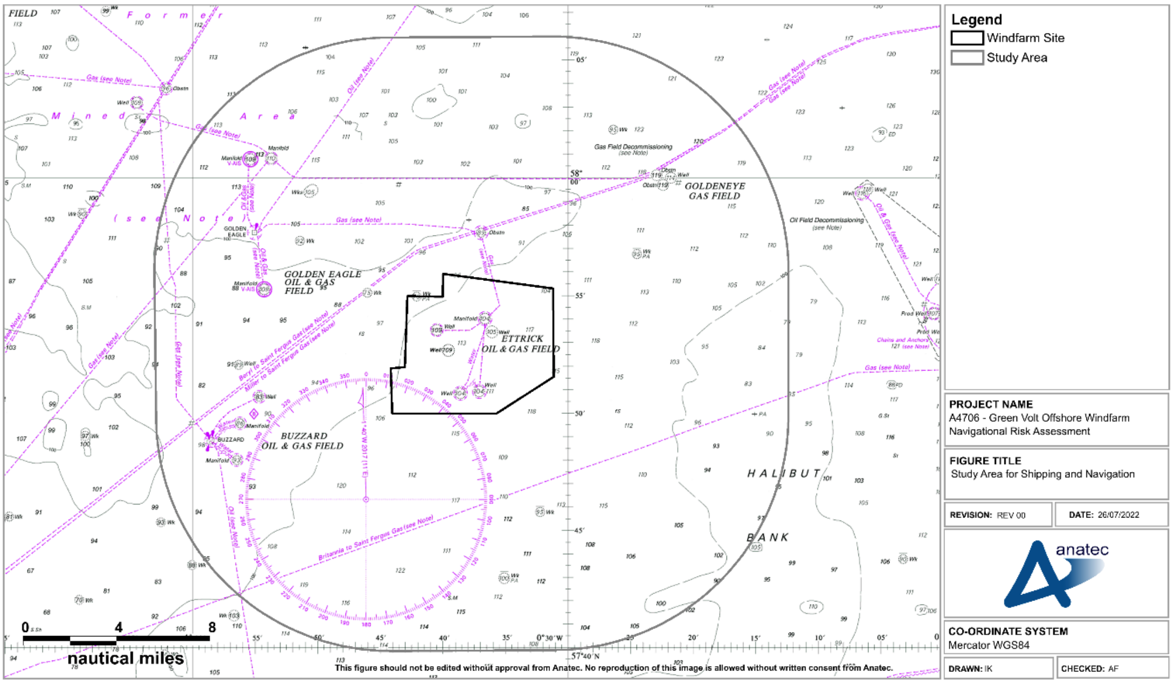


Figure 3.2: Study Area for Shipping and Navigation

Assessment of the Offshore Export Cable Corridor has been undertaken within a study area defined as a 2nm buffer as shown in **Figure 3.3**, hereafter referred to as the Cable Study Area.

[1] 10nm measured from Windfarm Site boundary assessed at Scoping stage.

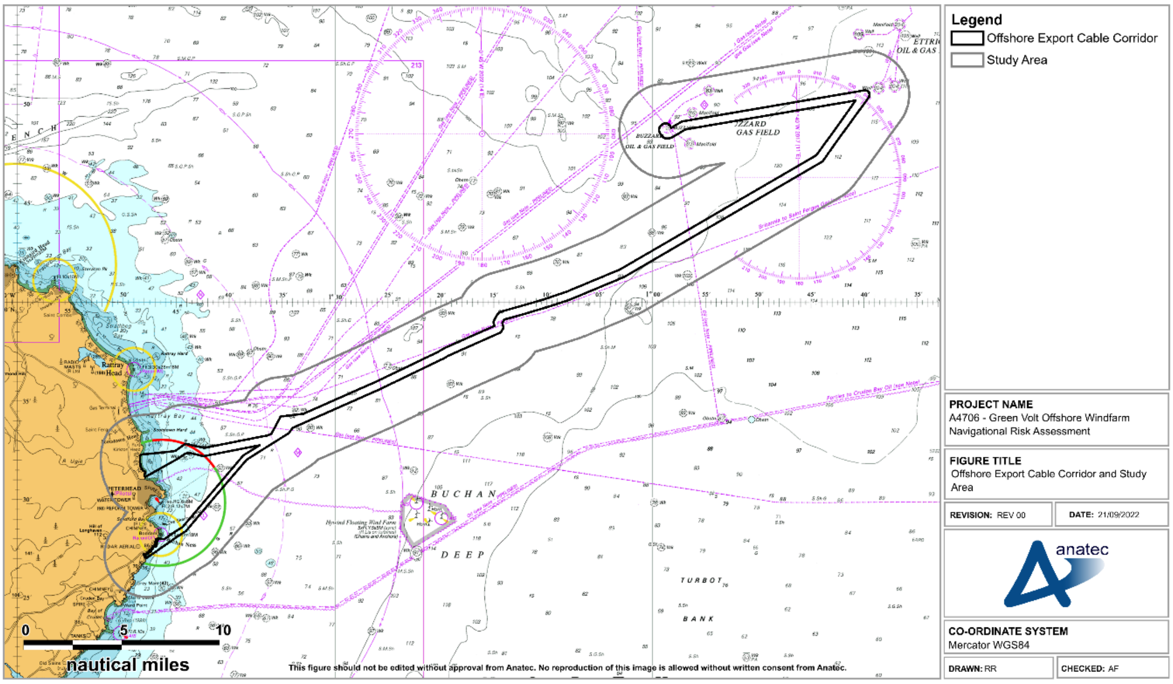


Figure 3.3: Study Area for Offshore Export Cable Corridor

4 Consultation

4.1 Key Stakeholders Consulted in the Navigational Risk Assessment Process

Key shipping and navigation stakeholders have been consulted in the NRA process as required. Key stakeholders consulted include:

- MCA;
- Northern Lighthouse Board (NLB);
- UK Chamber of Shipping (CoS);
- RYA Scotland;
- Cruising Association; and
- Royal National Lifeboat Institution (RNLI).

Regular Operators identified from the vessel traffic surveys were also provided with an overview of the Project and offered the opportunity to provide comment (the full Regular Operator letter is presented in **Appendix D**). The full list of Regular Operators identified is provided below, noting responses are provided in Section 4.2.3:

- AET;
- Cargow;
- Esvagt;
- Fletcher Group;
- Golden Energy Offshore;
- Horizon Maritime;
- K Line Offshore;
- Metrostar Shipping;
- North Star Shipping;
- Ostensjo Rederi;
- Peak Group;
- Rem Offshore;
- Remoy Shipping;
- Scotline;
- Sentinel Marine;
- Solstad;
- Sub Sea 7;
- Tidewater;
- Vestland Offshore; and
- Vroon.

It is noted that the Hazard Workshop included a variety of industry sectors as detailed in Section 4.2.3.

4.2 Consultation Responses

Various responses have been received from a variety of shipping and navigation stakeholders during consultation undertaken in the NRA process, including via conference calls, email correspondence, and the Scoping Opinion. The responses received of relevance to shipping and navigation are summarised in this section.

4.2.1 Scoping

The Applicant submitted a Scoping Report to Marine Scotland Licensing Operations Team (MS-LOT) in December 2021. The Scoping Opinion was subsequently published in April 2022. The key points of relevance to shipping and navigation are summarised in **Table 4.1**, which includes where they have been addressed in the NRA or EIAR.

Table 4.1: Summary of Key Points Raised During Consultation from the Scoping Opinion

Stakeholder(s)	Date and form of correspondence	Point raised	Response and where addressed in the NRA
CoS	31 January 2022 - Letter	The Chamber welcomes the consultation and at this stage, does not have any particular items that need additional consideration other than those captured within the Scoping Report	The Applicant confirms all Items within Scoping Report are considered within the NRA and EIAR.
		The Chamber looks forward to more detailed analysis on shipping and navigation in due course.	A dedicated meeting was held with the CoS in July 2022 as per Section 4.2.2.
MCA	21 December 2021 - Letter	The EIA Report should supply detail on the possible impact on navigational impact on navigational issues for both commercial and recreational craft, specifically: ▪ Collision Risk ▪ Navigational Safety ▪ Visual intrusion and noise ▪ Risk Management and Emergency response ▪ Marking and lighting of Windfarm Site and information to mariners ▪ Effect on small craft navigational and communication equipment ▪ The risk to drifting recreational craft in adverse weather or tidal conditions ▪ The likely squeeze of small craft into the routes of larger commercial vessels.	All items listed have been considered and assessed as confirmed by the completed MGN 654 checklist (**Appendix A**).
		A NRA will need to be submitted in accordance with MGN 654 (and MGN 372) and the MCA's Methodology for Assessing the Marine Navigation Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI). This NRA should be accompanied by a detailed MGN 654 Checklist which can be downloaded from the MCA website at https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping	This document forms the NRA undertaken for the Project and in support of **Chapter 16: Shipping and Navigation**. MGN 654 compliance has been demonstrated by the completion of an MGN 654 checklist (**Appendix A**).

Stakeholder(s)	Date and form of correspondence	Point raised	Response and where addressed in the NRA
		Noted that a "vessel traffic survey will be undertaken to the standard of MGN 654 i.e. at least 28 days which is to include seasonal data (two x 14-day surveys) collected from a vessel based survey using automatic identification system (AIS), Radio Detecting And Ranging (Radar) and visual observations to capture all vessels navigating in the study area".	The NRA has considered 28 days of MGN 654 compliant vessel traffic survey data as per Section 5.2. The approach to vessel traffic survey data collection was agreed with the MCA as per Section 4.2.2.
		The turbine layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and Search and Rescue (SAR) aircraft operating within the Windfarm Site.	As per Section 21, the layout will be agreed with the MCA as part of the Development Specification and Layout Plan (DSLP) process post consent.
		If a 'worst-case' layout is used within the NRA, the applicant should ensure it is a realistic layout design that complies with MGN 654 guidance. Any additional navigation safety and/or Search and Rescue requirements, as per MGN 654 Annex 5, will be agreed at the approval stage.	The layout assessed within the NRA has been defined such that it is MGN 654 compliant and represents a realistic worst case (see Section 6.2.2).
		Attention should be paid to cabling routes and where appropriate burial depth for which a Burial Protection Index study should be completed and subject to the traffic volumes, an anchor penetration study may be necessary.	As per Section 21, the post consent Cable Burial Risk Assessment (CBRA) will be informed via vessel traffic assessment including anchoring studies if appropriate.
		If cable protection measures are required e.g., rock bags or concrete mattresses, the MCA would be willing to accept a 5% reduction in surrounding depths referenced to Chart Datum. This will be particularly relevant where depths are decreasing towards shore and potential impacts on navigable water increase, such as at the horizontal directional drilling (HDD) location.	As per Section 21, the Applicant will comply with MGN 654 including the requirement to consult with the MCA if charted water depths would be reduced by more than 5%.
		Consideration of electromagnetic deviation on ships' compasses should be included within the assessment. The MCA would be willing to accept a three-degree deviation for 95% of the cable route. For the remaining 5% of the cable route no more than five degrees will be attained. The MCA may request a deviation survey post the cable being laid.	Effects associated with electromagnetic deviation have been considered in Section 12.5.

Stakeholder(s)	Date and form of correspondence	Point raised	Response and where addressed in the NRA
		Regulatory mooring expectations is identified as a potential mitigation. The MCA confirmed this guidance should be followed and that a Third-Party Verification of the mooring arrangements will be required.	As per Section 21, all relevant regulatory requirements will be followed including third party mooring verification.
		Particular consideration will need to be given to the implications of the Windfarm Site size and location on SAR resources and Emergency Response Co-operation Plans (ERCoP). Attention should be paid to the level of radar surveillance, AIS, and shore-based very high frequency (VHF) radio coverage and give due consideration for appropriate mitigation such as radar, AIS receivers and in-field, Marine Band VHF radio communications aerial(s) (VHF voice with Digital Selective Calling (DSC)) that can cover the entire Windfarm Sites and their surrounding areas. A SAR checklist will also need to be completed in consultation with MCA.	As per Section 21, the Applicant will comply with MGN 654 including the agreement of an ERCoP and SAR checklist with the MCA.
		MGN 654 Annex 4 requires that hydrographic surveys should fulfil the requirements of the International Hydrographic Organisation (IHO) Order 1a standard, with the final data supplied as a digital full density data set, and survey report to the MCA Hydrography Manager. Failure to report the survey or conduct it to Order 1a might invalidate the NRA if it was deemed not fit for purpose.	As per Section 21, the Applicant will comply with MGN 654 including on hydrographic survey requirements (see Section 22.7).
NLB	03 December 2021 - Letter	NLB note the inclusion within Section 7 of a proposal to engage with both NLB and MCA regarding Lighting and Marking across both the construction and Operational phases of the windfarm.	As per Section 21, lighting and marking will be agreed with NLB and MCA.
RYA Scotland	21 December 2021 – Letter	Recreational boating should be scoped into the *Shipping and Navigation* section of the EIA as the Windfarm Site is on the route from southwest (SW) Norway to Scotland.	Baseline recreational activity has been assessed in Section 10.1.2.5. Associated impacts are assessed in Sections 17, 18, and 19 (construction, operation and decommissioning respectively).
		RYA Scotland (RYAS) requested to participate in the Hazard Workshop.	RYAS were invited to and subsequently attended the

Stakeholder(s)	Date and form of correspondence	Point raised	Response and where addressed in the NRA
			Hazard Workshop (see Section 4.2.4)
		This will be the first large grid-connected floating wind farm to be built and, as it is also located near oil and gas production infrastructure, there may turn out to be issues that were not relevant for existing and planned floating wind farms. On the other hand, the oil and gas industry has many years of experience of ensuring safe navigation near production platforms and the mitigation measures employed will be very relevant to the current proposal.	The NRA process has considered various including inputs lessons learnt from other floating developments (see Section 2.4) to determine appropriate mitigations.
		Although the current version of the UK Coastal Atlas of Recreational Boating published by the RYA has poor coverage of the sea at the proposed Windfarm Site, tracks can be seen heading towards the Windfarm Site. RYA estimate that a quarter of recreational vessels crossing the northern North Sea transmit an AIS signal and consider that their routes are typical of those of the other vessels	The NRA has considered the RYA Coastal Atlas as per Section 5.
		Noted that recreational boats can be difficult to spot on radar which may lead to an underestimate of numbers. This may be exacerbated by variations in numbers of vessels and routes from year to year depending inter alia on wind direction and strength. However, what matters is that some vessels will pass through the area, some of which will do so in conditions of poor visibility.	The NRA has considered multiple data sources and consultation input to ensure comprehensive understanding of non-AIS traffic in the area as per Section 5. This includes recreational representative input received in the Hazard Workshop. It is noted that the vessel traffic survey approach has been agreed with the MCA and NLB as per Section 4.2.2 and is MGN 654 compliant.
		There may be information on the ports of departure from Norway from the marinas at Whitehills and Peterhead. Also suggested that contact is made with the Norwegian Sailing Federation in case they are able to contribute their knowledge of the routes between Norway and Scotland.	The stated ports / marinas / organisations were contacted to determine whether any relevant data and / or feedback could be provided. No response was received.
		In terms of the proposed landfall sites, Peterhead is one of the termini of the	The EIAR will consider cumulative cable impacts.

Stakeholder(s)	Date and form of correspondence	Point raised	Response and where addressed in the NRA
		planned SEGL 2 High Voltage Direct Current (HVDC) link from Peterhead to Drax in Yorkshire which may lead to a cumulative impact.	Relevant shipping and navigation impacts are assessed in Section 20.
MS-LOT	MS-LOT Scoping Opinion 19/04/2022	The Scottish Ministers are broadly content with regards to the proposed study areas and baseline data sources identified in the Scoping Report. However, the Scottish Ministers draw attention to the representation from RYA and its point regarding potential underestimate of recreational boat numbers. The Scottish Ministers are content that the Developer has agreed the data collection method for the Navigational Risk Assessment in advance with the MCA.	The NRA has considered multiple data sources (including collection of non AIS vessel traffic data via Radar and the RYA Coastal Atlas) and consultation input to ensure comprehensive understanding of non-AIS traffic in the area as per Section 5. This includes recreational representative input received in the Hazard Workshop.
		In Table 7.4 of the Scoping Report the Developer summarises the potential impacts to shipping and navigation identified during the different phases of the Proposed Development which it proposes to scope in to the EIA Report. The Scottish Ministers agree with the impacts detailed and scoped in, however advise that recreational boating must also scoped in to the EIA Report for further assessment as the site is on the route from South West Norway to Scotland. Additionally, the Scottish Ministers advise that the representations from the MCA, RYA and NorthConnect must be fully addressed within the EIA Report. In relation to the embedded mitigation measures, the Scottish Ministers highlight the MCA and NLB representations which must be fully addressed by the Developer.	Impacts to recreational vessels have been assessed in **Chapter 16: Shipping and Navigation**. MCA, NLB and RYA representations have been fully considered as summarised in this table, including in terms of mitigations (see Section 21). Electromagnetic Interference within the context of shipping and navigation has been considered in Section 12.5. Other elements of the NorthConnect representation are addressed within the EIA Report where appropriate, including **Chapter 10 Fish and Shellfish Ecology**, **Chapter 11: Marine Mammals** and **Chapter 17 Infrastructure and Other Users**
		With regards to cabling routes and cable burial, the Scottish Ministers draw the	As per Section 21, the post consent CBRA will be

Stakeholder(s)	Date and form of correspondence	Point raised	Response and where addressed in the NRA
		Developers attention to the MCA representation. The MCA advises that a Burial Protection Index study should be completed and subject to the traffic volumes, an anchor penetration study may be necessary. The Scottish Ministers advise that this should be fully addressed in the EIA Report and highlight the MCA advice regarding a 5% reduction in surrounding depths referenced to Chart Datum for cable protection measures.	informed via vessel traffic assessment including anchoring studies if appropriate. The Applicant will comply with MGN 654 including the requirement to consult with the MCA if charted water depths would be reduced by more than 5%.
		Additionally with regards to cabling, the Scottish Ministers emphasise the representation from the SFF which states that impacts on safe navigation for fishing vessels around the export and inter-array cables should be scoped in to the EIA Report. The Scottish Ministers agree and advise that this point must be fully addressed by the Developer.	Navigational safety impacts to fishing vessels in transit are considered in **Chapter 16: Shipping and Navigation**. Additional assessment is available in **Chapter 13: Commercial Fisheries**.
		In addition, the Scottish Ministers highlight the MCA representation regarding Search and Rescue (“SAR”), Emergency Response Co-operation Plans, radar surveillance, Automatic Identification System and shore-based VHF radio coverage. The Scottish Ministers advise that the MCA representation must be fully addressed within the EIA Report and that a SAR checklist must be completed by the Developer in consultation with the MCA.	As per Section 21, the Applicant will comply with MGN 654 including the agreement of an ERCoP and SAR checklist with the MCA.
		For completeness, the Developer should note that the MCA confirmed that compliance with regulatory expectations on moorings for floating wind and marine devices as stated in Section 7.2.3.4 of the Scoping Report is required and a Third-Party Verification of the mooring arrangements will be required.	As per Section 21, all relevant regulatory requirements will be followed including third party mooring verification.

4.2.2 Dedicated Meetings

Key points raised at dedicated stakeholder meetings of relevance to shipping and navigation are summarised in **Table 4.2.**

Table 4.2: Key Stakeholder Meetings

Consultee	Date	Point raised	Response and where addressed in the NRA
MCA	07 June 2021	MCA confirmed content with vessel traffic survey approach.	Approach is as per agreed (Section 5.2).
MCA	02 February 2022	MCA confirmed content with NRA methodology.	Approach is as per agreed and in line with MGN 654 (see Section 3).
		MCA requested an invite to the Hazard Workshop.	MCA were invited to and subsequently attended the Hazard Workshop (see Section 4.2.4)
NLB	08 February 2022	NLB confirmed content with NRA methodology.	Approach is as per agreed and in line with MGN 654 (see Section 3).
		NLB requested an invite to the Hazard Workshop.	NLB were invited to and subsequently attended the Hazard Workshop (see Section 4.2.4)
CoS	28 July 2022	CoS confirmed content with NRA methodology.	Approach is as per agreed and in line with MGN 654 (see Section 3).
		CoS stated loss of station should be considered within the NRA.	Loss of station has been considered in Section 18.9.

4.2.3 Regular Operators

The key points raised as part of the Regular Operators outreach (see Section 4.1), are summarised in **Table 4.3**, including where each point raised has been addressed within the NRA or EIAR.

Table 4.3: Summary of Regular Operators Outreach

Regular Operator(s)	Date and form of correspondence	Point raised	Response and where addressed in the NRA
Esvagt	06 April 2022 – Email	No comments from ESVAGT	n/a
Scotline	19 April 2022 - Email	Noted concern over potential deviations including in relation to increased journey times and fuel.	Deviations have been quantitatively assessed in Section 14.5. Associated impact assessment has been undertaken in Sections 17.1, 18.1, and 19.1 (construction, operation and decommissioning respectively).

Regular Operator(s)	Date and form of correspondence	Point raised	Response and where addressed in the NRA
		Noted concern over general loss of searoom in particular in relation to adverse weather routeing (noting weather forecasts not always accurate).	Adverse weather has been assessed in Section 11.2. Associated impact assessment has been undertaken in Sections 17.1, 18.1, and 19.1 (construction, operation and decommissioning respectively).
		Stated it was unlikely Scotline vessels would transit through the Windfarm Site, however this would depend on circumstances at the time.	This input has been considered within the associated impact assessments, see Sections 17, 18, and 19 (construction, operation and decommissioning respectively).
		Noted floating structures would be viewed as higher risk than fixed foundations due to potential for loss of station	Loss of station has been assessed in Section 18.9.
		Requested to be kept updated on the Project and Hazard Workshop.	Scotline were invited to and subsequently attended the Hazard Workshop (see Section 4.2.4)
Tidewater	20 April 2022 - Email	No concerns raised.	n/a

4.2.4 Hazard Workshop

A key element of the consultation phase was the Hazard Workshop, a meeting of local and national marine stakeholders to identify and discuss potential shipping and navigation hazards. Using the information gathered from the Hazard Workshop, a hazard log was produced for use as input into the risk assessment undertaken in Sections 17, 18, and 19. This ensured that expert opinion and local knowledge was incorporated into the hazard identification process and that the hazard log was site-specific.

4.2.4.1 Hazard Workshop Attendance

The Hazard Workshop was held virtually via Microsoft Teams on the 30th May 2022. Participants were as follows:

- MCA;
- NLB;
- RNLI;
- RYA Scotland;
- Cruising Association;
- Project Fisheries Liaison Officer (FLO);
- Aberdeen Harbour Board;
- Scotline; and
- North Star Shipping.

It is noted that all regular operators contacted (see Section 4.1) were given the opportunity to attend the Hazard Workshop.

4.2.4.2 Hazard Workshop Process and Hazard Log

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

Following the Hazard Workshop, the risks associated with the identified hazards were ranked in the hazard log based upon the discussions held during the workshop, with appropriate and relevant mitigation measures identified. The hazard log was then provided to the Hazard Workshop attendees for comment and their feedback incorporated into the NRA. The hazard log has been used to inform the risk assessment in Sections 17,18, and 19 and is provided in full in **Appendix B**.

It is noted that local ports including Peterhead in addition to local fishing representatives were invited to participate in the Hazard Workshop.

Key points raised during the Hazard Workshop deemed of relevance to the NRA are provided in **Table 4.4**.

Table 4.4: Hazard Workshop Summary

Comment Originator	Point raised	Response and where addressed in the NRA
Cruising Association	Suggested the Baltic Section of the Cruising Association should be consulted with regards to recreational transits to / from Scandinavia.	The Baltic Section of the Cruising Association has been consulted as per Section 4.2.5.
Cruising Association	Stated decision as to whether recreational vessels would transit through would likely be taken on a case-by-case basis, with key factors being wind direction and general weather conditions. In adverse conditions it is likely most recreational vessels would avoid the Windfarm Site.	Input has been considered where relevant in the risk assessment undertaken in Sections 17, 18, and 19 (construction, operation and decommissioning respectively).
Cruising Association	Noted that Brexit means UK recreational users are no longer able to leave craft in the EU for extended periods of time. Therefore, there may now be an increase in transits in order to return vessels to the UK.	Input considered within the baseline assessment (see Section 10.1.2.5).

Comment Originator	Point raised	Response and where addressed in the NRA
FLO	The key mitigation is ensuring effective promulgation of information. Noted importance of ensuring relevant fishing vessels had access to and were aware of plotter overlays for the project infrastructure. Relevant information being relayed at local ports would be useful, including instructions of how to update plotter information. Noted that an awareness of mooring lines will also be important. Fishermen will have fished around oil and gas anchor lines before, and so know the proper procedures for doing so as long as they are aware of where anchor moorings are located. Pelagic fishing does not typically occur in the area.	Input has been considered where relevant in the risk assessment undertaken in Sections 17, 18, and 19 (construction, operation and decommissioning respectively). In particular, the promulgation and use of plotter overlays has been applied as a mitigation where appropriate.
NLB	Noted that with the emerging number of floating wind farms, mitigation is being considered by NLB for when turbines displaying aids to navigation are removed for maintenance.	This has been incorporated into the allision risk assessment (see Section 18.5).
NLB	Queried whether there is an emergency tow plan for the floating turbines	The aim is to design out the scenario where an emergency tow is required by following appropriate design codes and draw on experience gained by the oil and gas industry. The number of mooring lines per floating substructure allows for some failure (in relation to metocean conditions or vessel allision, for example) whilst maintaining integrity of the mooring system. The materials for each mooring line are selected to ensure stability and wear resistance, whilst the attachment points are designed for fatigue. During construction, all aspects of the mooring system and the attachment points will be subject to thorough scrutiny. As the floating substructures are classed as ships, there will be compliance with flag state rules and a class surveyor will be present throughout. Third party verification (TPV) of the mooring systems will be undertaken by an independent and competent body to ensure they meet the required standards. Once at the Windfarm Site, a programme of inspection of the

Comment Originator	Point raised	Response and where addressed in the NRA
		floating substructures and mooring systems will be in place on a pre-determined cycle. Each unit will have a GPS system which sets off an alarm if movement starts goes beyond a pre-set limit, for example from a ship allision. It should be noted that this limit is less than what would be expected from a mooring failure and would trigger a response to check the moorings. The alerts will be provided to the Marine Coordination Centre. The floating substructures will probably have mooring bollards that could take tow lines. However, onboard access would be required to attach tow lines, which may be challenging in adverse weather conditions. In such an event, warning mechanisms will be used to give adequate notification to ensure the safety of other sea users until weather conditions are suitable for a towing connection to be made. The procedures for emergency situations will all be detailed in an Emergency Response Cooperation Plan (ERCoP) that will be approved by the MCA and the Northern Lighthouse Board. When the units are under tow to or from the Windfarm Site there will be emergency tow bridles in place, in addition to the tow lines. The bridles float on the surface with a buoy at the free end, but these are not permanent features as the floating lines can be degraded by UV and marine growth and potentially fail at the critical moment
North Star Shipping	Noted any impacts on oil and gas vessels from the Windfarm Site are unlikely to be significant based on typical transit frequencies	Input considered in risk assessment in Sections 17, 18, and 19 (construction, operation and decommissioning respectively).
North Star Shipping	Noted that towage of semisubs and rigs may occur in the area.	Baseline O&G activity is assessed in Section 10.2.2.1. Associated collision risk is assessed in the risk assessment in Sections 17, 18, and 19 (construction, operation and decommissioning respectively).
North Star Shipping	Noted that vessel numbers in the area may increase due to the South Aberdeen Port expansion.	Future case scenarios have been considered as per Section 14.1.
RYA Scotland	Noted that recreational activity can vary by year and season. The majority of recreational vessels in the area will usually be in transit to	Input considered within the baseline assessment (see Section 10.1.2.5).

Comment Originator	Point raised	Response and where addressed in the NRA
	Scandinavia in May / June, with these vessels usually returning in August / September.	
RYA Scotland	Noted that data collected during 2021 may be affected by COVID.	Considered in Section 10.1.2.5 and Section 5.4.2.
RYA Scotland	Noted that operational wind farms often form useful Aids to Navigation for recreational users. It was therefore important to ensure procedures were in place to repair / replace any failed lights as quickly as feasible (noting the distance offshore) to minimise allision risk particularly in adverse weather.	As per Section 21, the Project will comply with IALA G1162 (IALA, 2021) and NLB requirements. This includes the meeting of IALA Availability requirements for the Aids to Navigations (AtoNs) installed. Any associated NLB requirements will be complied with.
RYA Scotland	Promulgation of information is an important mitigation for recreational vessels.	Input has been considered where relevant in the risk assessment undertaken in Sections 17, 18, and 19 (construction, operation and decommissioning respectively).
RYA Scotland	Noted that vessels under sail may find navigation difficult in proximity to the Windfarm Site, but may sail in proximity depending on wind direction.	Input has been considered where relevant in the risk assessment undertaken in Sections 17, 18, and 19 (construction, operation and decommissioning respectively).
RYA Scotland and Cruising Association	Stated limited concern with nearshore sections of the Offshore Export Cable Corridor and / or protection with regards to anchor or underkeel interaction assuming cables were charted.	Anchor interaction has been assessed in Section 18.8, under keel clearance has been assessed in Section 18.7.
Scotline	Noted that assessing 14 day periods of data may miss certain commercial vessel routeing / activity.	Anatec's ShipRoutes database has been used to validate the routeing assessment of commercial vessels (see Section 5).
Scotline	Stated that most Scotline vessels would likely avoid the Windfarm Site leading to increased journey times and fuel emissions. Scotline vessels may pass in closer proximity under certain emergency circumstances.	Deviations have been quantitatively assessed in Section 14.5. Associated impact assessment has been undertaken in Sections 17.1, 18.1, and 19.1 (construction, operation and decommissioning respectively). Vessel drifting risk has been assessed on a quantitative basis in Section 15.4.3.
Scotline	Key concern was cumulative deviations between / around Windfarm Sites that commercial vessels may view as being less	Cumulative deviations are considered in Section 14.6. Adverse weather routeing is considered in Section 11.2.

Comment Originator	Point raised	Response and where addressed in the NRA
	preferable than previous routing options especially in adverse weather.	
Scotline	Noted that vessels in the area will likely have professional seafarers on board who should have expertise on taking avoidance action.	Input considered in risk assessment in Sections 17, 18, and 19 (construction, operation and decommissioning respectively).

4.2.5 Recreational Outreach

Based on input from RYA Scotland and the Cruising Association, the following were contacted with a request for input on the Project:

- Norwegian Sailing Federation;
- Whitehills Marina;
- Peterhead Bay Marina; and
- Baltic Section of the Cruising Association.

The output of this outreach is summarised in **Table 4.5**.

Table 4.5: Recreational Outreach Summary

Consultee	Date and form of correspondence	Point raised	Response and where addressed in the NRA
Baltic Section of the Cruising Association	Letter, 11 August 2022	The Windfarm Site is small enough to not cause a major obstruction to small craft sailing to and from Scandinavian waters and eventually entering the Baltic via the Skagerrak and Kattegat.	Adverse weather routeing has been considered in Section 11.2. The input has also been considered within the associated impact assessments, see Sections 17, 18, and 19 (construction, operation and decommissioning respectively).
		For outward journeys from Peterhead, recreational vessels are unlikely to set off in unsettled conditions and plan their passage accordingly to avoid the area of concern. However, if returning to Peterhead from Scandinavia, small vessels will set out in favourable conditions but as the passage can take several days the weather conditions may change and on seeking refuge in heavy weather will want to make as direct approach to Peterhead as possible. Potential concern if the Project were to expand.	

5 Data Sources

This section summarises the main data sources used to characterise the shipping and navigation baseline relative to the Offshore Development Area (which is defined as the offshore components of the Project, consisting of the Windfarm Site and the Offshore Export Cable Corridor).

5.1 Summary of Data Sources

The main data sources used to characterise the shipping and navigation baseline relative to the Offshore Development Area 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 AIS, Radar and visual observations for the study area (14 days, 5^{th} of August – 18^{th} of August 2021) recorded from a dedicated survey vessel on-site.	Characterising vessel traffic movements within and in proximity to the Offshore Development Area in line with MGN 654 (MCA, 2021) requirements.
	Winter vessel traffic survey data consisting of AIS, Radar and visual observations for the study area (14 days, 5^{th} of January – 18^{th} of January 2022) recorded from a dedicated survey vessel on-site.	
	AIS data for the Offshore Export Cable Corridor (covers same periods as the vessel traffic surveys for the Windfarm Site).	
	Fishing AIS data for the study area (three years between 2018 and 2020) recorded from offshore receivers.	Assessment of historical fishing activity in proximity to the Windfarm Site.
	Anatec's ShipRoutes database (2020).	Secondary source for characterising vessel traffic movements including cumulatively within and in proximity to Offshore Development Area.
	Vessel Monitoring System (VMS) data spanning 2021.	Secondary source for assessing fishing vessel activity relative to the Windfarm Site and Offshore Export Cable Corridor.

Data	Source(s)	Purpose
	RYA Coastal Atlas (2019).	Secondary source for assessing recreational vessel activity relative to the Windfarm Site and Offshore Export Cable Corridor.
Maritime incidents	Maritime Accident Investigation Branch (MAIB) marine accidents database (2000 to 2019).	Review of maritime incidents within and in proximity to the Windfarm Site.
	RNLI incident data (2000 to 2019).	
	Department of Transport (DfT) UK civilian SAR helicopter taskings (2015 to 2021).	
Other navigational features	Admiralty Chart 278 (United Kingdom Hydrographic Office (UKHO), 2021).	Characterising other navigational features in proximity to the Offshore Development Area.
	Admiralty Sailing Directions NP52 (UKHO, 2018) and Admiralty Sailing Directions NP54 (UKHO, 2018).	
Weather	Green Volt Wind Farm Indicative Energy Yield Assessment (33232-ASE-RE-23, K2 Management Jan 2022).	Characterising weather conditions in proximity to the Windfarm Site for use as input in the collision and allision risk modelling.
	PhysE C-14-02-R040-2F report: Buzzard Field Metocean Criteria for Design.	

5.2 Vessel Traffic Surveys

The vessel traffic surveys were undertaken by the Emergency, Response, and Rescue Vessel (ERRV) *Fastnet Sentinel* (IMO number 9696656) and in agreement with the MCA and NLB (see Section 4.2.2).

A number of vessel tracks recorded during the survey period were classified as temporary (non-routine), such as the tracks of the survey vessel and vessels performing guard duties on nearby oil and gas platforms and were therefore excluded from the characterisation of the vessel traffic baseline.

The dataset is fully assessed in Section 10.

5.3 Long-Term Marine Fishing Traffic Data

The long-term marine fishing traffic data consists of AIS covering three years from 2018 to 2020, collected from local offshore receivers. The assessment of this dataset allowed historical fishing activity to be captured over an extended period to ensure seasonal variation was captured within the NRA. The dataset is assessed in Section 10.1.2.1.

5.4 Data Limitations

5.4.1 Automatic Identification System Data

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

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 Fastnet Sentinel. A proportion of smaller vessels also carry AIS voluntarily, typically utilising a Class B AIS device.

Throughout the summer survey, approximately 96% of vessel tracks were recorded via AIS with the remaining 4% recorded via Radar. Throughout the winter survey, approximately 99% of vessel tracks were recorded via AIS with the remaining 1% recorded via Radar.

The long-term vessel fishing traffic data – an AIS only dataset – assumes that vessels under a legal obligation to broadcast via AIS will do so. Both the long-term marine fishing traffic data and the AIS component of the vessel traffic survey data assume that the details broadcast via AIS is accurate (such as vessel type and dimensions) unless there is clear evidence to the contrary.

5.4.2 COVID-19

It is widely accepted that the COVID-19 pandemic resulted in a substantial effect on shipping movements globally during 2020. It should therefore be considered that the vessel traffic survey data may have been affected to some degree particularly during 2021. In line with best practices the Applicant has agreed the approach to data collection with relevant stakeholders, including the MCA and NLB noting this includes consideration of multiple data sources (see Section 5).

5.4.3 Historical Incident Data

Although all UK commercial vessels are required to report accidents to the MAIB, non-UK vessels do not have to report unless they are in a UK port or within 12nm territorial waters (noting that the study area is not located entirely 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.

The RNLI incident data cannot be considered comprehensive of all incidents in the study area. 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.

5.4.4 United Kingdom Hydrographic Office Admiralty Charts

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

6 Project Description

The NRA reflects the design envelope which is detailed in full in **Chapter 5: Project Description**. The following subsections outline the maximum extent of the Project for which any shipping and navigation hazards are assessed to determine the MDS.

6.1 Windfarm Site

The Windfarm Site is located approximately 38nm off the north-east coast of Aberdeenshire. The total area covered by the Windfarm Site is approximately 34 square nautical miles (nm^2) with charted water depths ranging between 96 and 115m below Chart Datum (CD).

The key coordinates defining the boundary of the Windfarm Site are illustrated in **Figure 6.1** and provided in **Table 6.1** using World Geodetic System 1984 (WGS84) Universal Transverse Mercator (UTM) Zone 30N.

It is noted that the Windfarm Site represents a decrease of approximately 20% in total area covered compared to the equivalent area considered at Scoping.

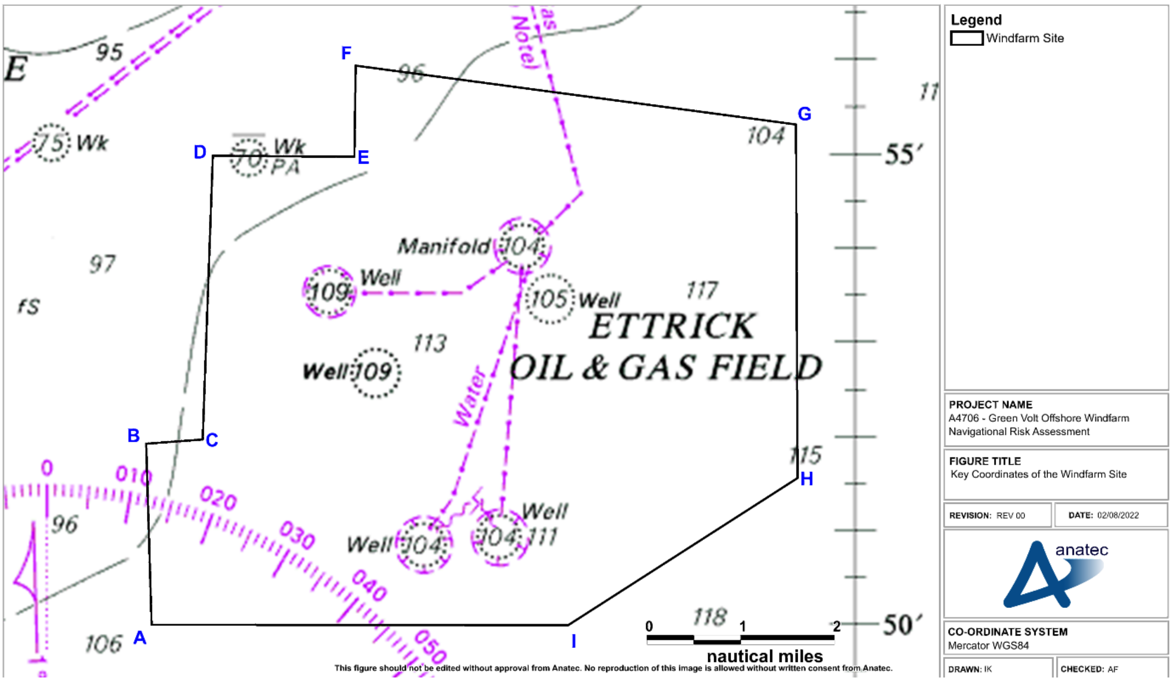


Figure 6.1: Key Coordinates of the Windfarm Site

Table 6.1: Key Coordinates of the Windfarm Site

Point	Latitude	Longitude
A	57° 49′ 59.47″ North (N)	000° 44′ 03.96″ West (W)
B	57° 51′ 55.00″ N	000° 44′ 10.32″ W
C	57° 51′ 57.77″ N	000° 43′ 02.53″ W
D	57° 54′ 58.81″ N	000° 42′ 50.49″ W
E	57° 54′ 58.08″ N	000° 40′ 00.65″ W
F	57° 55′ 56.21″ N	000° 39′ 59.21″ W
G	57 °55′ 18.72″ N	000° 31′ 10.97″ W
H	57° 51′ 32.92″ N	000° 31′ 09.21″ W
I	57° 49′ 59.09″ N	000° 35′ 44.00″ W

6.2 Surface Infrastructure

6.2.1 Indicative Worst-Case Layout

Up to 36 surface structures will be installed, consisting of 35 wind turbine generators (WTGs) and one offshore substation platform (OSP). Although the final locations of infrastructure have not yet been defined, an indicative worst-case layout has been determined for shipping and navigation and is presented in **Figure 6.2.**

The minimum spacing between structures under consideration (measured centre-to-centre) is 1,540 m and the layout is considered to be compliant with the requirements of MGN 654 (MCA, 2021). The OSP has been assumed to be located on the periphery as a worst case.

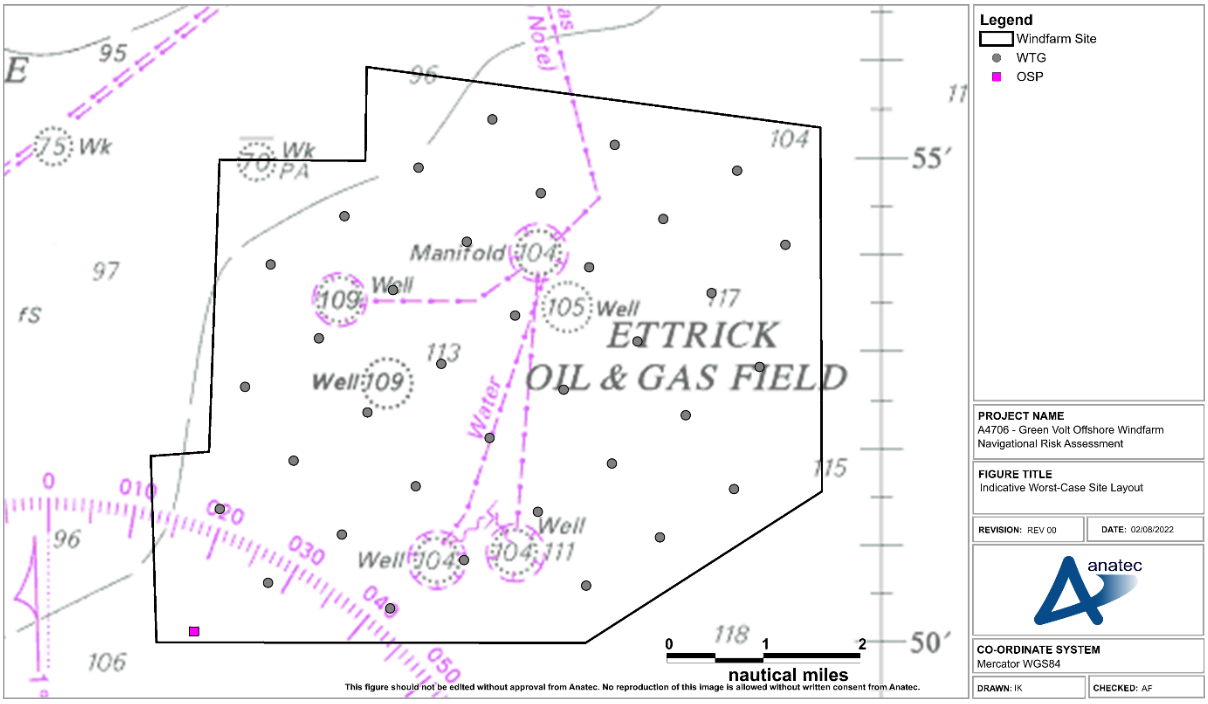


Figure 6.2: Indicative Worst-Case Site Layout

6.2.2 Wind Turbine Generators

The WTGs within the indicative layout have a maximum rotor diameter of 220 m and a maximum blade tip height (above Lowest Astronomical Tide (LAT)) of 242 m. These values represent the worst case for shipping and navigation rather than the Project as a whole but fall within the scope of the PDE. Relevant parameters for WTGs are presented in **Table 6.2**.

Table 6.2: MDS for shipping and navigation - WTGs

Parameter	MDS for Shipping and Navigation
Foundation type	Semisubmersible
Dimensions at sea surface	125 x 125m
Maximum blade tip height (above LAT)	242 m
Minimum air gap (above Mean Sea Level (MSL))	22 m
Maximum rotor diameter	220 m

6.2.2.1 Floating Substructures

Relevant parameters of the floating substructures under consideration are provided in **Table 6.3**. This includes barge and semisubmersible options, with both Tension Leg Platforms (TLPs) and catenary mooring lines under consideration.

Table 6.3: Floating Substructure Parameters

Parameter	Semi-submersible		Barge	
	TLPs	Catenary Moorings	TLPs	Catenary Moorings
Maximum Number of Mooring Lines	6	6	6	6
Angle of Descent (°)	13	38	n/a	38
Mooring radius (m)	402	570	n/a	650
Horizontal Distance between mooring connection and waterline (m)	-10	-10	n/a	+5

6.2.3 Offshore Substations

The OSP may be installed on either a four or six-legged piled or suction caisson jacket foundation, in either case the maximum topside dimensions will be 43x33.5 m.

6.3 Subsea Cables

6.3.1 Inter-Array Cables

The inter-array cables will connect individual WTGs to the OSP. The maximum potential length of inter-array cable that would be required is approximately 72 nm noting this will be dependent on the final layout. All inter-array cables will be installed within the Windfarm Site.

6.3.2 Offshore Export Cables

The offshore export cables will carry the energy generated by the WTGs to the Buzzard Field with any excess carried to the onshore grid connection. There are two potential landfalls, both in the vicinity of Peterhead as shown in **Figure 6.3**. Hereafter, these are referred to as the 'North' and 'South' landfall options. Up to four offshore export cables will be required, two to the landfall and two to Buzzard. The combined length will be up to 149 nm and will be installed within the Offshore Export Cable Corridor as presented in **Figure 6.3**. The total area covered by the offshore cable corridor is approximately 26 nm^2 with charted water depths ranging between zero (nearshore) and 106 m below CD.

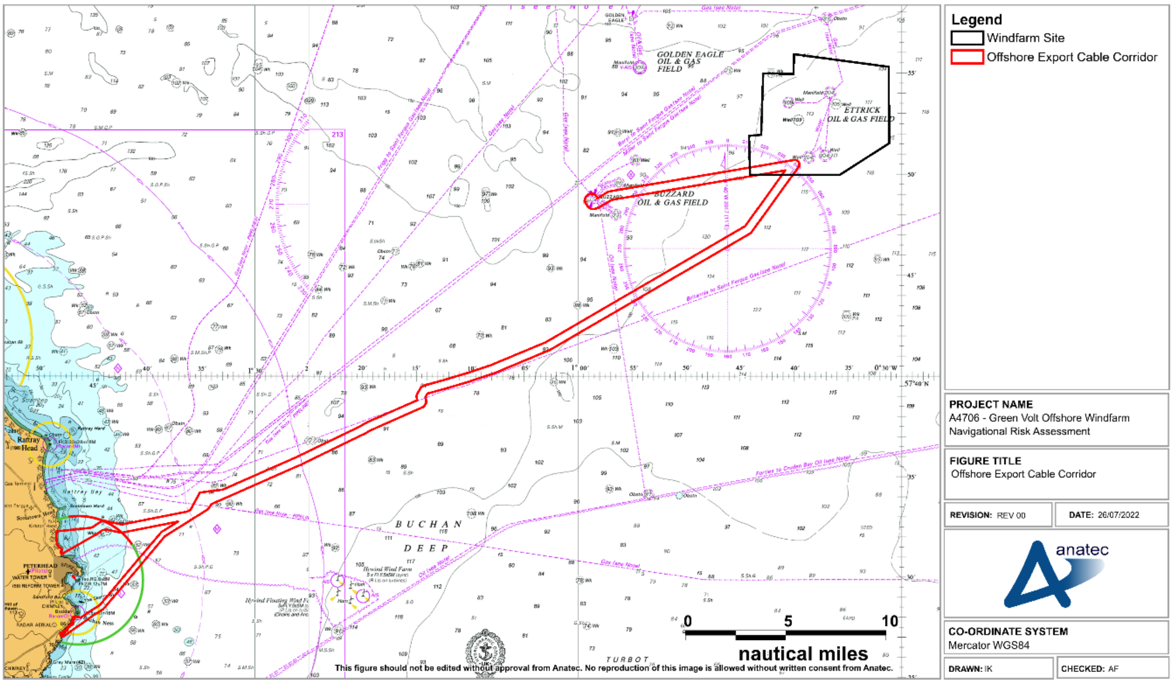


Figure 6.3 Offshore Export Cable Corridor

6.3.3 Cable Burial and Protection

Where feasible, the primary means of cable protection will be via seabed burial. The extent and method by which the sub-sea cables will be buried will be determined via seabed survey and the cable burial risk assessment. For the purposes of the NRA, it is anticipated that burial depth of the inter-array cables and offshore export cables will be between 0.6 and 1.5m, in line with guidance where appropriate.

Where cable burial is not feasible and / or not sufficient, alternative cable protection methods may be deployed (e.g., remedial rock placement, concrete mattresses). It is estimated that up to 4 kilometres (km) of subsea cables in the Offshore Export Cable Corridor may require external protection (3km between the Windfarm Site and shore, 1km between the Windfarm Site and Buzzard), with maximum height of 1.5m.

Cable burial and protection is captured in the embedded mitigation measures (see Section 21) via implementation of the cable burial risk assessment.

6.4 Timelines

It is anticipated that the offshore construction phase will last for between two and three years. The anticipated design life of the Project is 35 years.

6.5 Indicative Vessel Numbers

6.5.1 Construction Vessels

Construction vessels will be involved in movement to and from base ports to the Windfarm Site. Any other harbour/port involved with construction traffic will be confirmed during the later design and planning stages. A breakdown of anticipated construction vessel numbers is summarised in **Table 6.4**.

Table 6.4: Construction Vessels and Indicative Maximum Vessel Quantities

Activity	Vessel	Number
Seabed preparation	Supply Vessel / Survey Vessel	2
Foundation Installation	Tugs/Anchor Handling Vessel	3
Turbine installation	Wind farm service vessel	1
	Tugs/Anchor Handling Vessel	2
OSP installation	Support vessels	1
	Dynamic Position Heavy Lift Vessel	1
Cable installation	IA Cable Installation Vessel	1
	Offshore Export Cable Installation Vessels	1
	Pre-trenching vessel	1
	Cable survey vessel	1
	Commissioning Vessels	1
Other vessels	Crew transfer	1
Total		**16**

6.5.2 Operation and Maintenance Vessels

It is anticipated that up to eight vessel round trips to port may be required per year for planned maintenance. An on-site service operation vessel (SOV) is likely to be utilised.

6.6 Decommissioning Phase

The decommissioning sequence will generally be the reverse of the construction works sequence and is likely to involve similar types and numbers of vessels. The decommissioning durations of the offshore infrastructure may take a similar amount of time as the construction of the Project i.e., up to three years as per Section 6.4.

The Project will also follow the requirements in place at the time of decommissioning. The present guidance - Offshore renewable energy: decommissioning guidance for Scottish waters (The Scottish Government, 2022) - has a presumption for full removal with any exceptions requiring justification. Potentially, fully-buried cables may be left in areas where sediment is stable so that they are likely to remain buried.

6.7 Maximum Design Scenario

The MDS for each shipping and navigation hazard is provided in **Table 6.5** and has been defined based on the parameters described in the previous subsections.

Table 6.5: MDS by Hazard for Shipping and Navigation

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
Vessel Displacement	Construction	▪ Maximum extent of Windfarm Site including any required construction buoyage; ▪ Use of 500m construction safety zones and 50m pre-commissioning safety zones; ▪ Up to four offshore export cables with total length 149 nm; ▪ Construction phase up to three years; and ▪ Up to 16 construction vessels.	Largest possible extent and greatest duration resulting in the maximum effect on vessel displacement.
	Operation	▪ Full build out of Windfarm Site; ▪ Use of 500m major maintenance safety zones; and ▪ Operational life of 35 years.	
	Decommissioning	▪ Assumed equivalent to construction phase.	
Increased vessel to vessel collision risk between third-party vessels.	Construction	▪ Maximum extent of Windfarm Site including any required construction buoyage; ▪ Use of 500m construction safety zones and 50m pre-commissioning safety zones; ▪ Up to four offshore export cables with total length 149 nm; ▪ Construction phase up to three years; and ▪ Up to 16 construction vessels.	Largest possible extent and greatest duration resulting in the maximum effect on vessel displacement and hence collision risk.
	Operation	▪ Full build out of Windfarm Site; ▪ Use of 500m major maintenance safety zones; ▪ Up to eight unplanned maintenance vessel round trips; and ▪ Operational life of 35 years.	

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
	Decommissioning	▪ Assumed equivalent to construction phase.	
Increased vessel to vessel collision risk between third-party vessels and Project Vessels.	Construction	▪ Maximum extent of Windfarm Site including any required construction buoyage; ▪ Use of 500m construction safety zones and 50m pre-commissioning safety zones; ▪ Up to four offshore export cables with total length 149 nm; ▪ Construction phase up to three years; and ▪ Up to 16 construction vessels.	Largest possible extent, greatest number of vessel movements and activities associated with the Project and greatest duration.
	Operation	▪ Full build out of Windfarm Site; ▪ Up to eight unplanned maintenance vessel round trips; and ▪ Operational life of 35 years.	
	Decommissioning	▪ Assumed equivalent to construction phase.	
Vessel to structure allision risk.	Construction	▪ Full build out of Windfarm Site; ▪ Up to 35 WTGs and one OSP; ▪ Semisubmersible substructures of surface dimensions 125 x 125m; ▪ OSP topside of 43 x 33.5m; ▪ Construction phase up to three years; and ▪ Up to 16 construction vessels.	Largest possible extent, greatest number of surface structures and greatest duration resulting in the maximum effect on vessel to structure allision risk.
	Operation	▪ Full build out of Windfarm Site; ▪ Up to 35 WTGs and one substation; ▪ Semisubmersible substructures of surface dimensions 125 x 125m; ▪ OSP topside of 43 x 33.5m; and ▪ Operational life of 35 years.	
	Decommissioning	▪ Assumed equivalent to construction phase.	
Reduced access to local ports.	Construction	▪ Up to four offshore export cables with total length 149 nm; ▪ Construction phase up to three years; and ▪ Up to 16 construction vessels.	Largest possible extent, greatest number of vessel movements and activities associated with the Project and greatest duration.

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
	Operation	▪ Full build out of Windfarm Site; ▪ Up to four offshore export cables with total length 149 nm; ▪ Up to eight unplanned maintenance vessel round trips; and ▪ Operational life of 35 years.	
	Decommissioning	▪ Assumed equivalent to construction phase.	
Reduction of under keel clearance.	Operation	▪ Full build out of Windfarm Site; ▪ Up to 35 WTGs; ▪ Barge substructures; ▪ Up to six mooring lines; ▪ Mooring line angle of descent of 14° from horizontal; ▪ Up to four offshore export cables with total length 149 nm; ▪ Up to 72nm of inter array cables; ▪ Burial of cables to between 0.6 and 1.5m where feasible, external protection used where target depths cannot be met; ▪ Up to 3km of cables requiring external protection, with a height of up to 1.5m; and ▪ Operational life of 35 years.	Maximum number of floating structures with mooring lines of shallowest angle of descent. Maximum length of subsea cables.
Anchor snagging interaction	Operation	▪ Full build out of Windfarm Site; ▪ Up to 35 WTGs; ▪ Up to six mooring lines; ▪ Up to four offshore export cables with total length 149 nm; ▪ Up to 72nm of inter array cables; ▪ Burial of cables to between 0.6 and 1.5m where feasible, external protection used where target depths cannot be met; ▪ Up to 3km of cables requiring external protection, with a height of up to 1.5m; and ▪ Operational life of 35 years.	Maximum extent of subsea infrastructure including subsea cables and mooring lines.
Loss of station	Operation	▪ Full build out of Windfarm Site; ▪ Up to 35 WTGs and one OSP; ▪ Semisubmersible substructures of surface dimensions 125 x 125m; ▪ OSP topside of 43 x 33.5m; and ▪ Operational life of 35 years.	Maximum number of WTGs with greatest surface dimensions.

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
Reduction in Emergency Response Capability	Construction	▪ Maximum extent of Windfarm Site including any required construction buoyage; ▪ Up to 35 WTGs and one OSP; ▪ Semisubmersible substructures of surface dimensions 125 x 125m; ▪ OSP topside of 43 x 33.5m; ▪ Up to four offshore export cables with total length 149 nm; ▪ Construction phase up to three years; and ▪ Up to 16 construction vessels.	Largest possible extent, greatest number of vessel activities associated with the Project, greatest number of surface structures and greatest duration resulting in the maximum effect on emergency response capability.
	Operation	▪ Full build out of Windfarm Site; ▪ Up to 35 WTGs and one OSP; ▪ Semisubmersible substructures of surface dimensions 125 x 125m; ▪ OSP topside of 43 x 33.5m; ▪ Up to eight unplanned maintenance vessel round trips; and ▪ Operational life of 35 years.	
	Decommissioning	▪ Assumed equivalent to construction phase.	

7 Navigational Features

The navigational features in proximity to the Offshore Development Area have been identified using the relevant UKHO Admiralty Sailing Directions (UKHO, 2021) and the UKHO Admiralty Charts (UKHO, 2022) with due consideration also given to consultation input (see Section 4). The features of relevance to the Windfarm Site are presented in **Figure 7.1**. Following this, **Figure 7.2** presents the key navigational features relevant to the Offshore Export Cable Corridor and landfall options at the coast. The following subsections then discuss each of the navigational features presented.

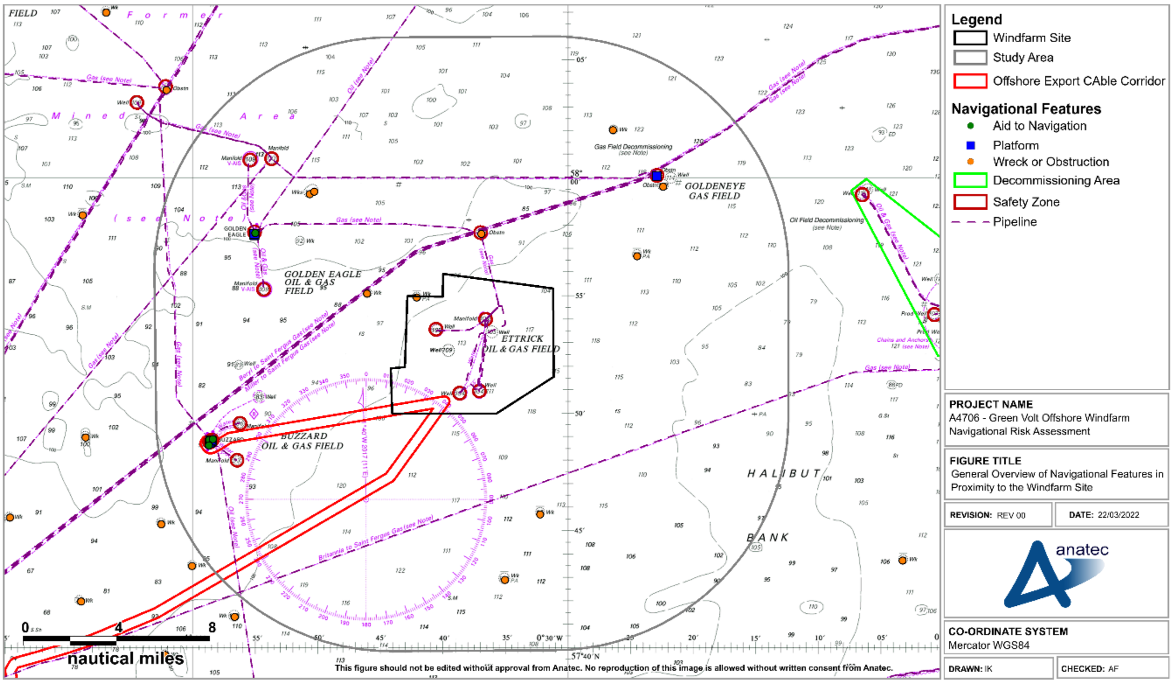


Figure 7.1: General Overview of Navigational Features in Proximity to the Windfarm Site

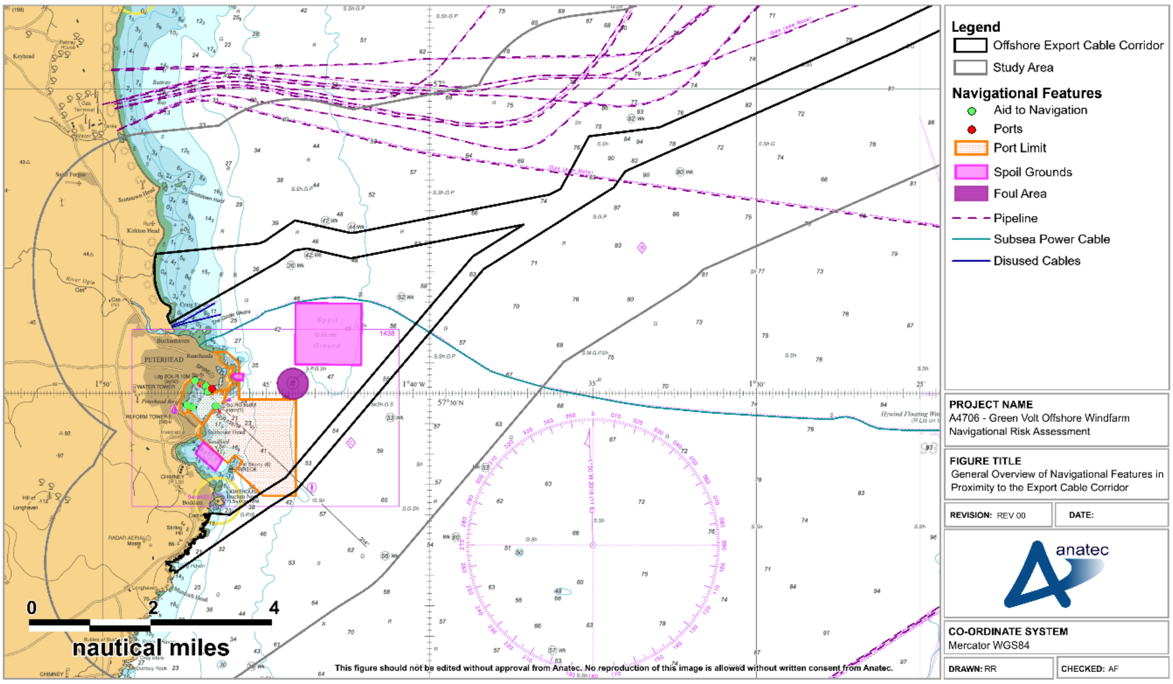


Figure 7.2 General Overview of Navigational Features in Proximity to the Offshore Export Cable Corridor

7.1 Other Offshore Wind Farm Developments

The nearest operational offshore wind farm is Hywind, located 28nm to the southwest of the Windfarm Site. Hywind was fully commissioned in 2017 and consists of five WTGs on floating substructures.

Planned projects including ScotWind projects are considered within the cumulative assessment (see Section 13).

7.2 Oil and Gas Features

The oil and gas platforms and pipelines within the study area are presented in **Figure 7.3**, with a summary of details of relevance presented in **Table 7.1**.

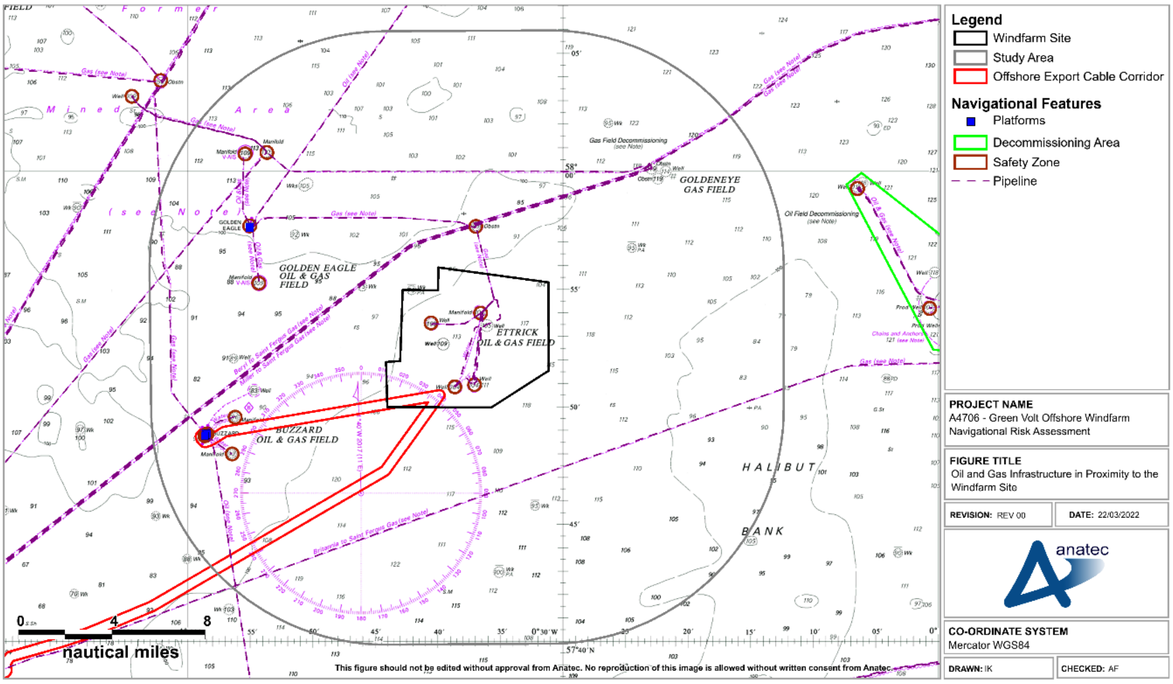


Figure 7.3: Oil and Gas Infrastructure in Proximity to the Windfarm Site

The Ettrick and Blackbird oil and gas field is situated within the Windfarm Site, noting that production has ceased. Fields in the study area currently in production include Buzzard, which is approximately 8 nm to the southwest of the Windfarm Site. The Golden Eagle Complex approximately 6nm to the northwest is also still in production and includes the nearby Peregrine and Solitaire fields. Oil and gas fields that have ceased production and are in proximity to the Windfarm Site include Atlantic, Goldeneye, and Cromarty.

A summary of details of the relevant oil and gas fields is provided in **Table 7.1.**

Table 7.1: Details of Oil and Gas Fields in Proximity to the Windfarm Site

Name	Type	Distance from Windfarm Site (nm)	Status
Ettrick and Blackbird	Oil	0.0	Decommissioning
Golden Eagle Complex	Gas	6	Operational
Goldeneye	Oil and Gas	6.5	Decommissioned
Buzzard Complex	Oil and Gas	7.8	Operational
Atlantic	Gas	9.4	Decommissioned
Cromarty	Gas	14.0	Decommissioned

7.3 IMO Routeing Measures

There are no IMO routeing measures in proximity to the Offshore Development Area.

7.4 Ports, Harbours, and Related Facilities

A plot of key ports and harbours in the area is presented in **Figure 7.4**, relative to the Offshore Development Area

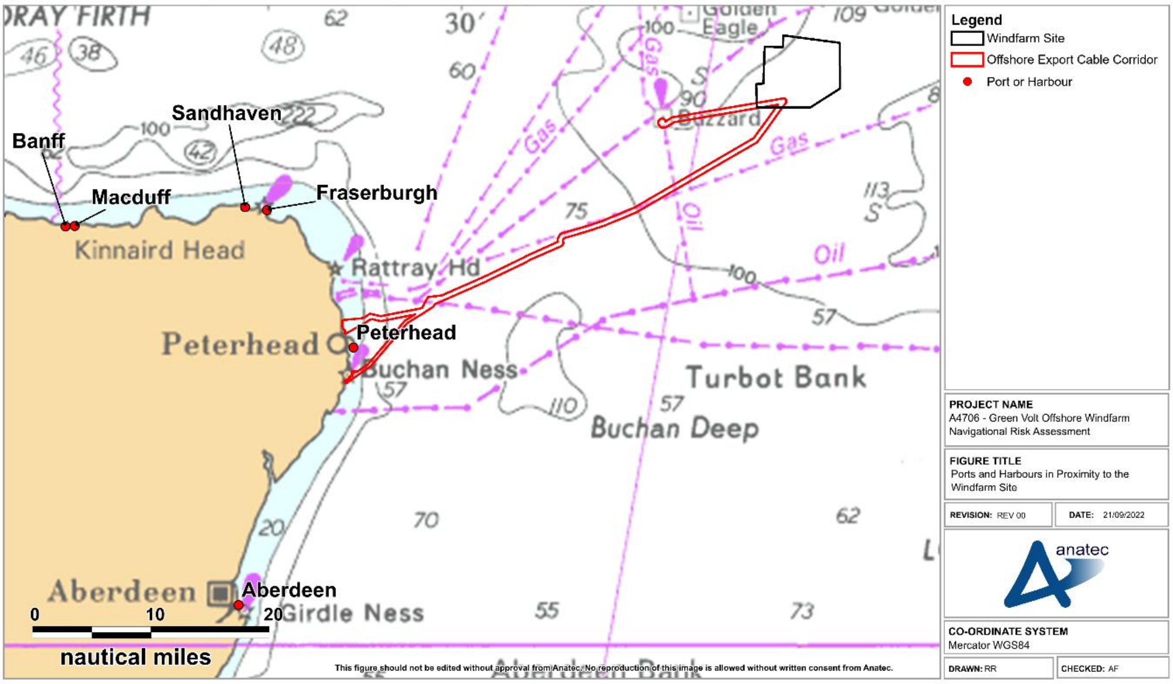


Figure 7.4: Ports and Harbours in Proximity to the Windfarm Site

The closest port or harbour to the Windfarm Site is Peterhead Port, located approximately 39nm to the south-west. Fraserburgh Harbour (41nm south-west), Sandhaven Harbour (43nm to the south-west), and Aberdeen Harbour (60nm south-west) are also situated in the vicinity.

The following subsections provide further details on the main ports and harbours in proximity to the Windfarm Site, namely Aberdeen, Fraserburgh, and Peterhead.

7.4.1 Aberdeen

Aberdeen Harbour is a commercial port of significance and the most important base for the offshore oil and gas industry in north-west Europe. The port exports timber, grain, scrap metals, and oilfield equipment. A Vessel Traffic Service (VTS) is in operation for the control of shipping within port limits. Pilotage is compulsory for vessels navigating in the Aberdeen Pilotage District except for:

- Vessels under 60m in length;
- Vessels from 60m-75m in length fitted with an operational bow thruster unit;

- Vessels moving within the harbour from berth to berth with permission of the Harbour Master.

Pilotage is compulsory for all vessels when manoeuvring with the assistance of tugs, or when deemed necessary by the Harbour Master.

7.4.2 Fraserburgh

Fraserburgh Harbour is primarily a fishing port with a large locally based fishing fleet, noting there are also commercial vessel facilities. Pilotage is compulsory for commercial vessels of 300 tonnes and over except those that are exempt by law. A 24-hour service is operated, with pilots normally boarding in Fraserburgh bay (by arrangement), and in suitable weather, within a 2nm radius of the harbour entrance.

7.4.3 Peterhead

Peterhead Port, located within Peterhead Bay, is comprised of 11 distinct areas – North Harbour, Port Henry Basin, Albert Quay, Merchant's Quay, North Base, Princess Royal Jetty, South Base, Tanker Jetty and Peterhead Bay Marina. Peterhead is a major supply base for the offshore oil and gas industry and the most important fishing port in the UK for white and pelagic species. The port is approximately 1.2nm south of the north landfall option and approximately 2nm north of the south landfall option. As well as fishing and oil and gas, the port also handles tankers, general cargo vessels, and cruise ships.

Approximately 1.4km of the proposed south landfall export cable corridor option lies within the limit of Peterhead Port Authority (see **Figure** 7.2). A 24-hour pilot service operates at Peterhead and Pilotage is compulsory for any vessel:

- which has a gross tonnage exceeding 3,500 GT;
- which has a gross tonnage exceeding 200 GT and which is to enter the Inner Harbour;
- which in the opinion of the Harbour Master, is defective, damaged, or handicapped to such an extent that it ought not to be navigated without a Pilot having due regard to the interests of safety;
- carrying more than 12 passengers;
- engaged in the trade of carrying oil in bulk as a cargo within the meaning of sections 153 and 170 of the Merchant Shipping Act 1995 or any statutory modification or re-enactment thereof;
- carrying more than one tonne of explosives of IMO Class 1 category; or
- carrying hazardous cargo or dangerous goods in bulk in a quantity of 100 tonnes or more.

Within port limits, a VTS is provided on a 24-hour basis and radar monitoring and recording of vessel movements is carried out. Vessels should establish contact on VHF Channel 14, call sign “Peterhead Harbour”, prior to entering, leaving or manoeuvring within port limits, one hour prior to arrival and when 2nm from the breakwater.

7.5 Anchorage Areas

There are no charted anchorages in proximity to the Offshore Development Area. Anchoring is also prohibited within Peterhead Bay and Peterhead VTS unless in an emergency or authorised by the harbour master.

7.6 Aids to Navigation

Four aids to navigation are located in proximity to the Windfarm Site all positioned on operational oil and gas structures, as illustrated in **Figure 7.1**. The closest aid to navigation to the Windfarm Site is located approximately 7nm to the north-west and positioned upon the Golden Eagle platform. Six aids to navigation are located within Peterhead Bay and between the two Offshore Export Cable Corridor landfall options, each of these aids to navigation are associated with Peterhead Port.

7.7 Submarine Cables

The export power cable for the Hywind offshore wind farm (see Section 7.1) makes landfall at Peterhead and intersects the south landfall option of the Offshore Export Cable Corridor at approximately 3nm offshore.

7.8 Military Practice and Exercise Areas

There are no military practice and exercise areas in proximity to the Offshore Development Area.

7.9 Charted Wrecks

There are 11 wrecks or obstructions located within the Study area, with none of these located within the Windfarm Site itself. The shallowest wreck or obstruction is at a depth of approximately 90m below CD. No wrecks or obstructions are located within the Offshore Export Cable Corridor.

Non-charted wrecks (which are not considered a danger to safe navigation) are considered in **Chapter 17: Offshore Archaeology and Cultural Heritage**.

7.10 Spoil Grounds and Foul Areas

There are three spoil grounds located in proximity to the Offshore Export Cable Corridor. The closest, and largest, spoil ground is approximately 500m north of the south landfall option and is situated directly below the Hywind export power cable (see Section 7.7).

There is one foul area in proximity to both Offshore Export Cable Corridor options, directly south of the spoil ground, approximately 0.7nm from the coast.

8 Meteorological Ocean Data

This section presents relevant meteorological and oceanographic statistics in the area local to the Windfarm Site. The data presented is used as input to the collision and allision risk modelling (see Section 15).

8.1 Wind Direction Probabilities

The distribution of wind direction data recorded in vicinity of the Windfarm Site is presented in **Figure 8.1**. This data is taken from the Green Volt Wind Farm Indicative Energy Yield Assessment (33232-ASE-RE-23, K2 Management Jan 2022).

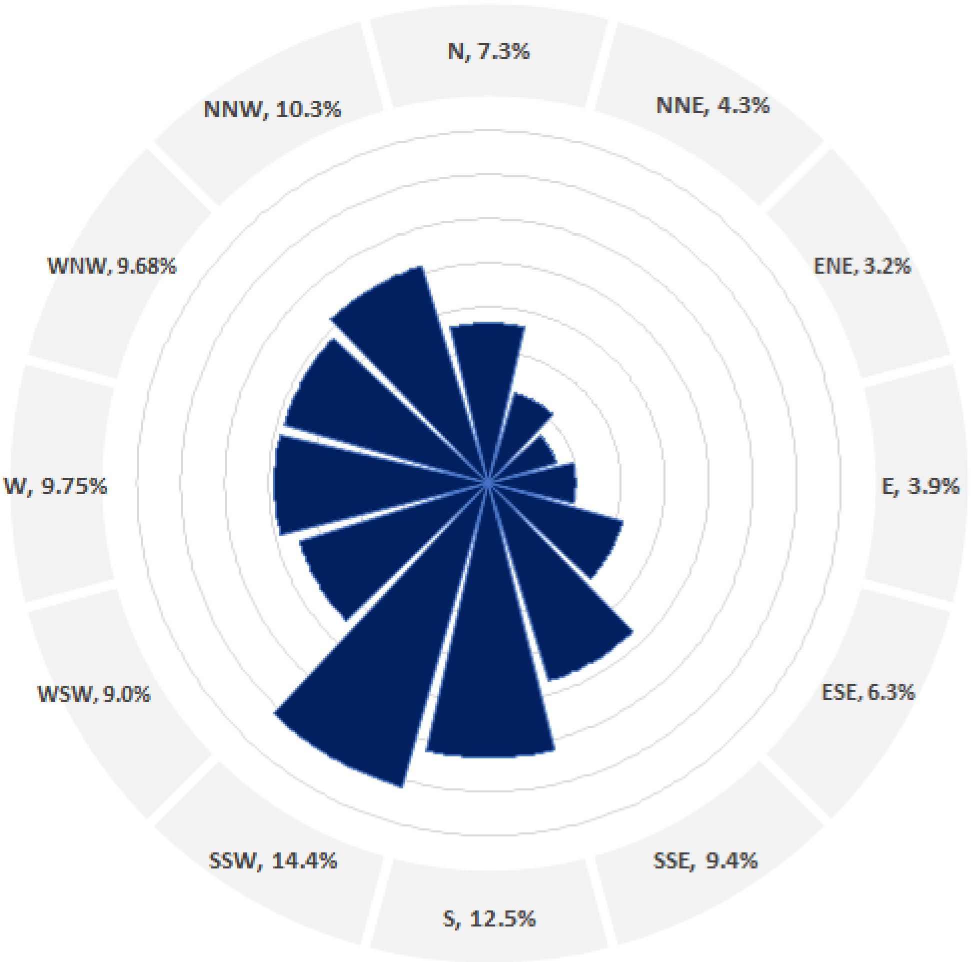


Figure 8.1: Wind Direction Probabilities

As shown, the wind direction is predominantly from the southwest and west.

8.2 Significant Wave Height

Table 8.1 presents sea state probabilities (calm, moderate, or severe) based upon significant wave height data taken from the PhysE C-14-02-R040-2F report: Buzzard Field Metocean Criteria for Design.

Table 8.1: Sea State Distribution

Sea State	Proportion (%)
Calm (<1m)	18.92
Moderate (1–5m)	78.08
Severe (>5m)	3.00

8.3 Visibility

The annual average incidence of poor visibility (defined as the proportion of a year where the visibility can be expected to be less than 1 km) is 3% based upon information from the relevant Pilot Book (UKHO, 2021).

8.4 Tidal

Peak tidal ebb and flood directions and speeds are given in **Table 8.2**. This is based on tidal details provided on Admiralty UKHO Chart 278.

Table 8.2: Peak Flood and Ebb Speed and Direction Data

Tidal Diamond (Chart 278)	Flood		Ebb	
	Direction (°)	Speed (knots)	Direction (°)	Speed (knots)
B	006	0.9	189	0.5

Based upon the available data, no impacts 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 have any additional impact on the existing tidal streams in relation to their effect on existing shipping and navigation users.

9 Emergency Response and Incident Overview

This section summarises the existing emergency response resources (including SAR) and reviews historical maritime incident data to assess baseline incident rates in proximity to the Windfarm Site.

9.1 Search and Rescue Helicopters

In March 2013, the Bristow Group were awarded the contract by the MCA (as an executive agency of the DfT) to provide helicopter SAR operations in the UK over a ten-year period. Bristow have now been operating the service since April 2015 and had their contract renewed for another ten years in July 2022.

The SAR helicopter service is operated out of ten base locations around the UK, with the closest to the Project located at Inverness Airport, approximately 94nm to the west of the Windfarm Site. This base operates two AgustaWestland 189 (AW189) helicopters. The SAR helicopter taskings undertaken between April 2015 and March 2021 within the study area are presented in **Figure 9.1**, colour-coded by tasking type.

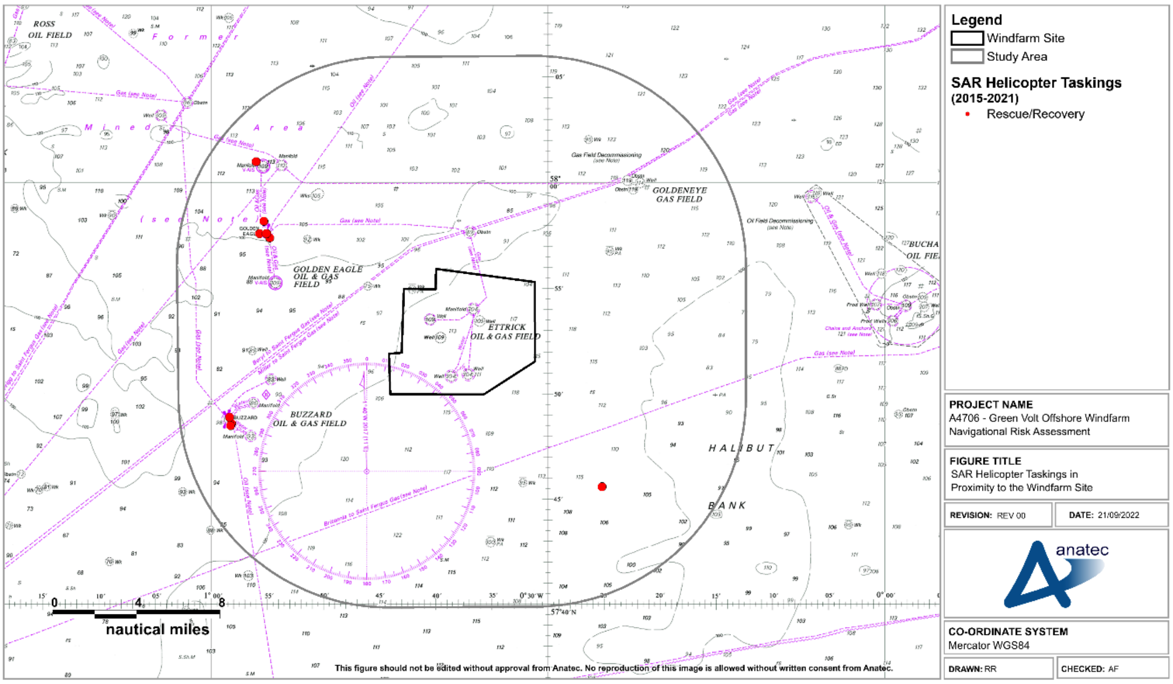


Figure 9.1: SAR Helicopter Bases and Tasking in Proximity to the Windfarm Site

A total of ten SAR helicopter taskings were undertaken for incidents within the study area between April 2015 and March 2021, corresponding to an average of between one and two taskings per year. All taskings were "*rescue/recovery*".

The majority of taskings were associated with the Golden Eagle and Buzzard platforms. None occurred in the Windfarm Site.

9.2 Royal National Lifeboat Institution

The RNLI is organised into six divisions, with the relevant region for the Project being 'Scotland'. Based out of more than 230 stations around the UK, there are over 400 active lifeboats across the RNLI fleet, including both all-weather lifeboats (ALB) and inshore lifeboats (ILB). RNLI lifeboats are available on a 24-hour basis throughout the year. The locations of RNLI stations in proximity to the Windfarm Site are presented in **Figure 9.2**. The closest RNLI station to the Windfarm Site is situated at Peterhead, approximately 40nm to the south-west.

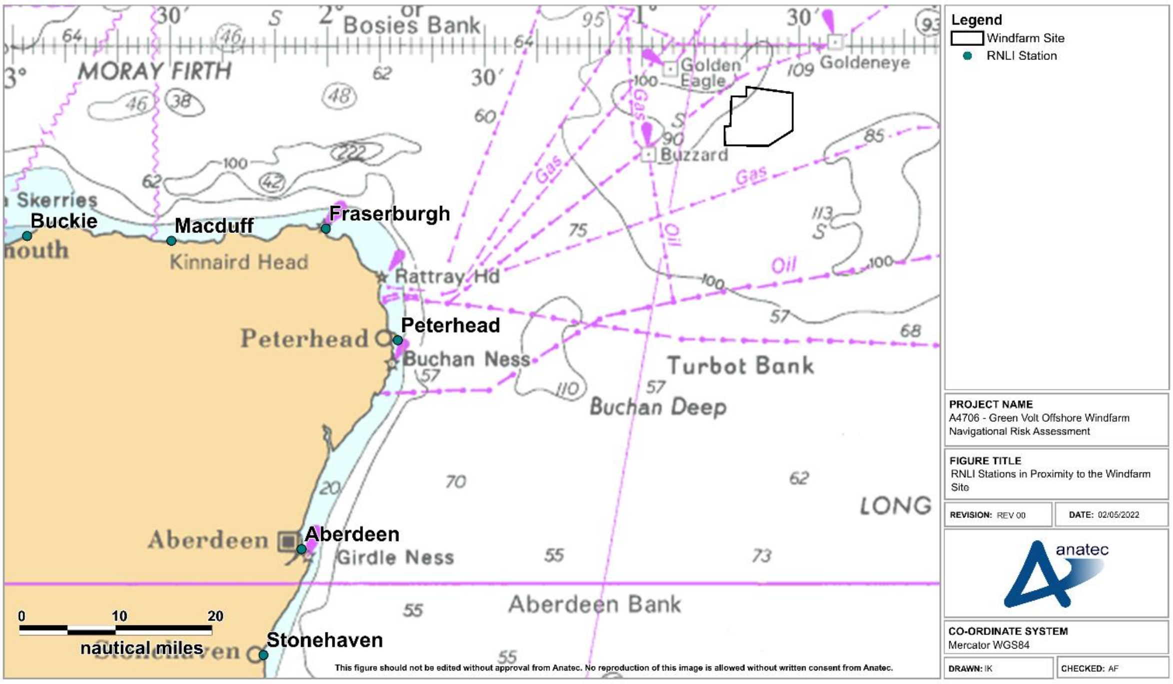


Figure 9.2: RNLI Stations in Proximity to the Windfarm Site

The RNLI have a strategic performance standard of reaching casualties up to a maximum of 100nm offshore. Between 7,000 and 9,500 incidents have generally been responded to by the RNLI annually in recent years.

9.2.1 Incident Data

Data on RNLI lifeboat responses within the study area for the two 10-year periods between 2010 and 2019, and 2000 to 2009 have been analysed (excluding hoaxes or false alarms). The most recent ten years has formed the primary assessment tool, with additional validation then undertaken based on the 2000 to 2009 data.

9.2.1.1 2010-2019

The locations of incidents responded to by the RNLI within the study area between 2010 and 2019 is presented in **Figure 9.3**, colour-coded by incident type. The same data is presented in **Figure 9.4**, colour-coded by casualty type.

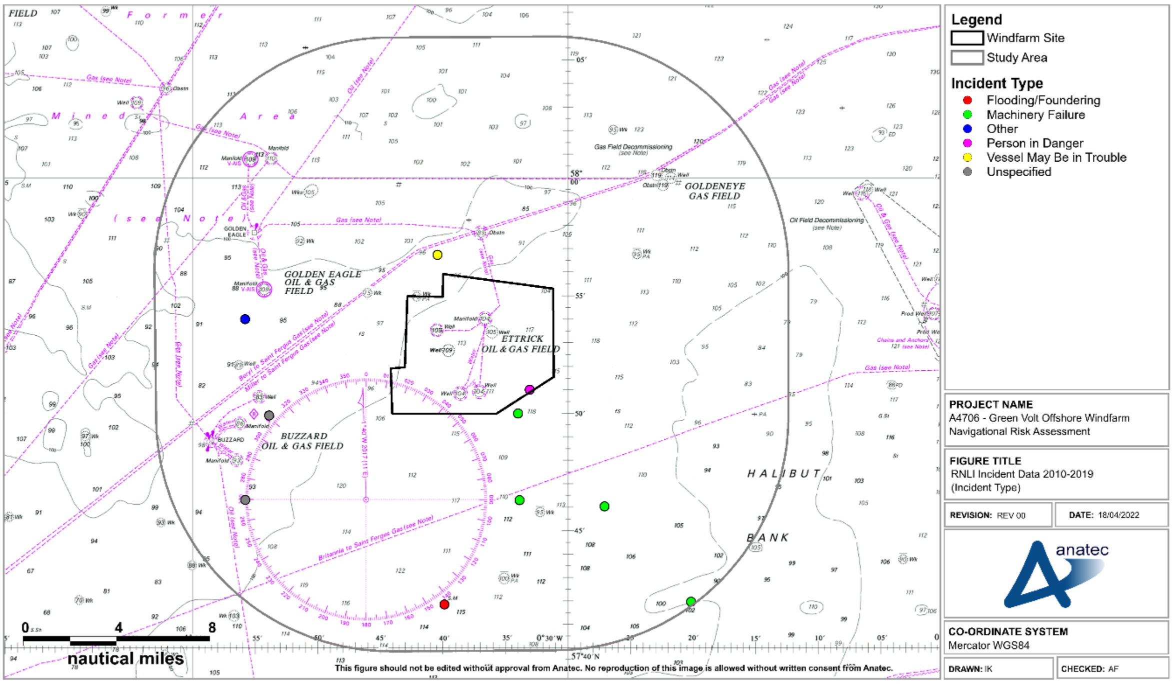


Figure 9.3: RNLI Incident Data from 2010-2019 by Incident Type

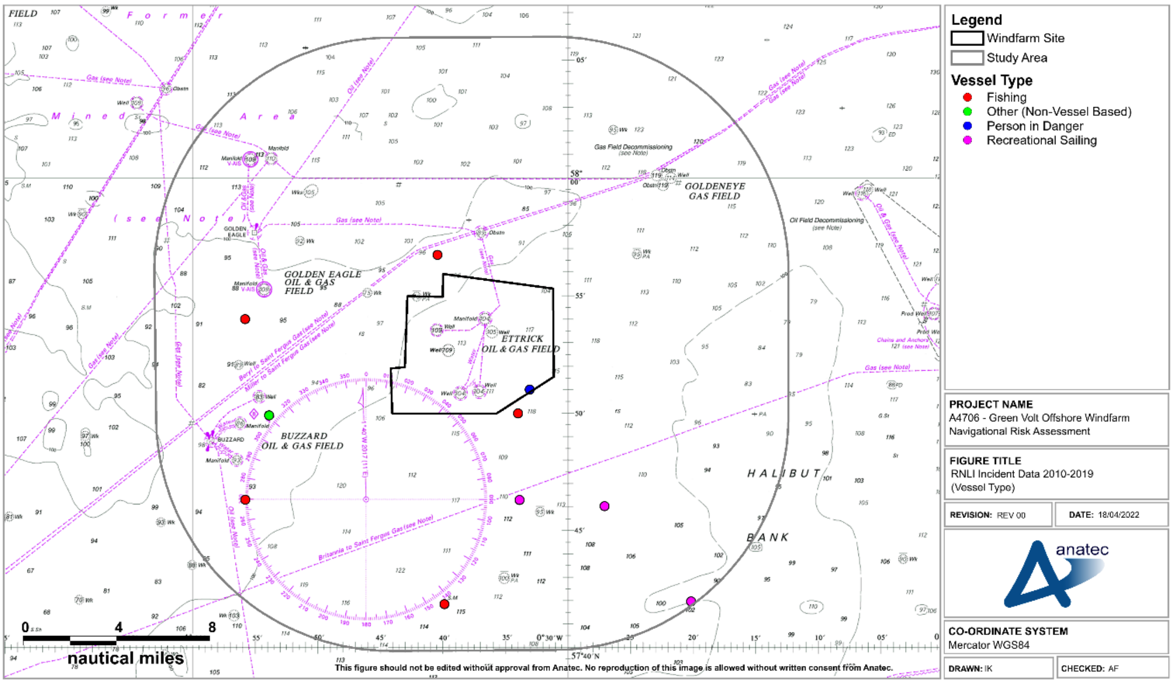


Figure 9.4: RNLI Incident Data from 2010-2019 by Vessel Type

A total of ten RNLI lifeboat launches to ten unique incidents were reported within the study area, corresponding to an average of one unique incident per year. Of the ten incidents, four were related to machinery failure, and one each to flooding/foundering, 'other', person in danger, and 'vessel may be in trouble'. Two incidents were unspecified. Five of the ten incidents involved fishing vessels, with two involving recreational sailing vessels and one each involving a person in danger, a powered boat, and a non-vessel based 'other'. One incident was reported to the Marine Accident Investigation Branch (MAIB) within the Windfarm Site – a 'person in danger'.

The most common base station recorded for lifeboat launches for incidents in the study area was Fraserburgh with seven launches.

9.2.1.2 2000-2009

There were two incidents responded to by the RNLI within the study area between 2000 and 2009. One incident recorded in 2001 was in relation to a stand-by operation for an ongoing incident, and the other recorded in 2002 involved a leak/swamping on a large fishing vessel which occurred within the Windfarm Site.

9.3 Maritime Rescue Coordination Centres and Joint Rescue Coordination Centres

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).

The HMCG coordinates SAR operations through a network of nine Maritime Rescue Coordination Centres (MRCC), a Maritime Rescue Sub Centre (MRSC) in London and the Joint Rescue Coordination Centre (JRCC) based in Hampshire. A corps of up to 3,500 volunteer Coastguard Rescue Officers (CRO) around the UK from around 350 Coastguard Rescue Teams (CRT) are involved in coastal rescue, searches and surveillance.

All of the MCA's operations, including SAR, are divided into three geographical regions. The 'Scotland' region covers the area encompassing the Offshore Development Area.

Each region is divided into six districts with its own MRCC, which coordinates the SAR response for maritime and coastal emergencies within its own district boundaries. The closest MRCC to the Offshore Development Area is at Aberdeen, located approximately 60nm south-west of the Windfarm Site, as shown in **Figure 9.5**.

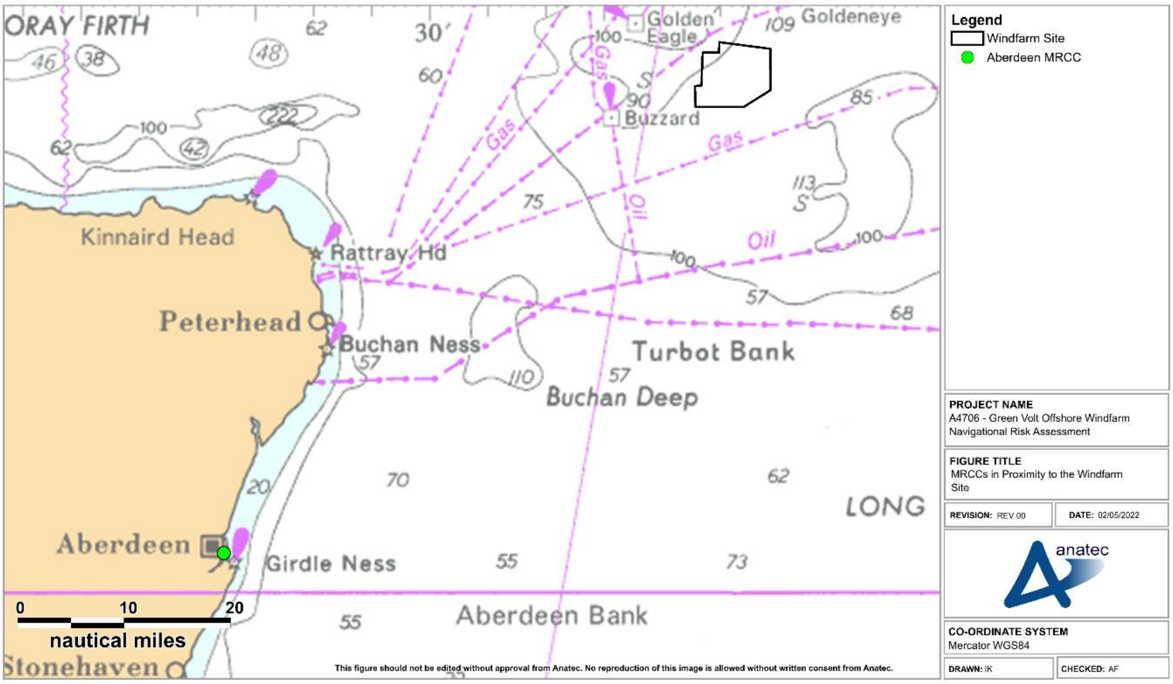


Figure 9.5: MRCCs in Proximity to the Windfarm Site

9.4 Global Maritime Distress and Safety System

The Global Maritime Distress and Safety System (GMDSS) is a maritime communications system used for emergency and distress messages, vessel-to-vessel routine 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.

There are four GMDSS sea areas, and in the UK it is the responsibility of the MCA to ensure VHF coverage from coastal stations within sea area A1. The Windfarm Site is located within sea area A1, as shown in **Figure 9.6**, and therefore in the event of an emergency any vessel located in proximity to the Windfarm Site would be able to contact HMCG via VHF.

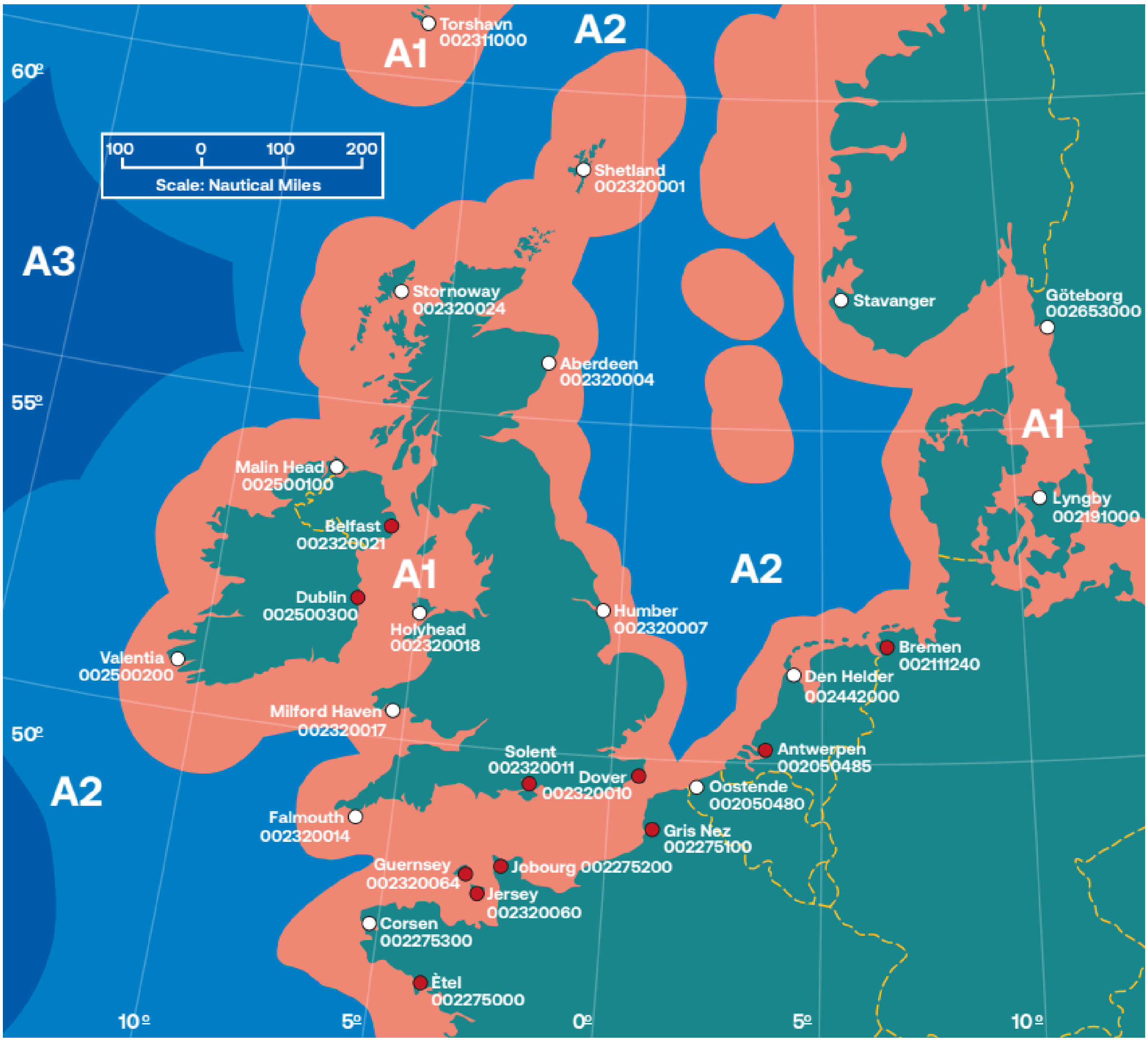


Figure 9.6: GMDSS Sea Areas (MCA, 2021)

9.5 Marine Accident Investigation Branch

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. Between 1,000 and 1,300 incidents have generally been reported to the MAIB annually in recent years. As for the RNLI incident data (see Section 9.2), the most recent ten years available (2010-2019) has formed the primary assessment tool, with additional validation then undertaken based on the 2000 to 2009 data.

9.5.1 2010-2019

The locations of accidents, injuries and hazardous incidents reported to the MAIB within the study area between 2010 and 2019 is presented in **Figure 9.7**, colour-coded by incident type. The same data is presented in **Figure 9.8** colour-coded by vessel type.

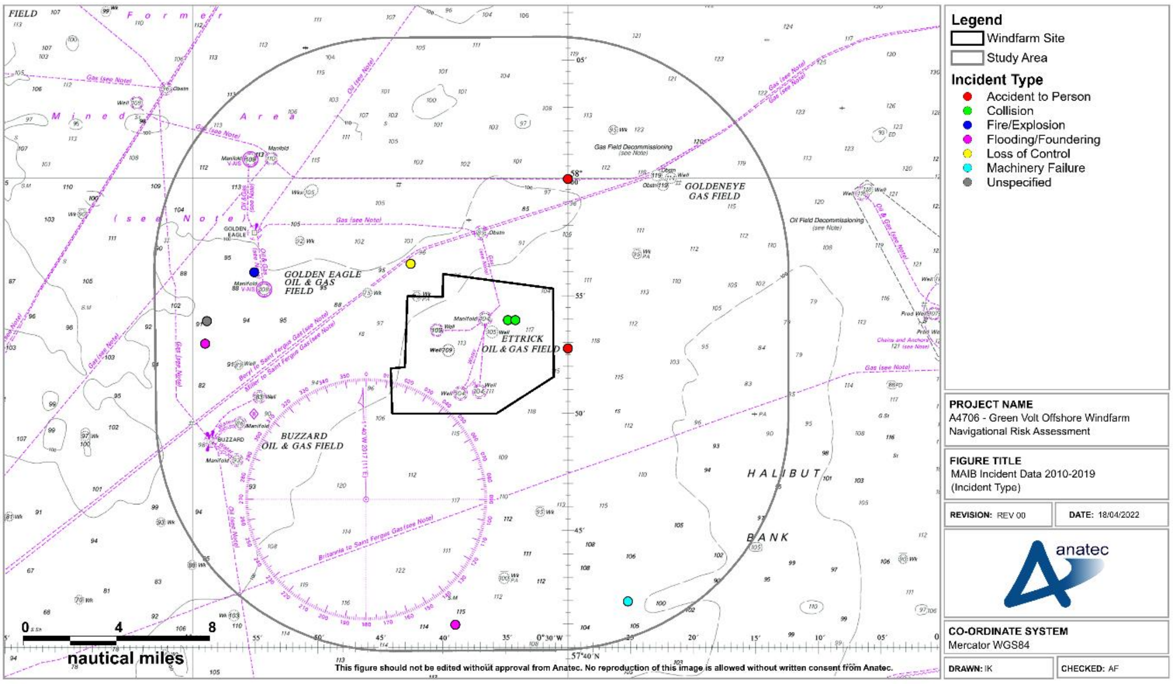


Figure 9.7: MAIB Incident Data from 2010-2019 by Incident Type

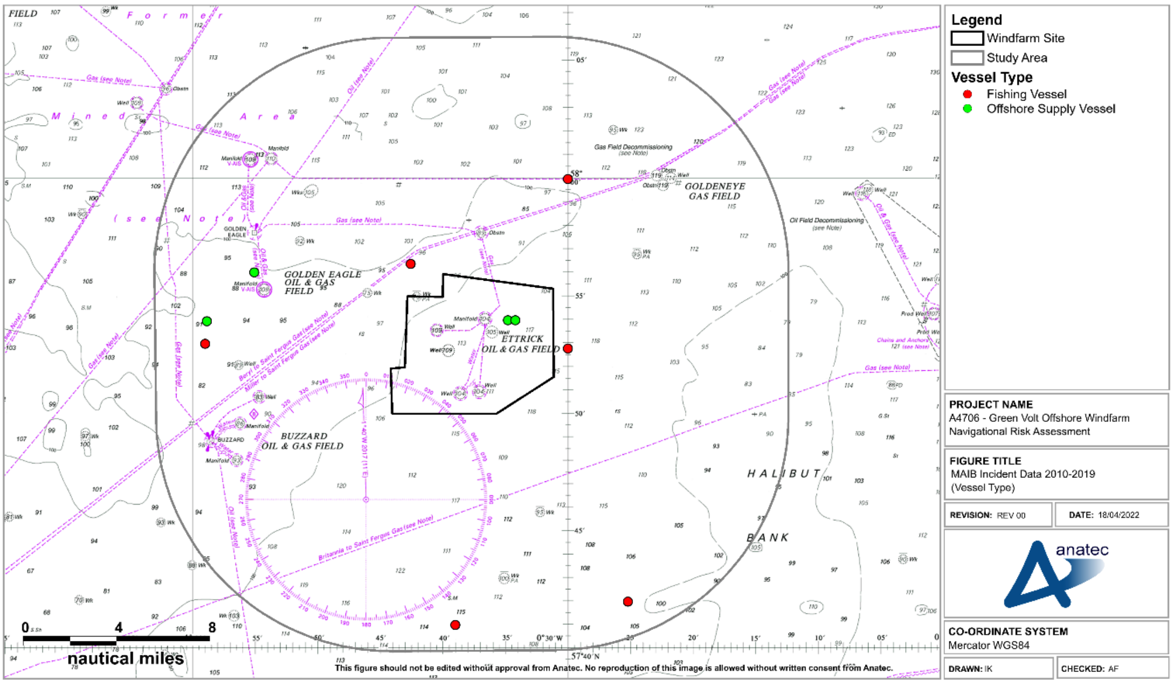


Figure 9.8: MAIB Incident Data from 2010-2019 by Vessel Type

A total of nine unique incidents involving ten vessels were reported to the MAIB within the study area, corresponding to an average of approximately one incident every year. Of the nine incidents, two were related to accident to person, two to flooding/foundering, and one each to collision, fire/explosion, loss of control, and machinery failure. One incident was unspecified. Six of the ten vessels involved were fishing vessels, with the other four involving offshore supply vessels. One incident was reported to the MAIB within the Windfarm Site – a collision involving two offshore supply vessels.

9.5.2 2000-2009

A review of older MAIB incident data within the study area between 2000 and 2009 indicates 15 unique incidents were recorded in the ten-year period, corresponding to an average of between one and two incidents every year. Two of these were hazardous incidents, both involving one fishing vessels and one vessel related to the offshore industry. Of the recorded incidents, incident types were primarily machinery failure (33%) and accidents to person (27%). Vessel types involved primarily included fishing vessels (65%) and vessels related to the offshore industry (29%). No incidents were recorded within the Windfarm Site between 2000 and 2009.

9.6 Historical Offshore Wind Farm Incidents

9.6.1 Incidents Involving UK Offshore Wind Farm Developments

As of November 2022, there are 41 operational and fully commissioned offshore wind farms in the UK, ranging from the North Hoyle Offshore Wind Farm (fully commissioned in 2003) to Moray East (fully commissioned in 2022). Between them these developments encompass approximately 19,000 fully operational WTG years.

MAIB incident data has been used to collate a list of reported historical collision and allision incidents involving UK offshore wind farm developments, 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	7 August 2005	WTG installation vessel allision with WTG base whilst manoeuvring alongside it. Minor damage sustained to a gangway on the vessel, the WTG tower and a WTG blade.	Minor damage to gangway on the vessel	None	MAIB
Project	Allision	29 September 2006	Offshore services vessel allision with rotating WTG blade.	None	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision	8 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	23 April 2011	Third-party catamaran collision with project guard vessel within harbour.	Moderate	None	MAIB
Project	Allision	18 November 2011	Cable-laying vessel allision with WTG foundation following watchkeeping failure. Two hull breaches to vessel.	Major	None	MAIB
Project / project	Collision	2 June 2012	Crew Transfer Vessel (CTV) allision with flotel. Nine persons safely evacuated and transferred to nearby vessel before being brought back in to port.	Moderate	None	UK CHIRP
Project	Allision	20 October 2012	Project vessel allision with WTG monopile following human error (misjudgement of distance). Minor damage sustained by vessel.	Minor	None	MAIB
Project	Allision	21 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	21 November 2012	Work boat allision with unlit WTG 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	None	MAIB
Project	Allision	1 July 2013	Service vessel allision with WTG foundation following machinery failure. Minor damage sustained by vessel.	Minor	None	IMCA Safety Flash
Project	Allision	14 August 2014	Standby safety vessel allision with WTG pile. Oil leaked by vessel which moved away from environmentally sensitive areas until leak was stopped.	Minor with pollution	None	UK CHIRP

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Third-party	Allision	26 May 2016	Third-party fishing vessel allision with WTG following human error (autopilot). Lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)
Project	Allision	16 January 2020	Project vessel allision with WTG. Injury sustained by crew member but vessel able to proceed to port unassisted.	None	Injury	Web search (Vessel Tracker, 2020)
Third Party	Allision	9 June 2022	Local fishing vessel allided with a WTG resulting in damage to the bow and subsequent water ingress. Minor injuries to crew. The RNLI lifeboat escorted the vessel (under its own power) back to port.	Minor	Injury	Web search (RNLI, 2022) and web search (Vessel Tracker, 2022)

(*) As per incident reports.

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.

As of September 2022, 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 a harbour.

As of September, there have been 13 reported cases of an allision between a vessel and a WTG (under construction, operational, or disused) in the UK, with all but one involving a support vessel for the development, and the errant vessel in each case under power rather than drifting. Therefore, there has been an average of 1,585 years per WTG allision incident in the UK, noting that this is a conservative calculation given that only operational WTG hours have been included (whereas allision incidents counted include non-operational WTGs).

9.6.2 Incidents Involving Non-UK Offshore Wind Farms

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.

One high profile non-UK incident which is noted is that involving a bulk carrier which dragged anchor during a storm in Dutch waters and collided with another 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 where it allided with a WTG foundation and a platform foundation before being taken under tow.

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

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.

It is noted that this 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) but does not affect the operation of the vessel involved.

Table 9.2: Historical Incidents Responded to by Vessel Associated with UK Offshore Wind Farm Developments

Incident Type	Date	Related Development	Description of Incident	Source
Capsize	21 June 2018	Walney Offshore Wind Farm	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 Offshore Wind Farm	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 Offshore Wind Farm	Yacht in difficult sought shelter by tying up to a WTG 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 Offshore Wind Farm	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
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 Offshore Wind Farm	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)

10 Vessel Traffic Movements

10.1 Windfarm Site

This section presents an overview of vessel traffic movements within the study area, primarily based upon the findings of the summer and winter vessel traffic surveys undertaken in August 2021 and January 2022 respectively (see Section 5.2).

A number of vessel tracks recorded during the survey periods were classified as temporary (non-routine), including the survey vessel, vessels performing guard duties at nearby oil and gas platforms, and vessels undertaking other surveys. These have therefore been excluded from the analysis to ensure the focus of the assessment is routine traffic.

A plot of the vessel tracks recorded during the 14-day summer period within the study area is colour-coded by type and presented in **Figure 10.1**. Following this, **Figure 10.2** presents the same data converted to a density heat map.

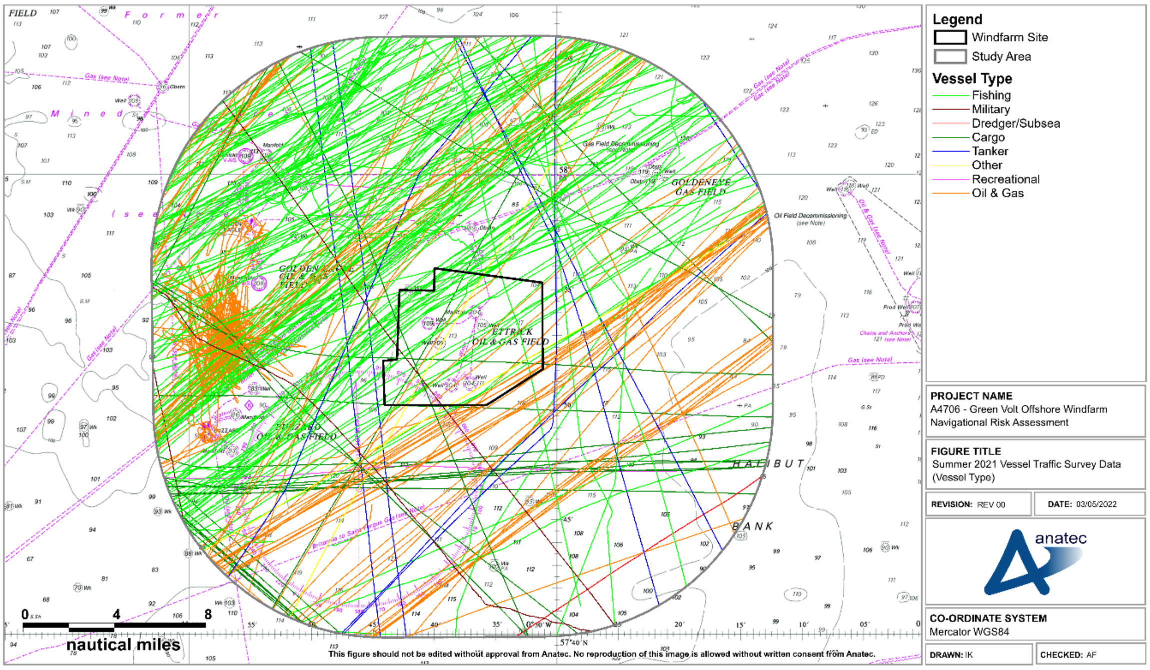


Figure 10.1: Summer 2021 Vessel Traffic Survey Data by Vessel Type

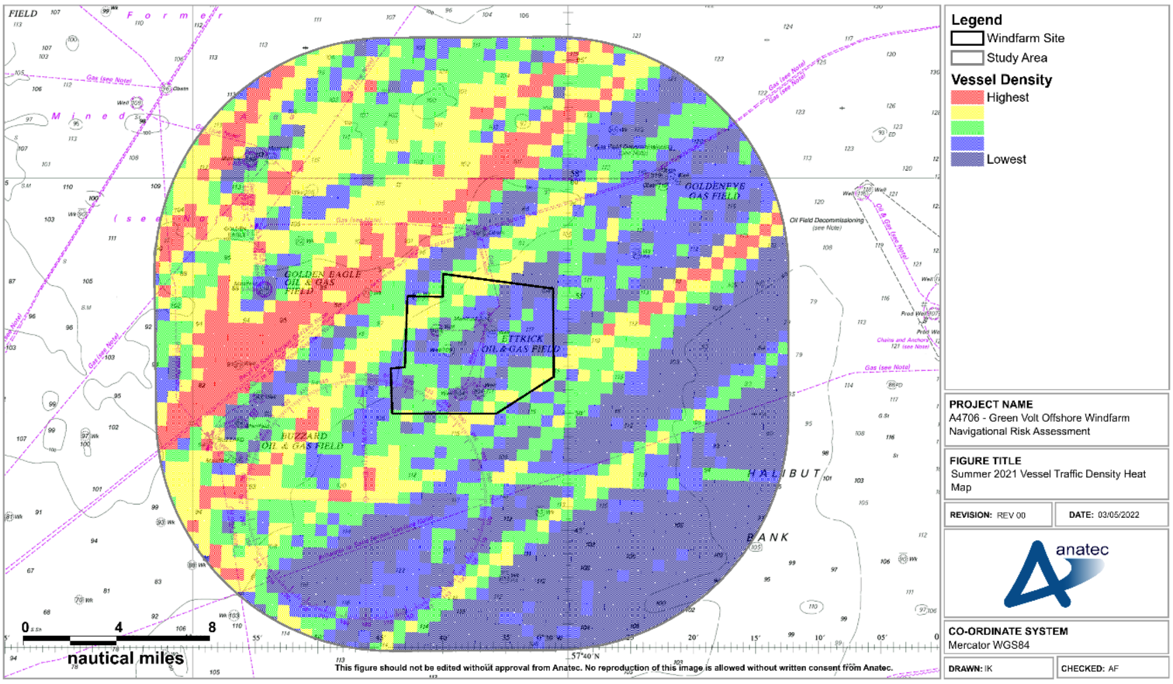


Figure 10.2: Summer 2021 Vessel Traffic Density Heat Map

A plot of the vessel tracks recorded during the 14-day winter period within the study area is colour-coded by type and presented in **Figure 10.3**. Following this, **Figure 10.4** presents the same data converted to a density heat map. It is noted that the same density brackets were used for the winter period as was used for the summer period (**Figure 10.2**) to allow direct comparison.

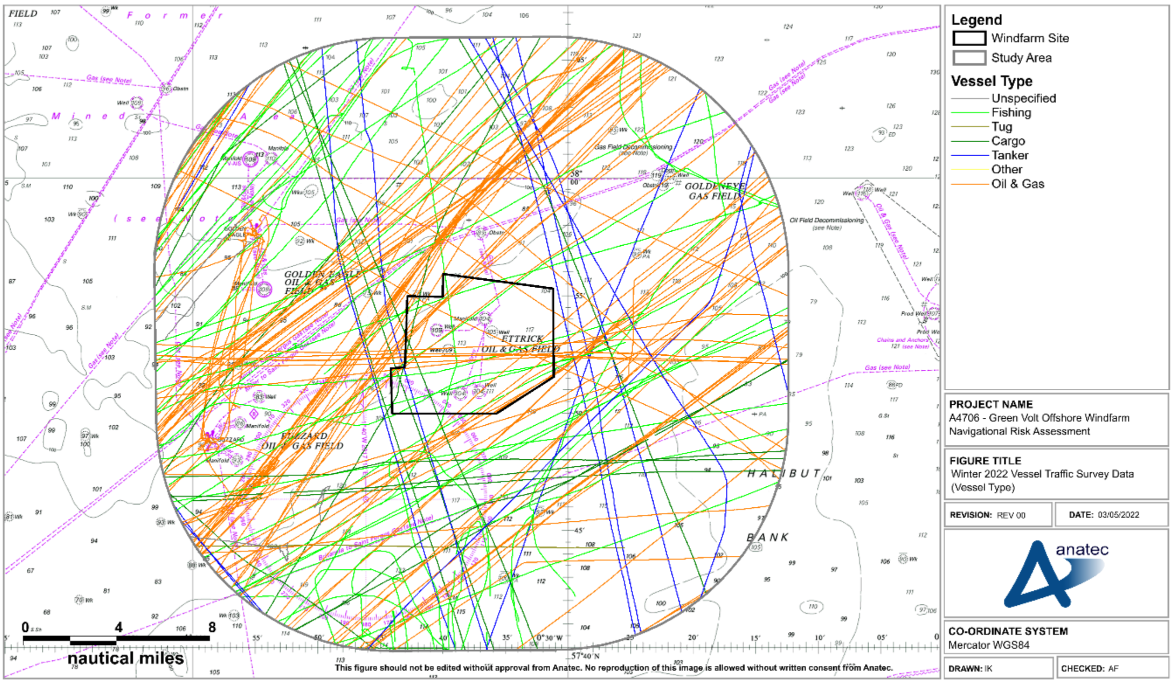


Figure 10.3: Winter 2022 Vessel Traffic Survey Data by Vessel Type

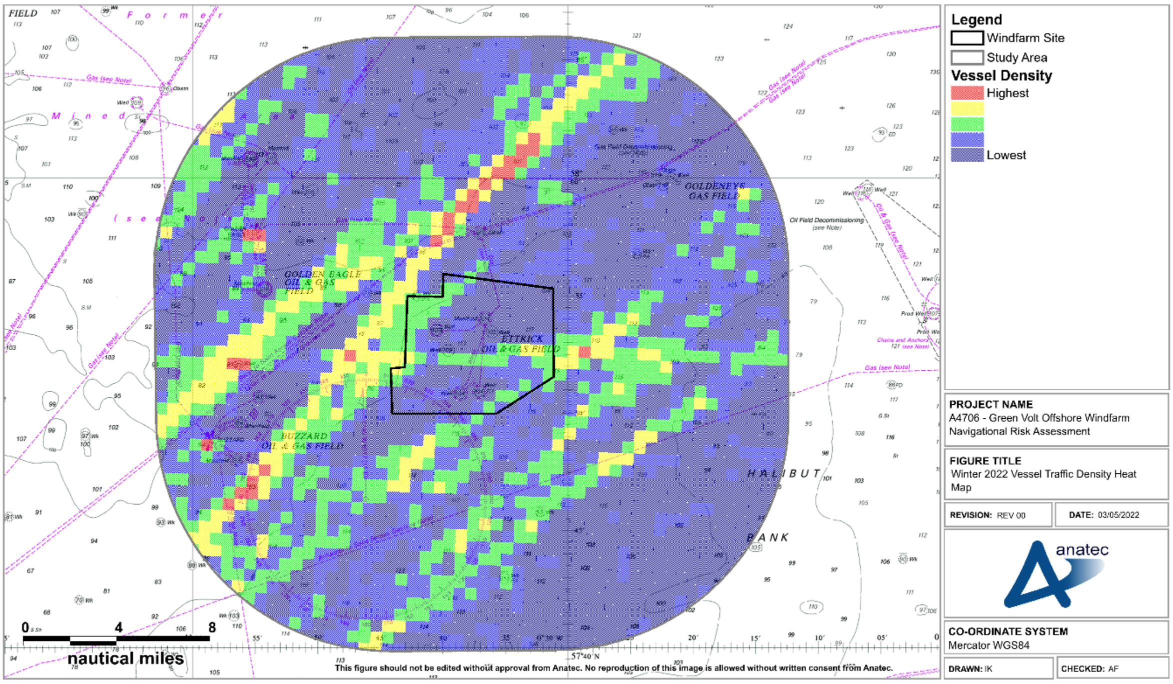


Figure 10.4: Winter 2022 Vessel Traffic Density Heat Map

10.1.1 Vessel Counts

For the 14 days analysed in the summer survey period, there was an average of 22 unique vessels per day recorded within the study area. An average of between three and four unique vessels per day were recorded intersecting the Windfarm Site.

The daily number of unique vessels recorded within the study area, as well as intersecting the Windfarm Site, during the summer survey period, is presented in **Figure 10.5**. Throughout the summer survey period approximately 16% of vessel traffic recorded within the study area intersected the Windfarm Site.

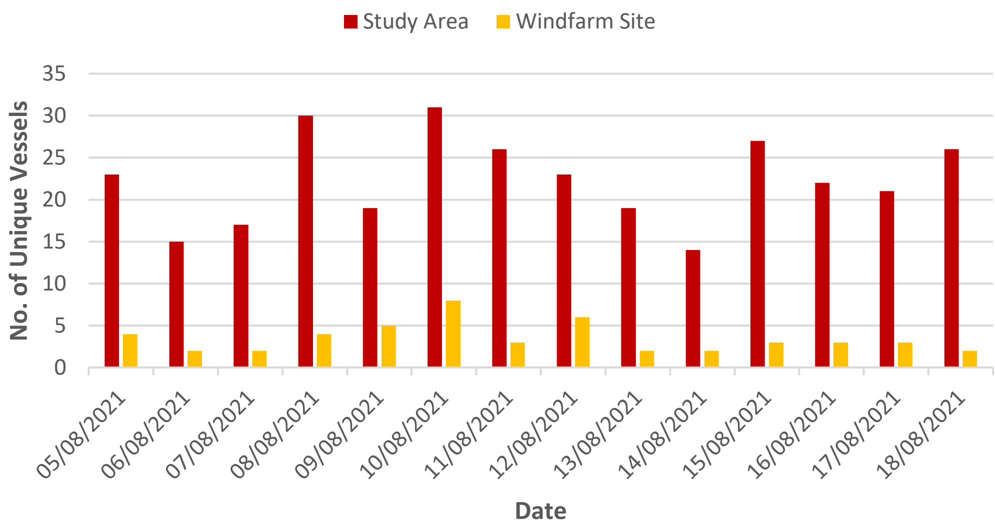


Figure 10.5: Daily Unique Vessel Counts within the Study Area and Windfarm Site (Summer 2021)

The busiest day recorded within the study area during the summer survey period was the 10th of August 2021, when 31 unique vessels were recorded. The busiest day recorded within the Windfarm Site during the summer survey period was also the 10th of August, when eight unique vessels were recorded.

The quietest day recorded within the study area during the summer survey period was the 14th of August 2021, when 14 unique vessels were recorded. Two vessels were recorded in the Windfarm Site on the quietest days.

For the 14 days analysed in the winter survey period, there was an average of 14 unique vessels per day recorded within the study area. An average of three unique vessels per day were recorded intersecting the Windfarm Site.

The daily number of unique vessels recorded within the study area, as well as intersecting the Windfarm Site, during the winter survey period, is presented in **Figure 10.6**. Throughout the winter survey period approximately 21% of vessel traffic recorded within the study area intersected the Windfarm Site.

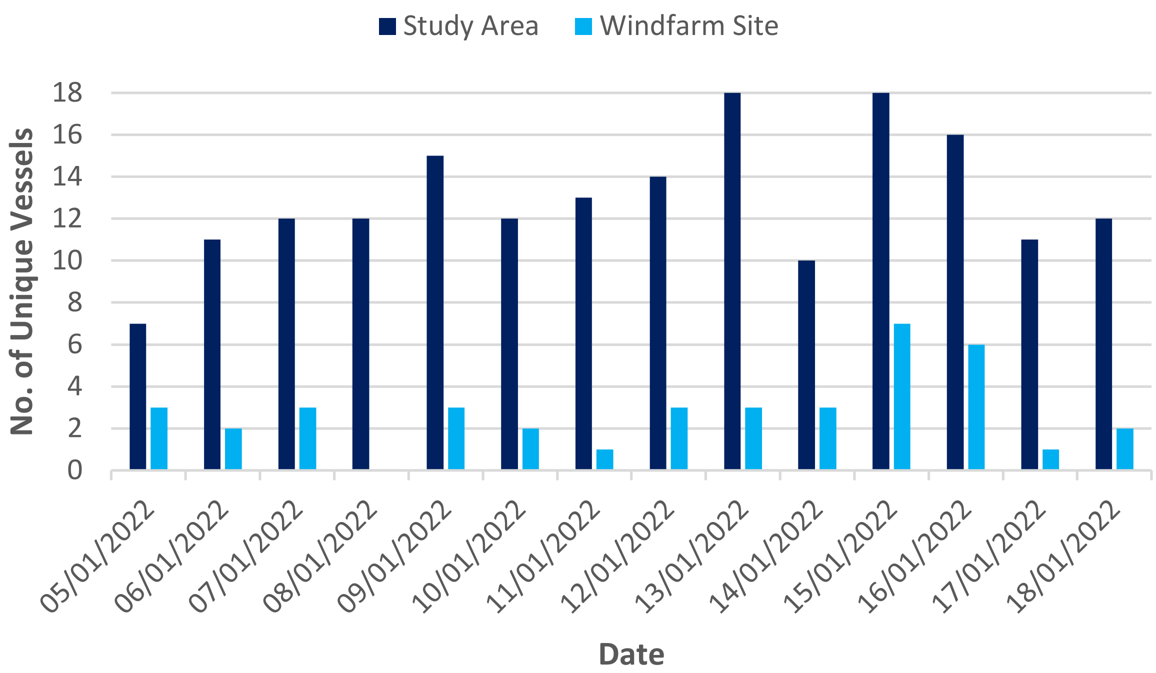


Figure 10.6: Daily Unique Vessel Counts within the Study Area and Windfarm Site (Winter 2022)

The busiest days recorded within the study area during the winter survey period were the 13th and 15th of January 2022, when 18 unique vessels were recorded. The busiest day recorded within the Windfarm Site during the winter survey period was the 15th of January 2022, when seven unique vessels were recorded.

The quietest day recorded within the study area during the winter survey period was the 5th of January 2022, when eight unique vessels were recorded. The quietest day recorded within the Windfarm Site during the winter survey period was the 8th of January 2021, when no vessels were recorded.

10.1.2 Vessel Type

The percentage distribution of the vessel types recorded passing within the study area, as well as intersecting the Windfarm Site, during the summer survey period is presented in **Figure 10.7**. The same distribution of the winter survey data is presented in **Figure 10.8**.

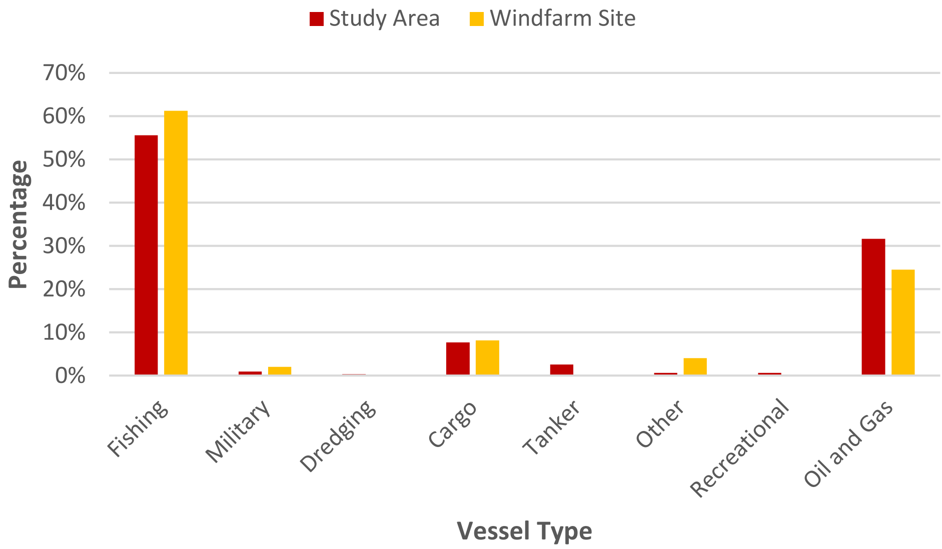


Figure 10.7: Vessel Type Distribution (Summer 2021)

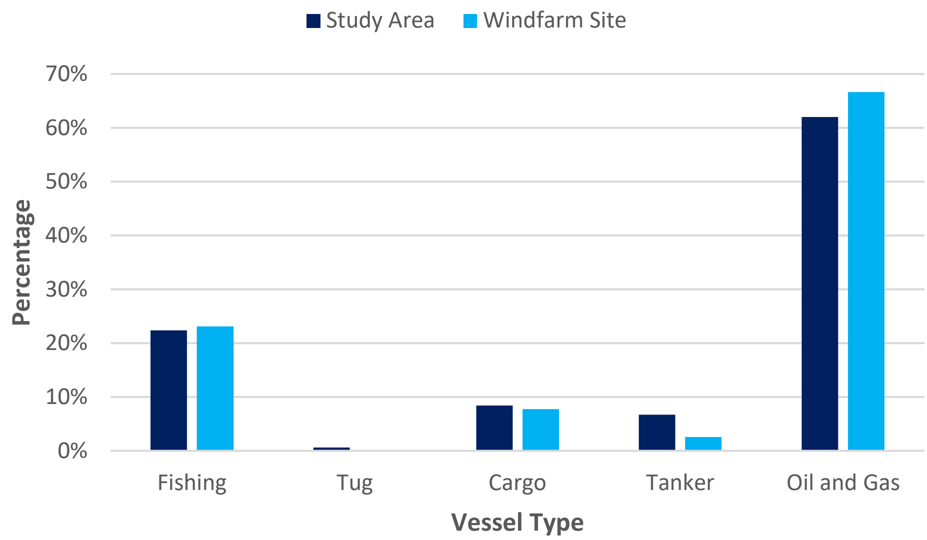


Figure 10.8: Vessel Type Distribution (Winter 2022)

During the summer survey period, the main vessel types within the study area were fishing vessels (56%), oil and gas vessels (32%), and cargo vessels (8%). The distribution was broadly similar in the winter survey period, with the main vessel types being oil and gas vessels (62%), fishing vessels (22%), and cargo vessels (8%).

The following subsections consider key vessel types individually and in more detail.

10.1.2.1 Fishing Vessels

In addition to the 2021/22 vessel traffic survey data, the assessment of fishing vessels has also considered the long term AIS (2018-2020) and VMS data covering 2021. These additional datasets provide longer term assessment noting that fishing vessel activity can vary on a seasonal and yearly basis.

Vessel Traffic Survey Data

Tracks of fishing vessels recorded within the study area during both survey periods are presented in **Figure 10.9**.

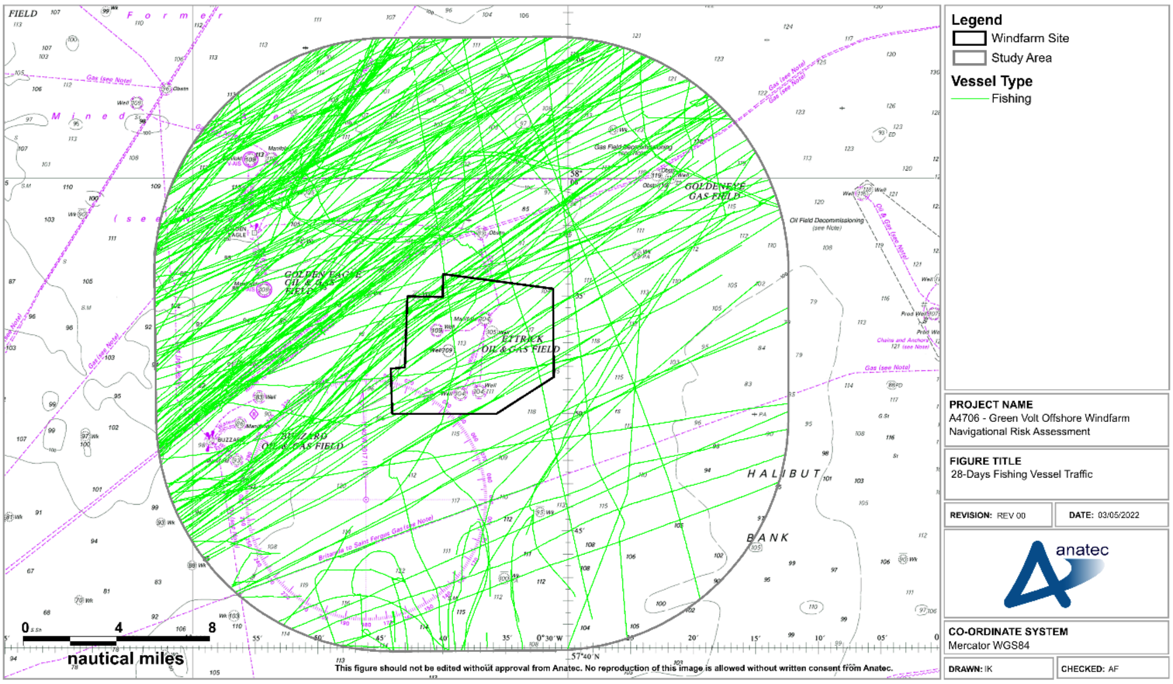


Figure 10.9: 28-Days Fishing Vessel Traffic

During the summer survey period an average of 12 unique fishing vessels per day were recorded within the study area. During the winter survey period an average of three unique fishing vessels per day were recorded within the study area.

Fishing vessels were predominately recorded on passage through the study areas as opposed to actively fishing, although instances of active fishing were also recorded directly to the north and south of the Windfarm Site.

Approximately 95% of fishing vessels during both survey periods were recorded on AIS, with 5% recorded on Radar.

Long Term AIS

To ensure seasonal variation in fishing activity is captured, the NRA has also considered three years of long term AIS fishing vessel data in addition to the 28 days of vessel traffic survey data. The data was recorded within the study area and covers the three year period from January 2018 to December 2020. The three year AIS dataset has then been assessed to identify potential active fishing (i.e., gear deployed) based on a behavioural and speed analysis. On this basis, **Figure 10.10** presents the fishing vessels deemed likely to be in transit in the study area over the three year period, and **Figure 10.11** presents the fishing vessels which displayed behaviour indicating potential fishing activity.

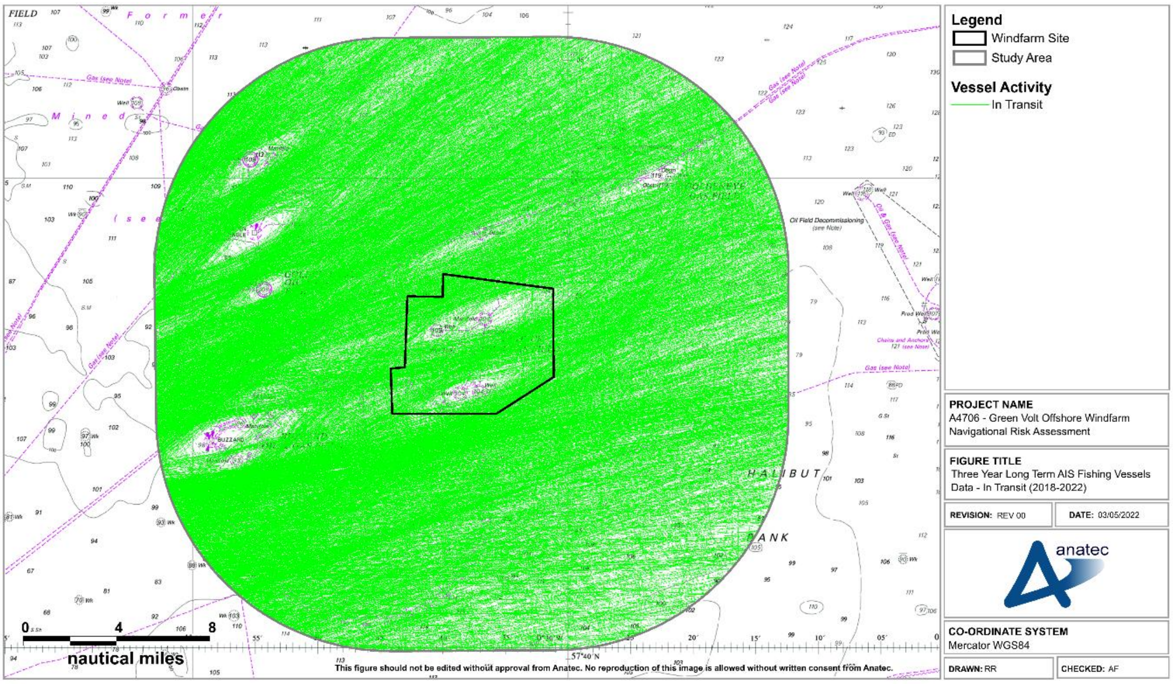


Figure 10.10 Three Year Long Term AIS Fishing Vessel Data – In Transit

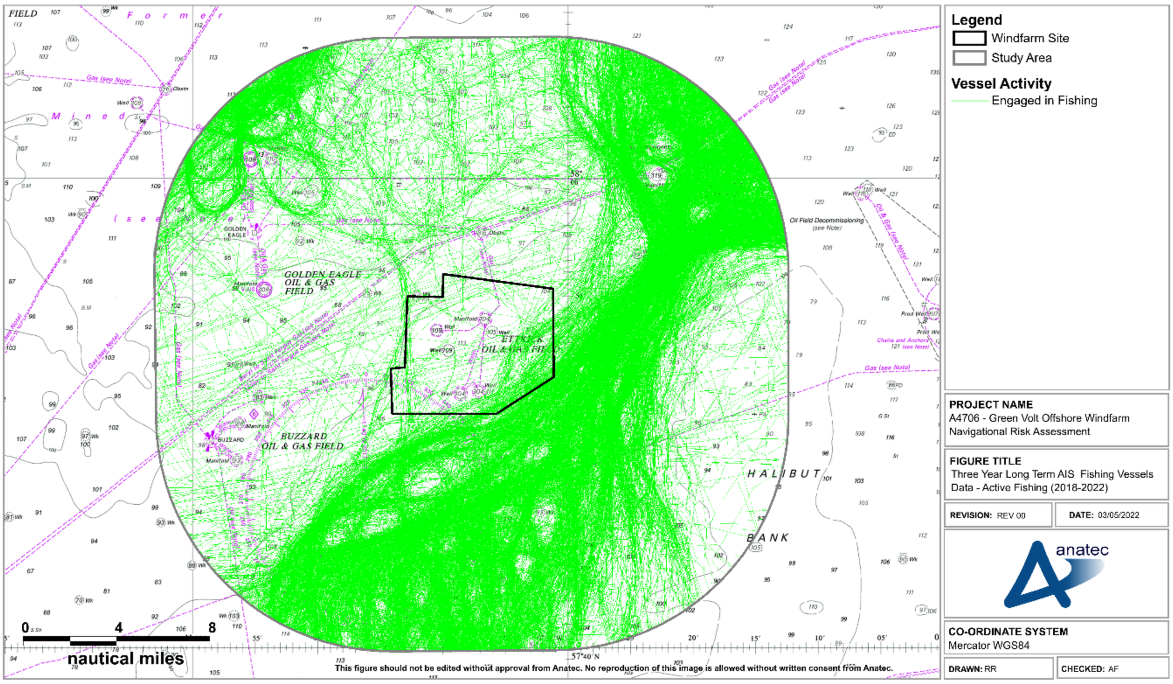


Figure 10.11: Three Year Long Term AIS Fishing Vessel Data – Active Fishing

As shown, the majority of active fishing occurred outside of the Windfarm Site, with the most prominent area being to the southeast. Vessels in the Windfarm Site tended to be in transit. This is demonstrated in **Figure 10.12** and **Figure 10.13**, which show the number of fishing vessels in transit and actively fishing respectively.

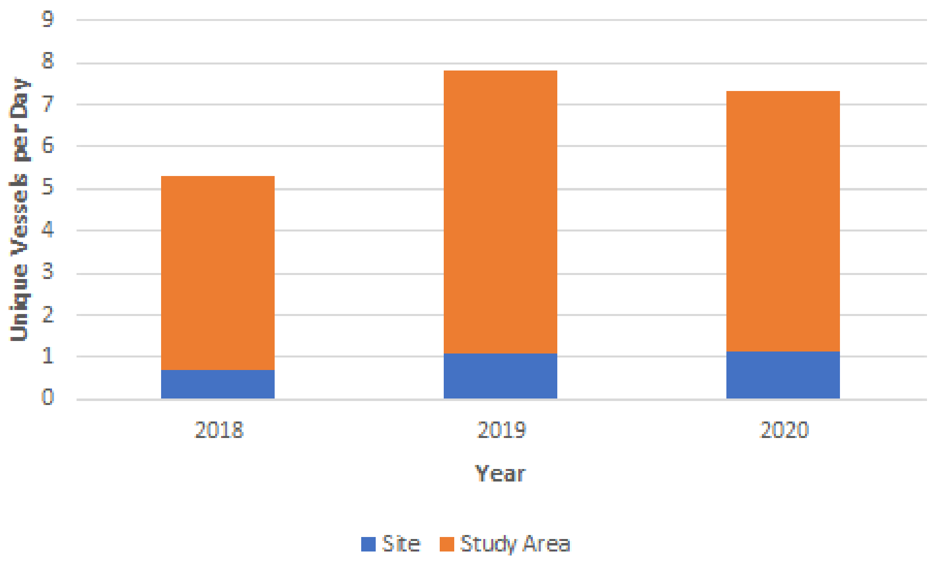


Figure 10.12: Fishing Vessel Numbers - Vessels in Transit

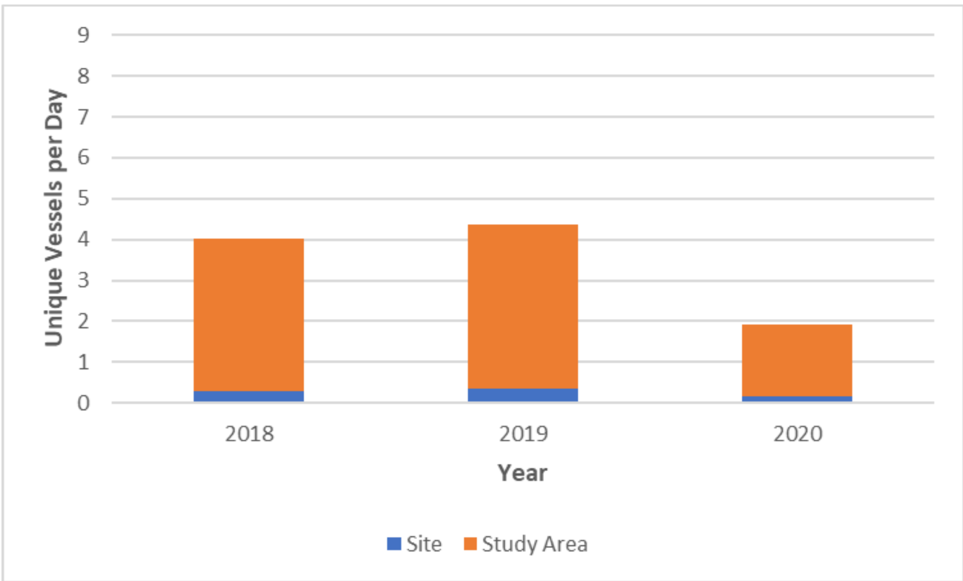


Figure 10.13: Fishing Vessel Numbers – Potential Active Fishing

As shown, approximately one vessel per day intersected the Windfarm Site whilst in transit, with active fishing intersections being less common.

VMS

In addition to the vessel traffic survey data, VMS data recorded for the entirety of 2021 has also been analysed within the Windfarm Site and study area. A density grid, using the VMS data during this period as input, is presented in **Figure 10.14.**

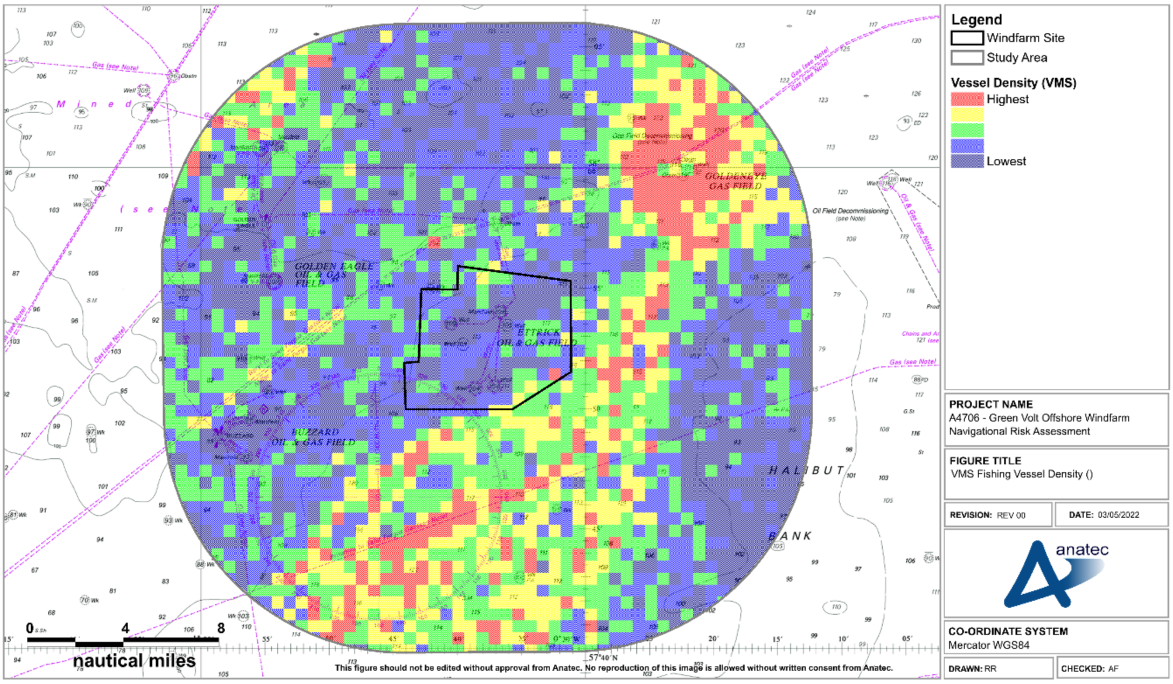


Figure 10.14: VMS Fishing Vessel Density (2021)

The highest density areas were the northeast and central south of the study areas with high density also occurring at the northwest extent of the study area. This correlates well with the long-term AIS data for fishing vessels during 2018-2020 as seen previously in **Figure 10.11.**

10.1.2.2 Oil and Gas Vessels

Tracks of oil and gas vessels recorded within the study area during both survey periods are presented in **Figure 10.15**.

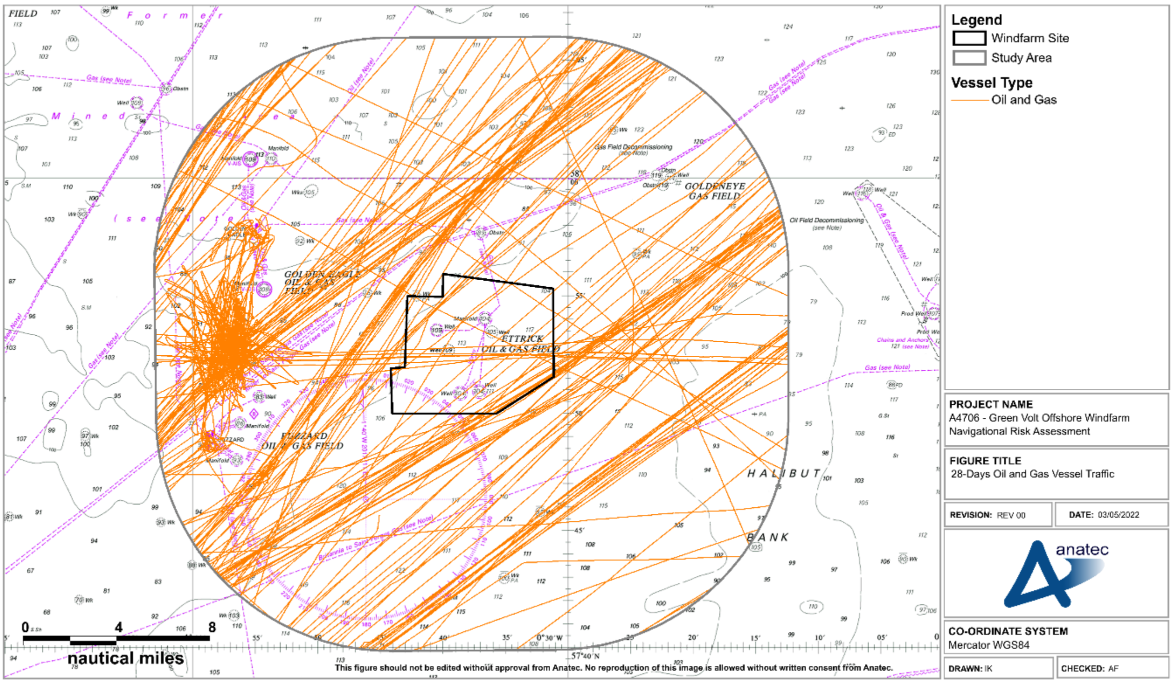


Figure 10.15: 28-Days Oil and Gas Vessel Traffic

During the summer survey period an average of seven unique oil and gas vessels per day were recorded within the study area. During the winter survey period an average of eight unique oil and gas vessels per day were recorded within the study area.

Oil and gas vessels recorded within the study area during the survey periods were predominately associated with activity around the Golden Eagle and Buzzard platforms, with other vessels transiting between Aberdeen and platforms such as Claymore, Scott, and Tiffany field.

10.1.2.3 Cargo Vessels

Tracks of cargo vessels recorded within the study area during both survey periods are presented in **Figure 10.16**.

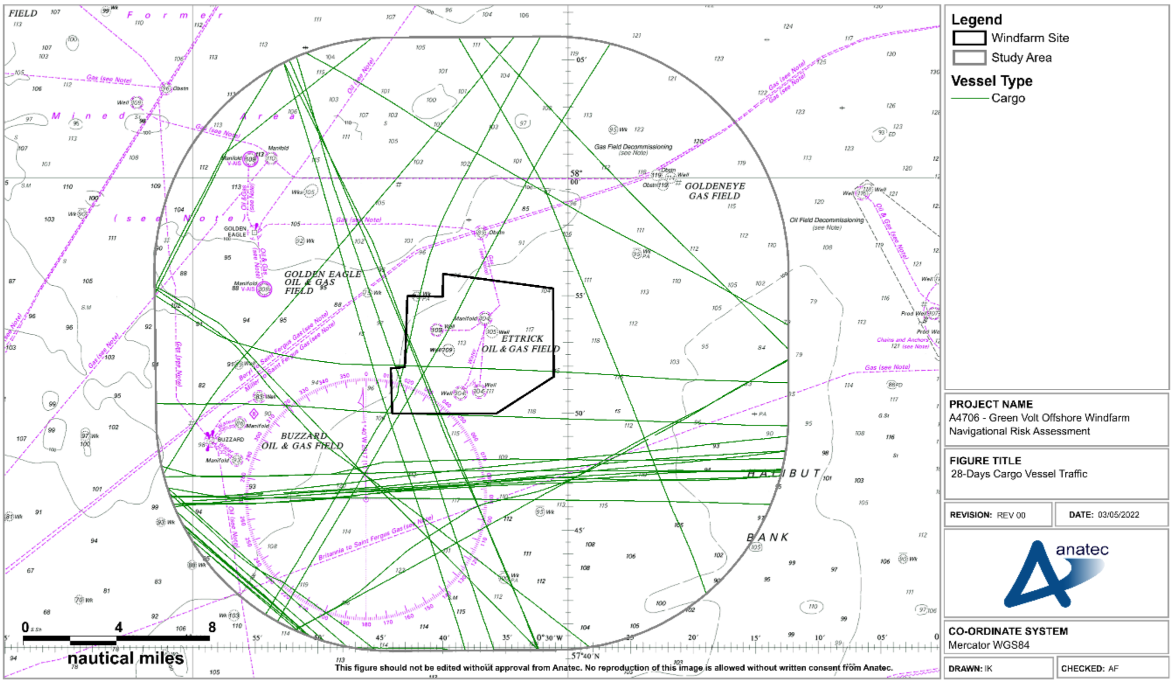


Figure 10.16: 28-Days Cargo Vessel Traffic

During the summer survey period an average of two unique cargo vessels per day were recorded within the study area. During the winter survey period an average of one unique cargo vessel per day was recorded within the study area.

10.1.2.4 Tankers

Tracks of tankers recorded within the study area during both survey periods are presented in **Figure 10.17**.

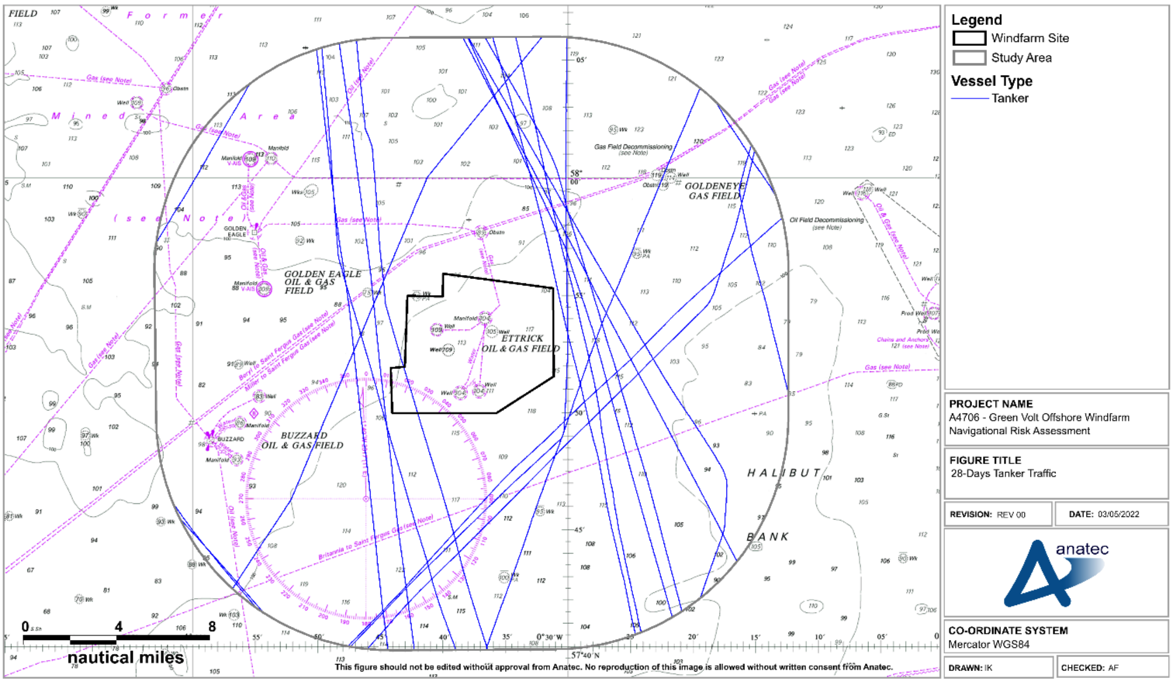


Figure 10.17: 28-Days Tanker Traffic

Tanker numbers were low during both survey periods, with an average of approximately one per day in the study area over the 28 days.

10.1.2.5 Recreational Vessels

Recreational activity recorded during the vessel traffic surveys was limited, with two vessels recorded during the summer survey, and none during the winter survey (noting this includes non AIS traffic). It is noted that RYA Scotland indicated recreational traffic levels during 2021 may have been affected by ongoing COVID-19 effects (see Section 4.2.4), and that EU-Exit means UK recreational users are no longer able to leave craft in the EU for extended periods of time. Therefore, there may now be an increase in transits in order to return vessels to the UK.

Further input received from RYA Scotland was that the levels of recreational activity were heavily seasonal and could vary by year (see Section 4.2.4), and that the majority of recreational vessels likely to be in the area would likely transit to Scandinavia in May / June, with these vessels usually returning in August / September.

RYA Scotland indicated during Scoping (see Section 4.2.1) that while coverage of the RYA Coastal Atlas is not comprehensive in areas further offshore, it would still provide indication of likely recreational routeing in the area including for non AIS traffic. The RYA Coastal Atlas is shown relative to the Windfarm Site in **Figure 10.18.**

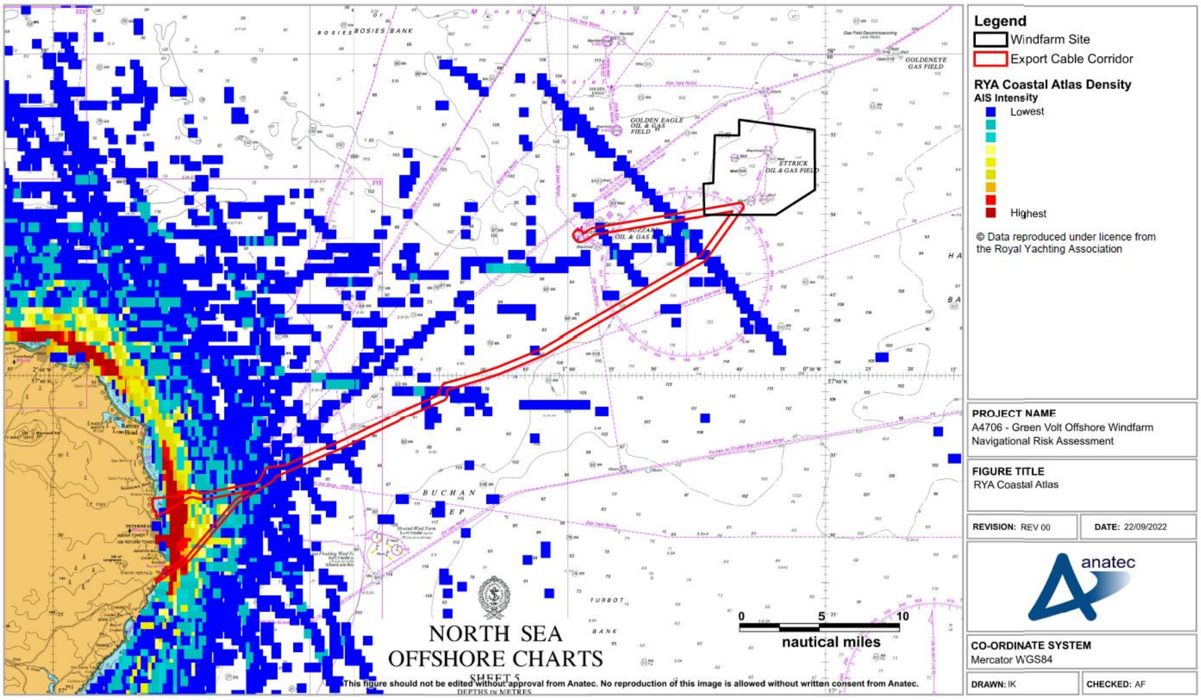


Figure 10.18: RYA Coastal Atlas

As shown, the RYA Coastal Atlas indicates that while recreational activity in the vicinity of the Windfarm Site is lower than coastal areas, transits may still occur in the area. Consideration is given to the Offshore Export Cable Corridor in Section 10.2.2.5.

On the basis of the available data and stakeholder input, for the purposes of the risk assessment undertaken in Sections 17, 18, and 19 it has been assumed that recreational transits do occur in the area, and that these are likely to be associated with transits between the UK and Scandinavia.

10.1.3 Anchored Vessels

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

For this reason, those vessels which travelled at a speed of less than one knot (kt) for more than 30 minutes had their corresponding vessel tracks individually checked for patterns characteristic of anchoring activity. After applying these criteria, no anchored vessels were identified within the study area during either survey period. This is as would be expected given the distance offshore and the water depths in the area.

10.1.4 Vessel Size

10.1.4.1 Vessel Length

Vessel length information was available for approximately 97% of vessels recorded during both survey periods and ranged from 7m for a Search and Rescue (SAR) vessel to 300m for a containership. The distribution of vessel lengths recorded during both survey periods is presented in **Figure 10.19**.

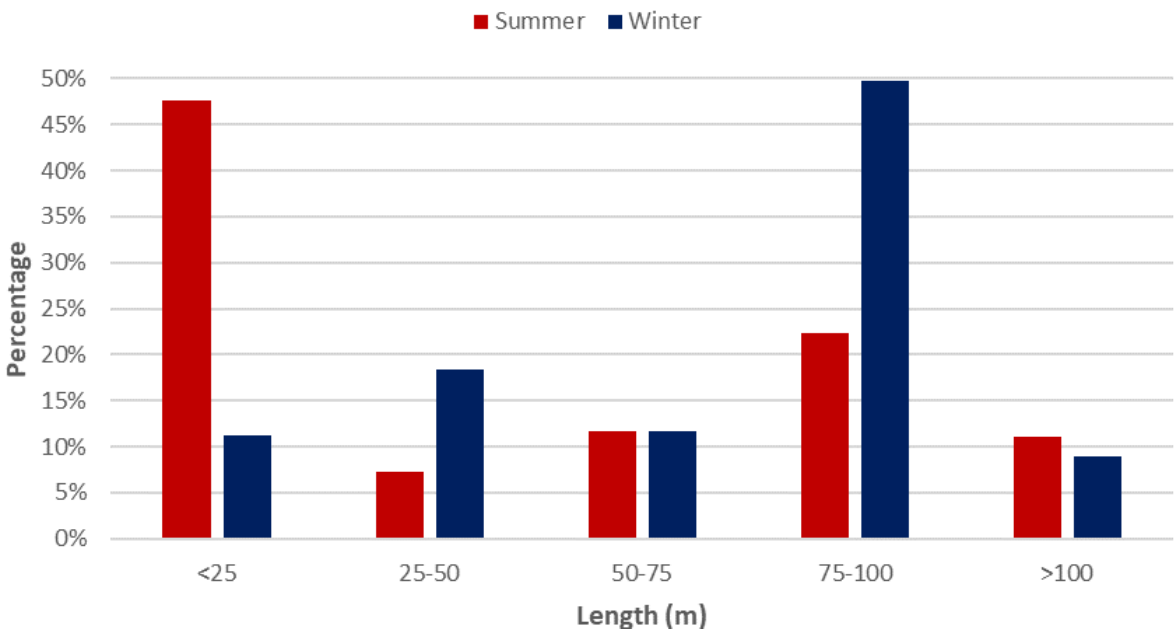


Figure 10.19: 28-Days Vessel Length Distribution

Excluding the proportion of vessels for which a length was not available the average length of vessels recorded within the study area during the summer and winter survey periods was 58m and 77m respectively. The increase in winter was due to lower numbers of fishing vessels which are typically of much lower length than commercial vessels.

The vessel tracks recorded during both survey periods are colour-coded by vessel length and presented in **Figure 10.20**.

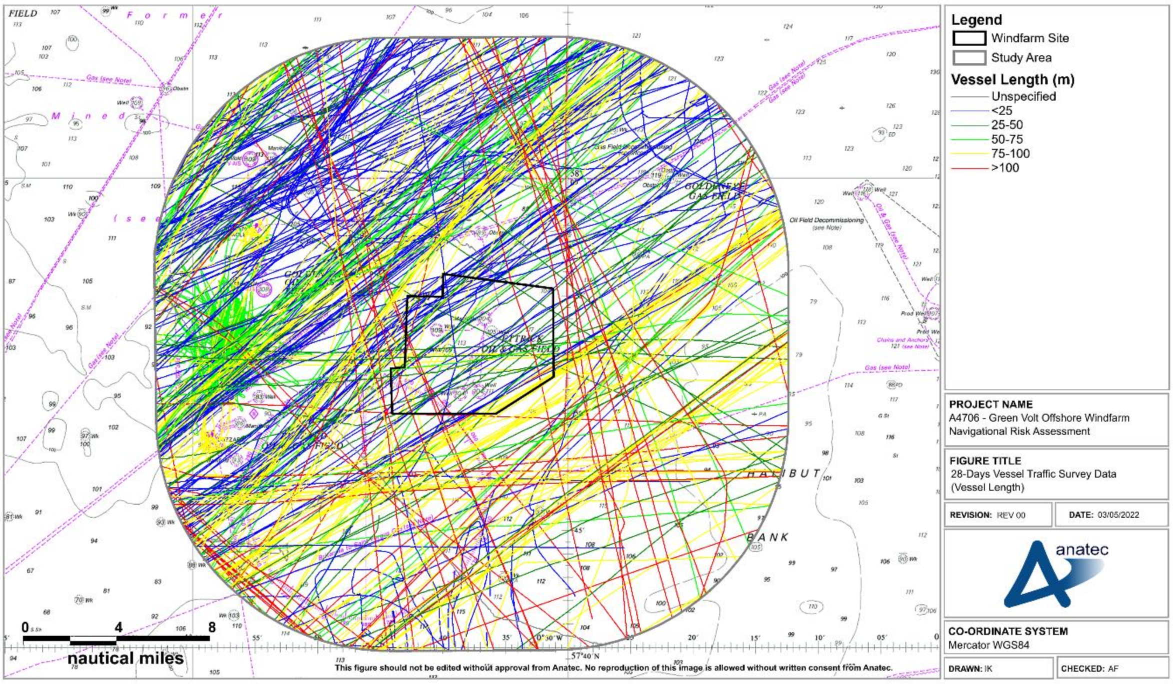


Figure 10.20: 28-Days Vessel Traffic Survey Data by Vessel Length

Large vessels were predominately noted on north / south routes in immediate proximity to the Windfarm Site and were generally cargo vessels and tankers. Smaller vessels were recorded transiting in a north-east to south-west orientation and primarily comprised fishing vessels.

10.1.4.2 Vessel Draught

Vessel draught information was available for approximately 81% of vessels recorded during both survey periods and ranged from 2.8m for a fishing vessel to 15m for a bulk carrier. The distribution of vessel draughts recorded during both survey periods is presented in **Figure 10.21**.

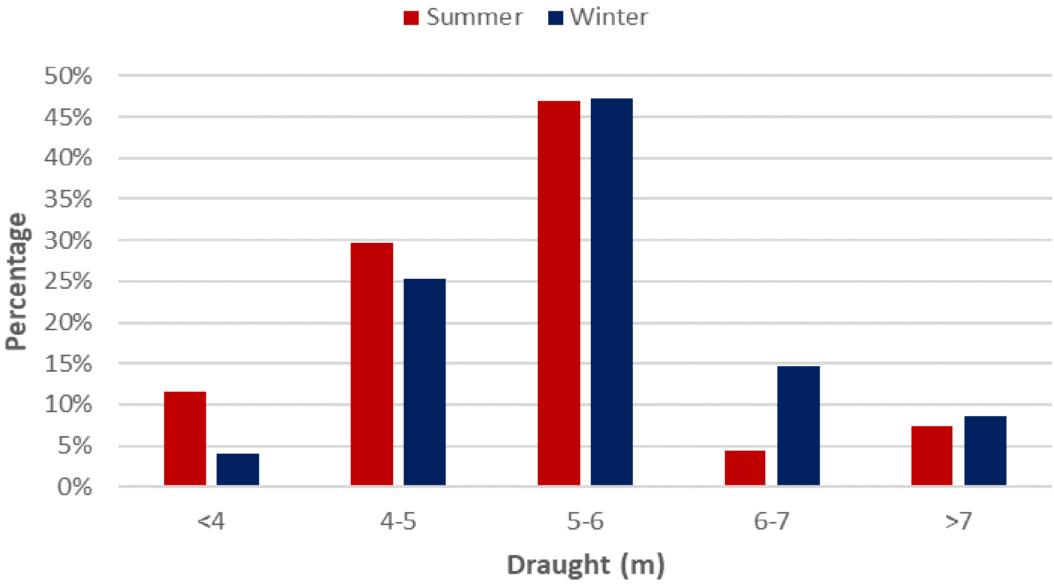


Figure 10.21: 28-Days Vessel Draught Distribution

Excluding the proportion of vessels for which a draught was not available the average draught of vessels recorded within the study area during the summer and winter survey periods was 5.2m and 5.5m respectively.

The vessel tracks recorded throughout both survey periods are colour-coded by vessel draught and presented in **Figure 10.22**.

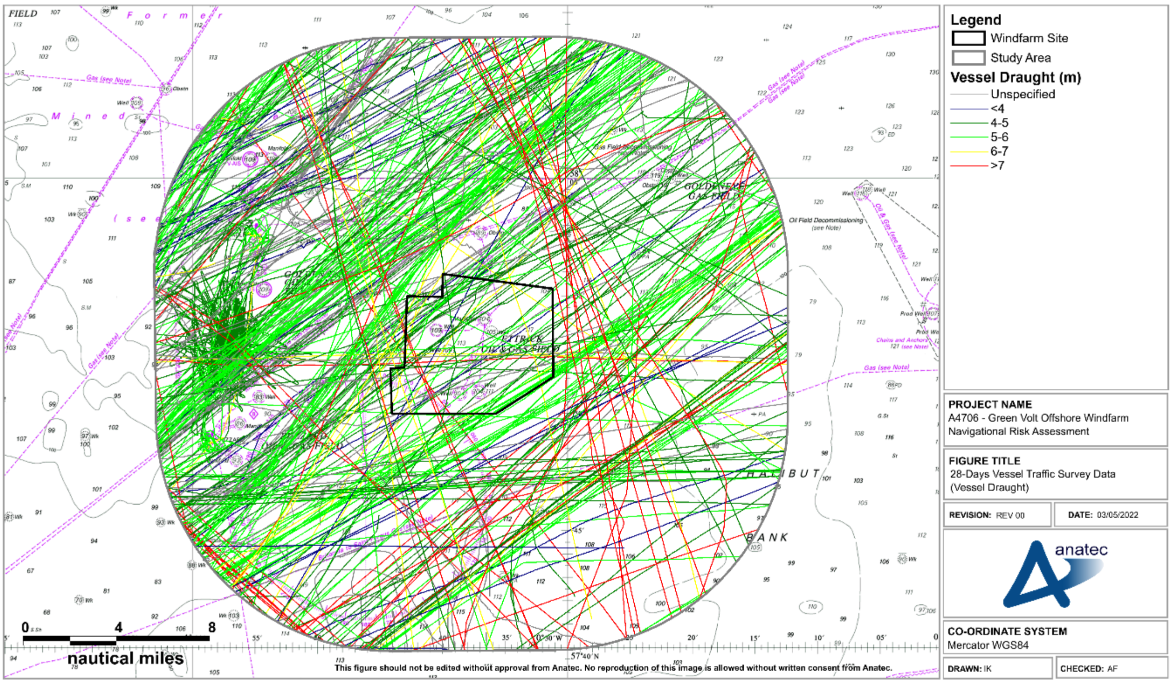


Figure 10.22: 28-Days Vessel Traffic Survey Data by Vessel Draught

As for vessel length (see Section 10.1.4.1), large vessels were predominately noted on north to south routes in immediate proximity to the Windfarm Site and were generally cargo vessels and tankers, with smaller vessels recorded transiting in a north-east to south-west orientation and primarily composing fishing vessels.

10.2 Offshore Export Cable Corridor

This section presents an overview of vessel traffic movements within the Cable Study Area based on assessment of AIS data. The same data periods were used as those for the Windfarm Site (August 2021 and January 2022, see Section 10.1).

Temporary traffic has been removed in line with the approach taken for the assessment of the Windfarm Site (see Section 10.1). Any vessels remaining within Peterhead Port have also been excluded.

A plot of the vessel tracks recorded during the 14 day summer period within the study area is colour-coded by type and presented in **Figure 10.23**. Following this, **Figure 10.24** presents the same data converted to a density heat map.

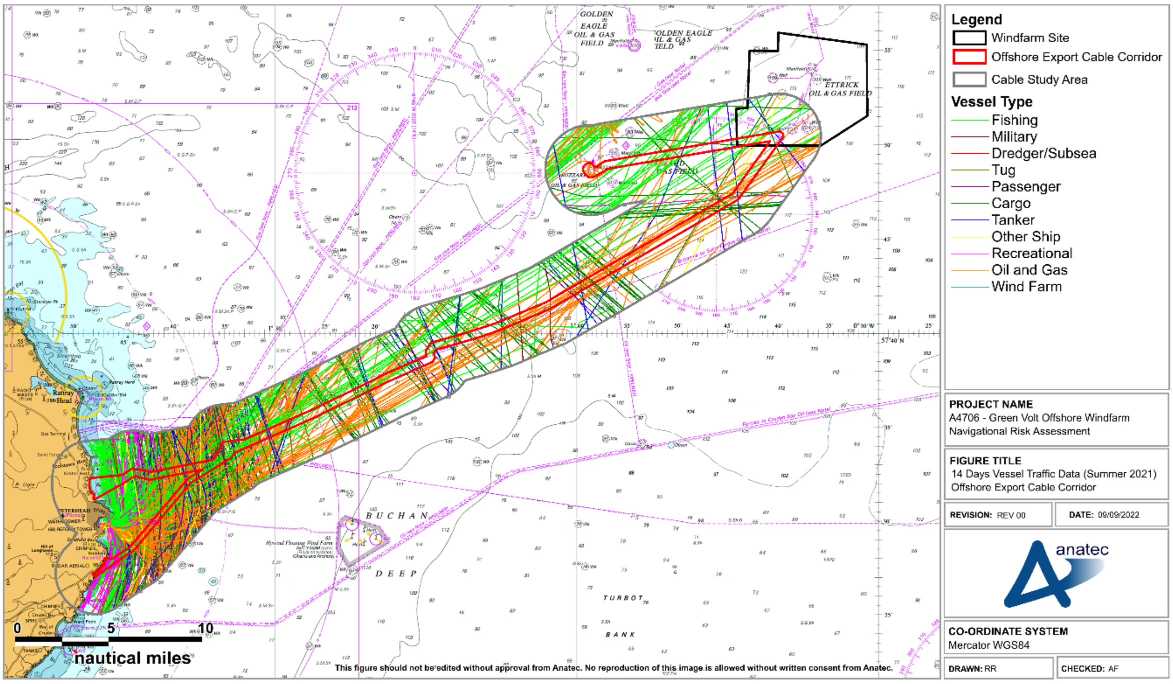


Figure 10.23: Summer 2021 Vessel Traffic Survey Data by Vessel Type

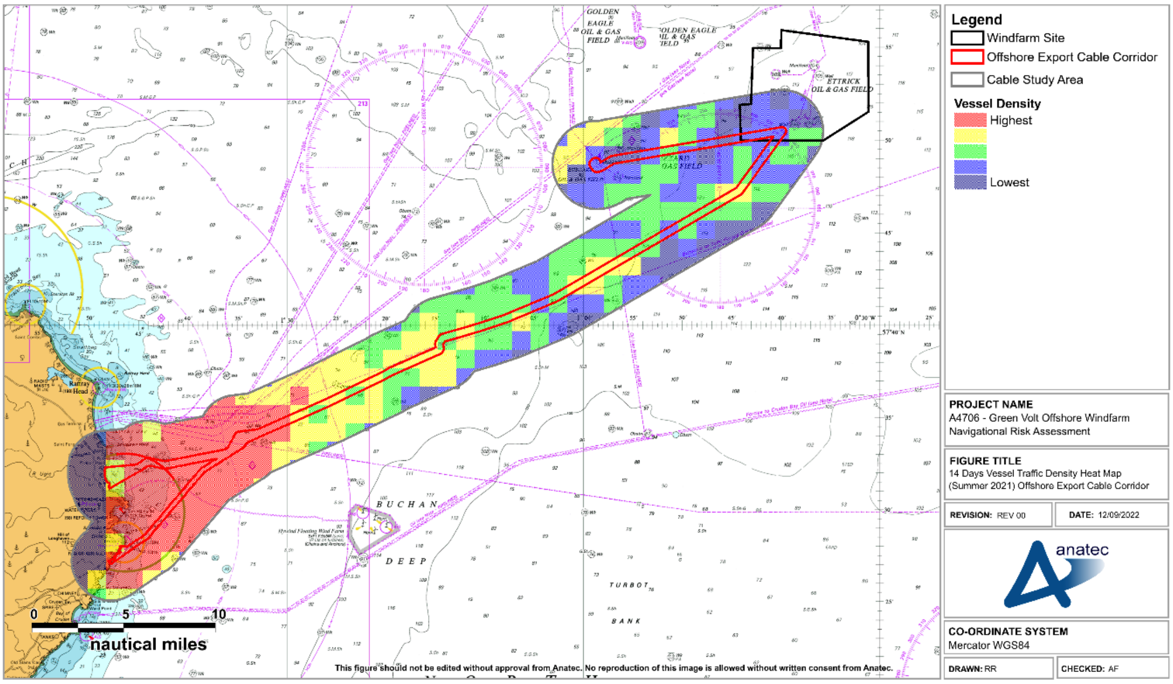


Figure 10.24: Summer 2021 Vessel Traffic Density Heat Map

A plot of the vessel tracks recorded during the 14 day winter period within the Cable Study Area is colour-coded by type and presented in **Figure 10.25**. Following this, **Figure 10.26** presents the same data converted to a density heat map. It is noted that the same density brackets were used for the winter period as was used for the summer period (**Figure 10.24**) to allow direct comparison.

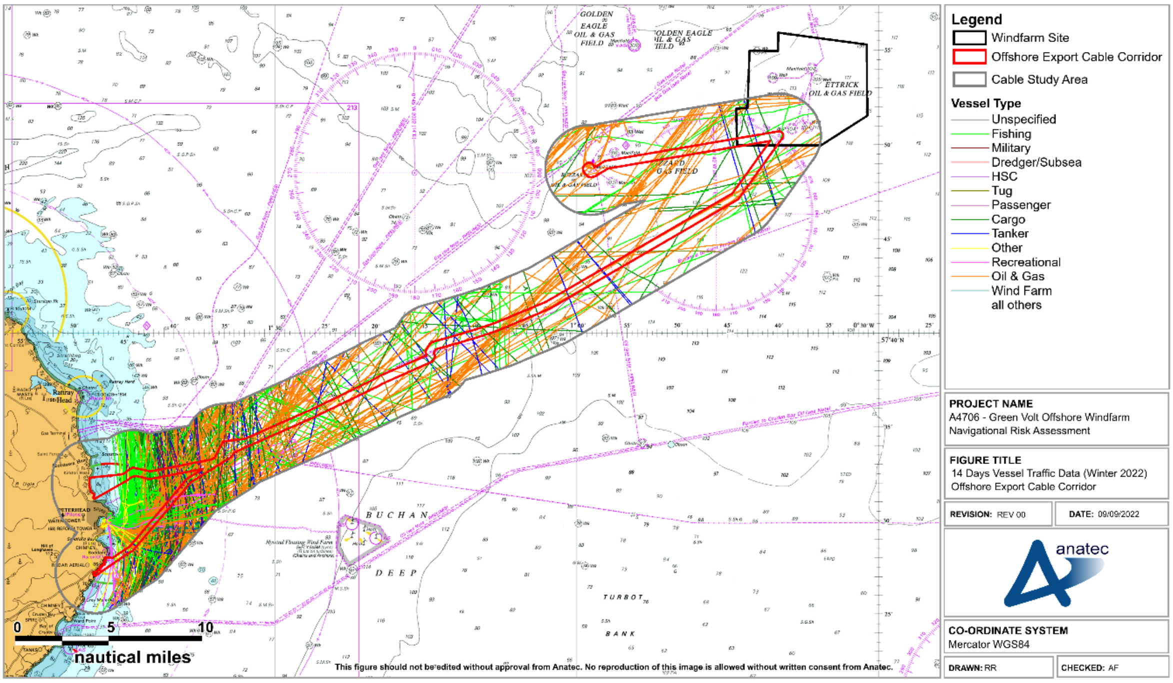


Figure 10.25: Winter 2021 Vessel Traffic Survey Data by Vessel Type

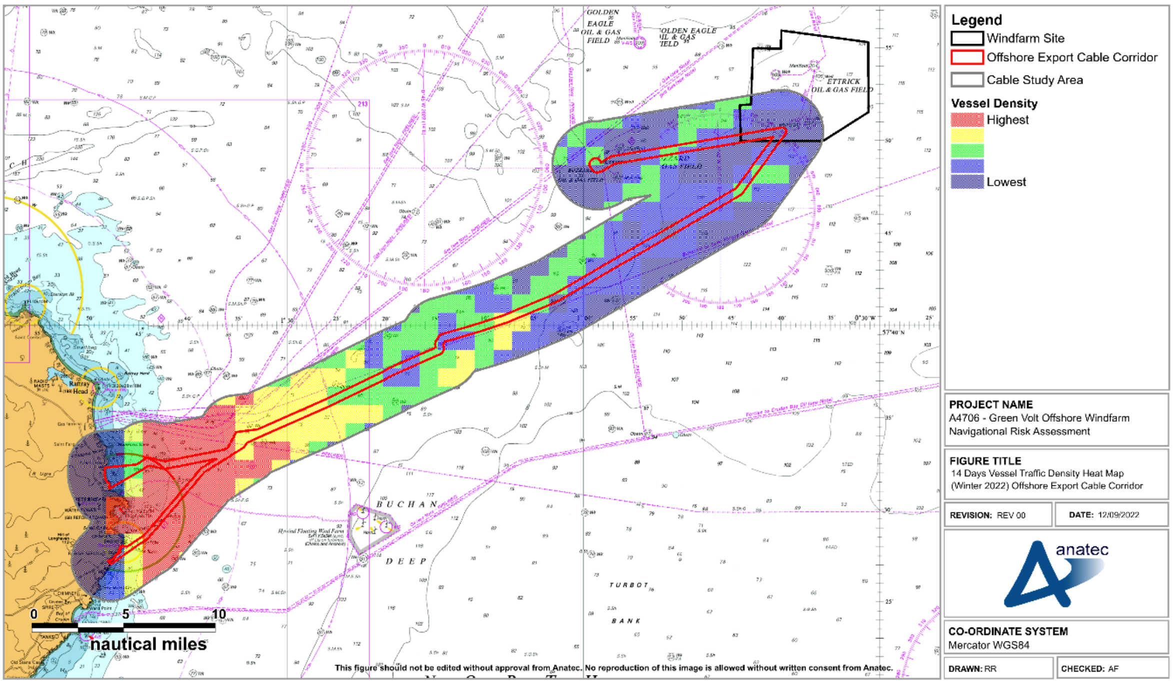


Figure 10.26: Winter 2022 Vessel Traffic Density Heat Map

10.2.1 Vessel Counts

The daily number of unique vessels recorded within the Cable Study Area, as well as intersecting the Offshore Export Cable Corridor during the summer survey period is presented in **Figure 10.27.** Throughout the summer survey period approximately 87% of vessel traffic recorded within the study area intersected the Offshore Export Cable Corridor.

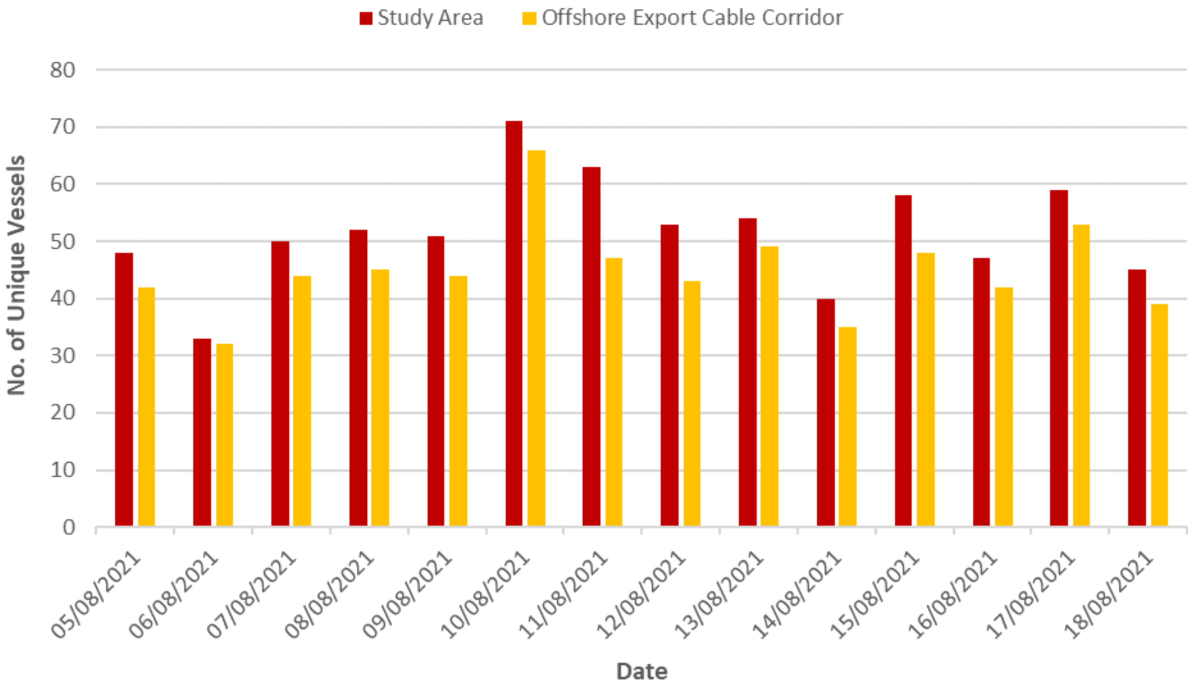


Figure 10.27: Daily Unique Vessel Counts within the Offshore Export Cable Corridor and Cable Study Area (Summer 2021)

During the 14 day summer period, an average of 52 unique vessels were present within the Cable Study Area per day. Of these vessels, an average of 45 unique vessels intersected the Offshore Export Cable Corridor per day.

The busiest day recorded within the Cable Study Area during the summer survey period was the 10th of August 2021, when 71 unique vessels were recorded. The busiest day recorded within the Offshore Export Cable Corridor during the summer survey period was also the 10th of August, when 66 unique vessels were recorded.

The quietest day recorded within the Cable Study Area during the summer survey period was the 6th of August 2021, when 33 unique vessels were recorded. The quietest days recorded within the Offshore Export Cable Corridor during the summer survey period was also the 6th of August, when 32 unique vessels were recorded.

The daily number of unique vessels recorded within the Cable Study Area, as well as intersecting the Offshore Export Cable Corridor, during the winter survey period, is presented in **Figure 10.28** Throughout the winter survey period approximately 88% of vessel traffic recorded within the study area intersected the Offshore Export Cable Corridor.

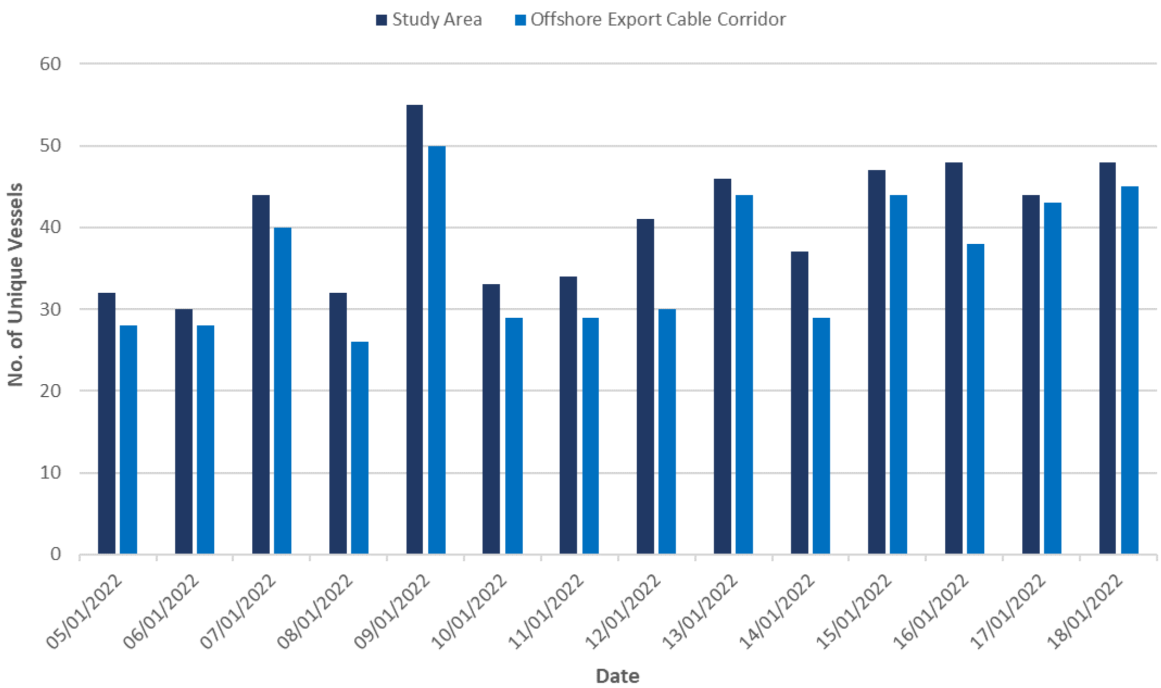


Figure 10.28: Daily Unique Vessel Counts within Offshore Export Cable Corridor and Cable Study Area (Winter 2022)

During the 14 day winter period, an average of 41 unique vessels were present within the Cable Study Area per day. Of these vessels, an average of 36 unique vessels intersected the Offshore Export Cable Corridor per day.

The busiest day recorded within the Cable Study Area during the winter survey period was the 9th of January 2022, when 55 unique vessels were recorded. The busiest day recorded within the Offshore Export Cable Corridor during the winter survey period was also the 9th of January, when 50 unique vessels were recorded.

The quietest day recorded within the Cable Study Area during the winter survey period was the 6th of January 2022, when 30 unique vessels were recorded. The quietest day recorded within the Offshore Export Cable Corridor during the winter survey period was the 8th of January, when 26 unique vessels were recorded.

10.2.2 Vessel Type

The percentage distribution of the vessel types recorded within the Cable Study Area, as well as intersecting the Offshore Export Cable Corridor, during the summer survey period is presented in **Figure 10.29.** The same distribution of the winter survey data is presented in **Figure 10.30.**

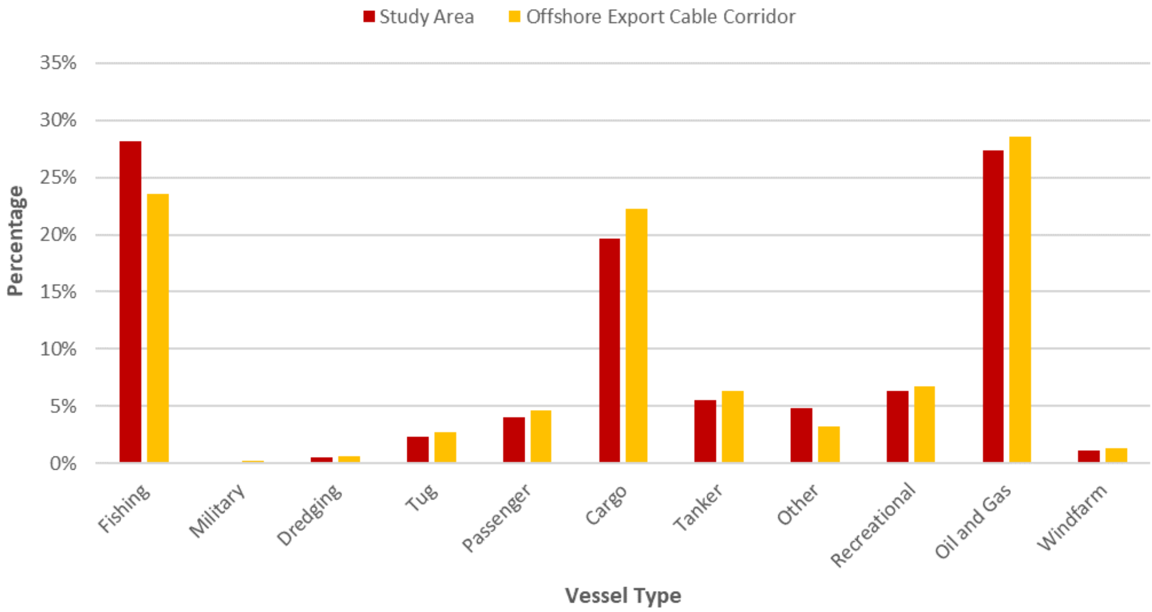


Figure 10.29: Vessel Type Distribution (Summer 2021)

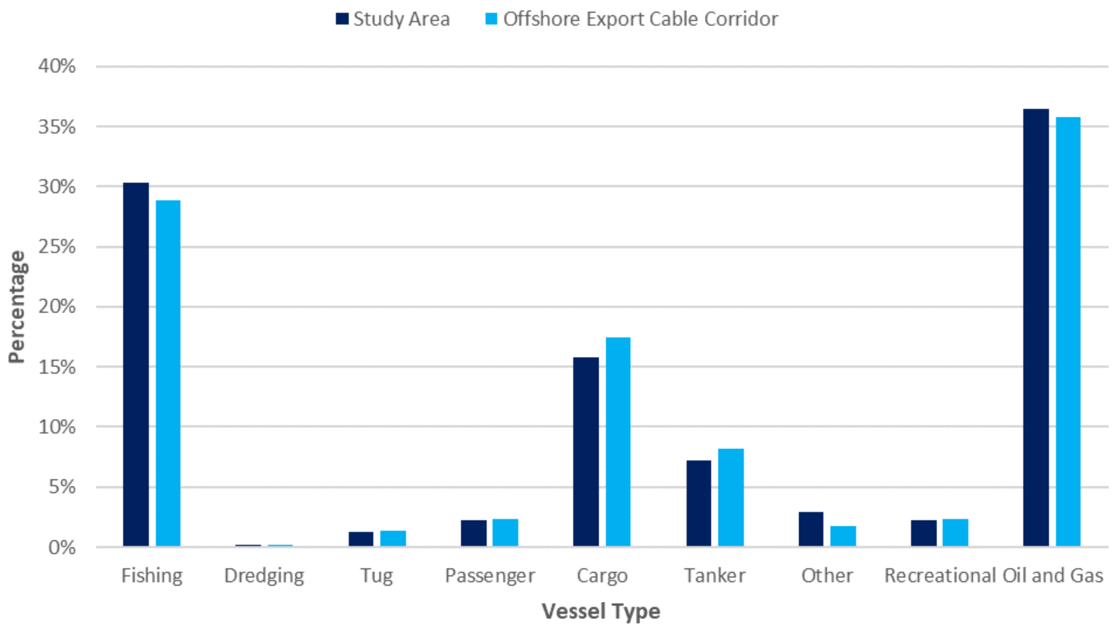


Figure 10.30: Vessel Type Distribution (Winter 2022)

During the summer survey period, the main vessel types recorded within the Cable Study Area were fishing vessels (28%), oil and gas vessels (27%), and cargo vessels (20%). This was broadly the same distribution as within the Offshore Export Cable Corridor itself.

During the winter survey period, the main vessel types recorded within the Cable Study Area were oil and gas vessels (36%), fishing vessels (30%) and cargo vessels (16%) also. Again, this was broadly the same distribution as within the Offshore Export Cable Corridor itself.

The following subsections consider each of the key vessel types individually and in more detail.

10.2.2.1 Oil and Gas Vessels

Tracks of oil and gas vessels recorded within the Cable Study Area during both survey periods are presented in **Figure 10.31.**

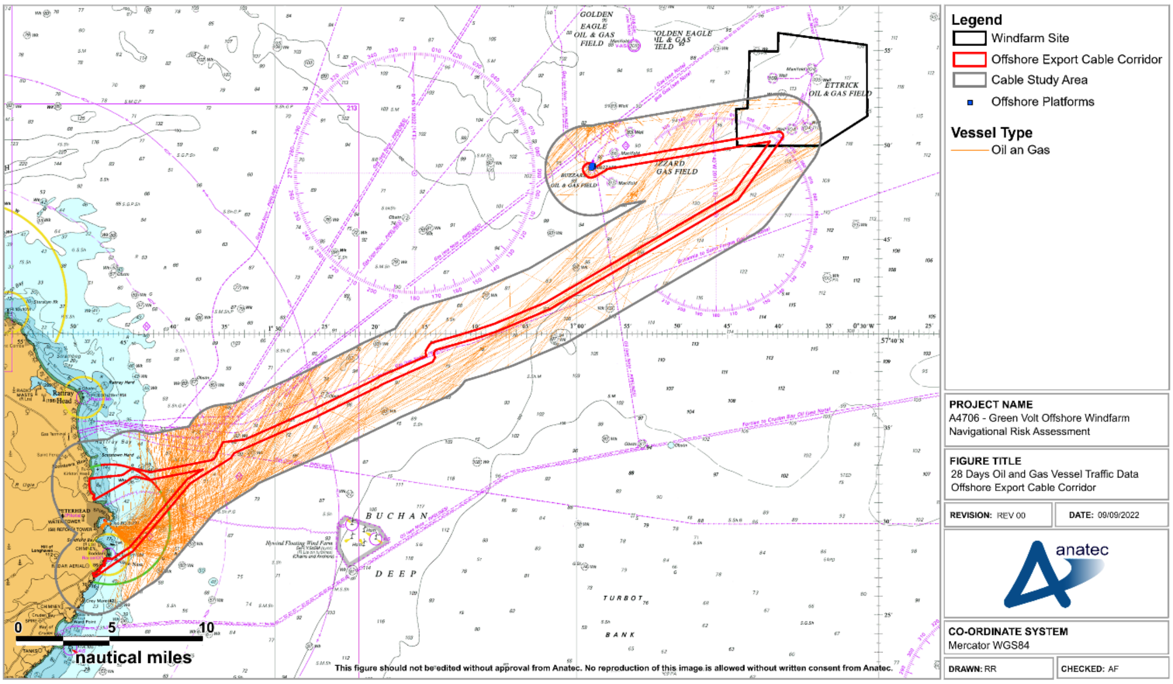


Figure 10.31: 28 Days Oil and Gas Vessel Traffic

During the summer survey period an average of 14 unique oil and gas vessels per day were recorded within the Cable Study Area. During the winter survey period an average of 15 unique oil and gas vessels per day were recorded within the Cable Study Area.

The majority of oil and gas vessels were on transit noting some were involved in active operations at local oil and gas fields and platforms including Buzzard and Golden Eagle.

10.2.2.2 Fishing Vessels

Tracks of fishing vessels recorded within the Cable Study Area during both survey periods are presented in **Figure 10.32.**

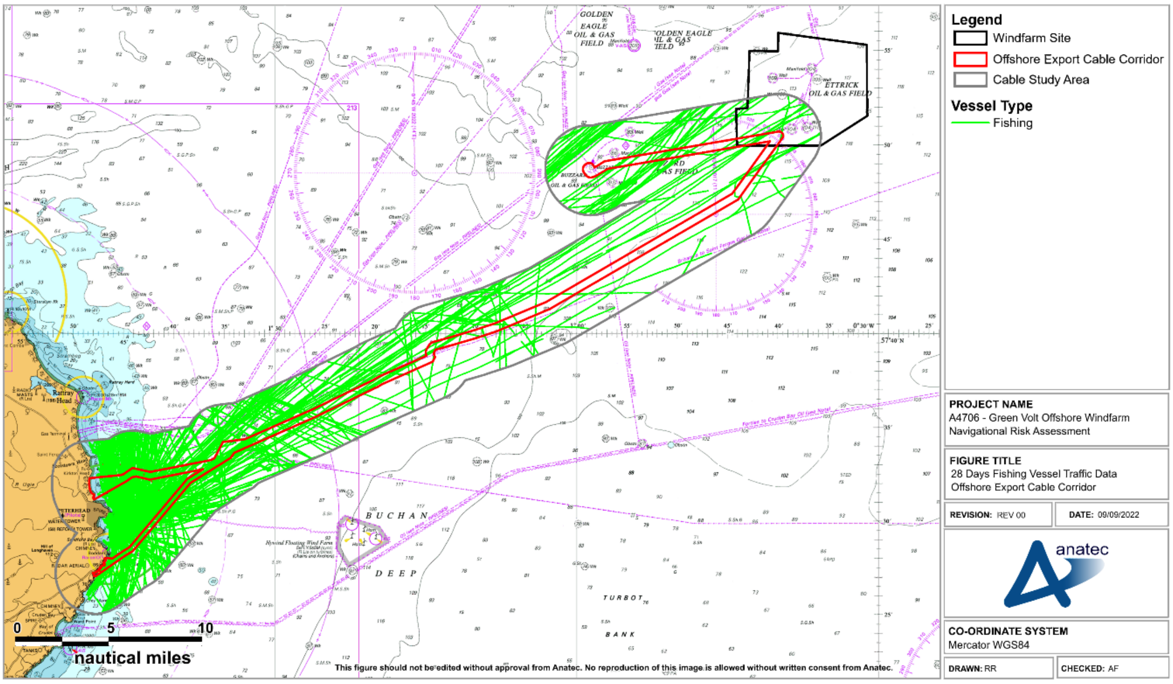


Figure 10.32: 28 Days Fishing Vessel Traffic

During the summer survey period an average of between 14 and 15 unique fishing vessels per day were recorded within the Cable Study Area. During the winter survey period an average of 12 unique fishing vessels per day were recorded within the Cable Study Area. The majority of fishing vessels on transit were either transiting to/from Peterhead port and although vessels numbers very higher in summer, seasonality in vessels was not greatly defined in the area.

Fishing vessels were predominately recorded on passage through the Cable Study Area as opposed to actively fishing, although instances of active fishing were also recorded close to shore at the west of the study area with occurrences of active fishing taking place in the Offshore Export Cable Corridor up to approximately 8 nm from the coast.

In addition to the vessel traffic survey data, VMS data recorded for the entirety of 2021 has also been analysed for the Cable Study Area. A density grid, using the VMS data during this period as input, is presented in **Figure 10.33.**

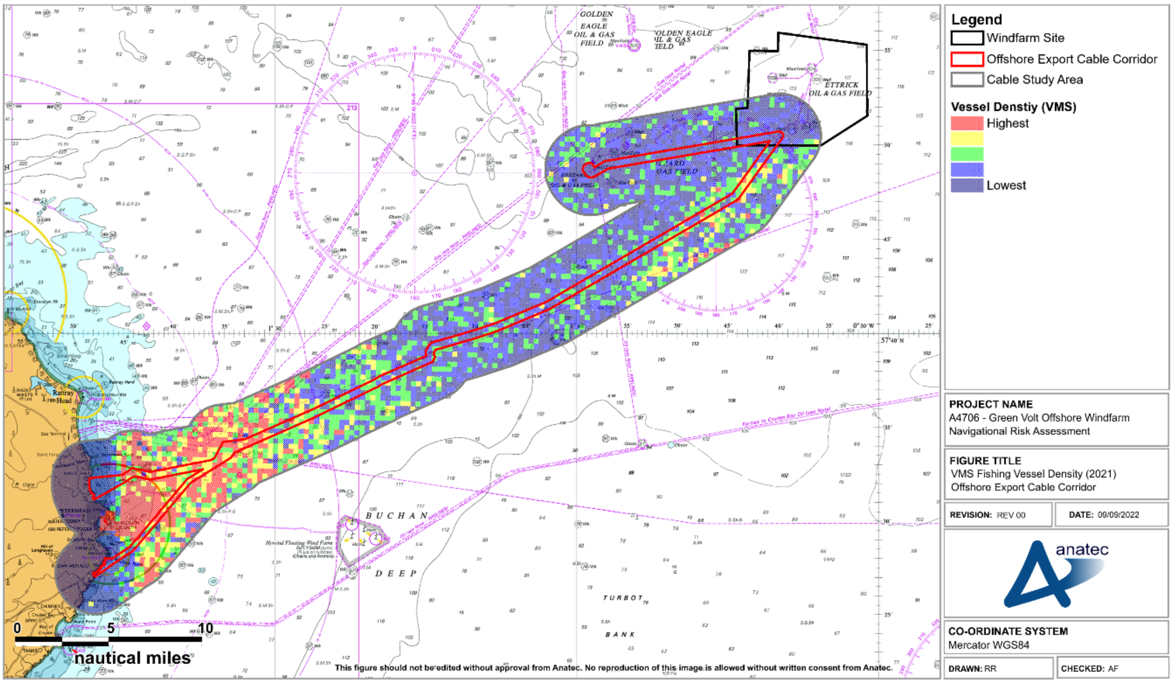


Figure 10.33: VMS Fishing Vessel Density within Offshore Export Cable Corridor (2021)

The highest density areas for fishing vessels throughout 2021 were coastal, with density decreasing in the offshore extent of the Cable Study Area. This correlates well with the AIS data.

10.2.2.3 Cargo Vessels

Tracks of cargo vessels recorded within the Cable Study Area during both survey periods are presented in **Figure 10.34.**

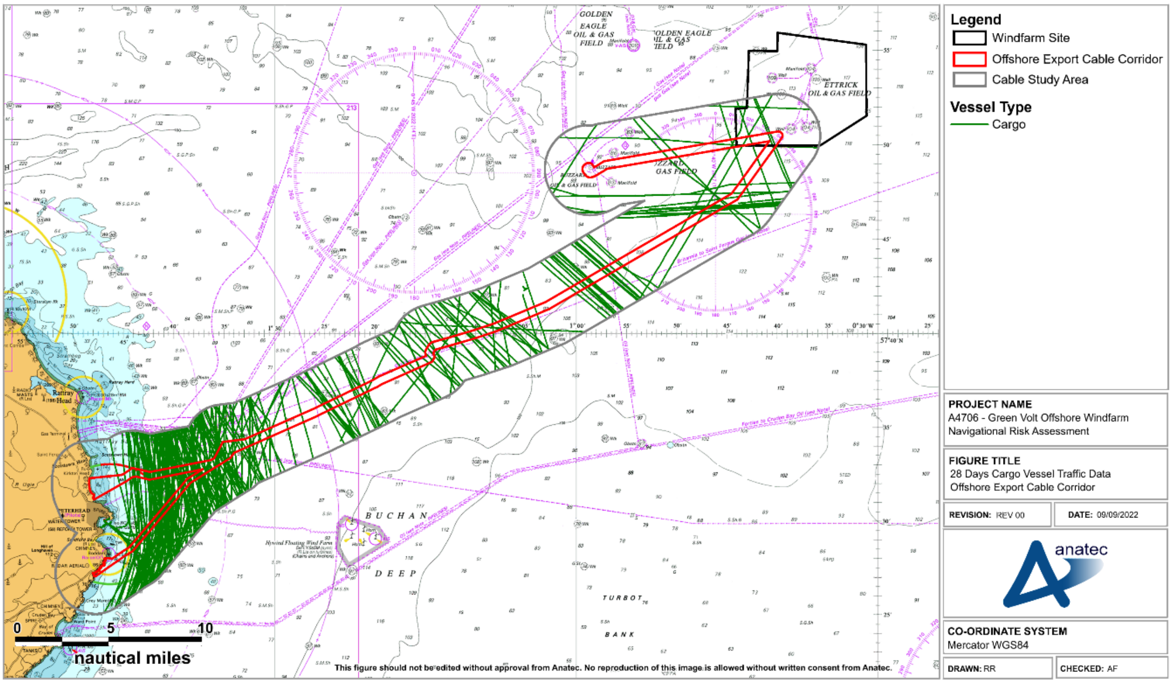


Figure 10.34: 28 Days Cargo Vessel Traffic

During the summer survey period an average of ten unique cargo vessels per day were recorded within the Cable Study Area. During the winter survey period an average of six unique cargo vessels per day were recorded. The majority of transits were observed to be coastal.

10.2.2.4 Tankers

Tracks of tankers recorded within the Cable Study Area during both survey periods are presented in **Figure 10.35**.

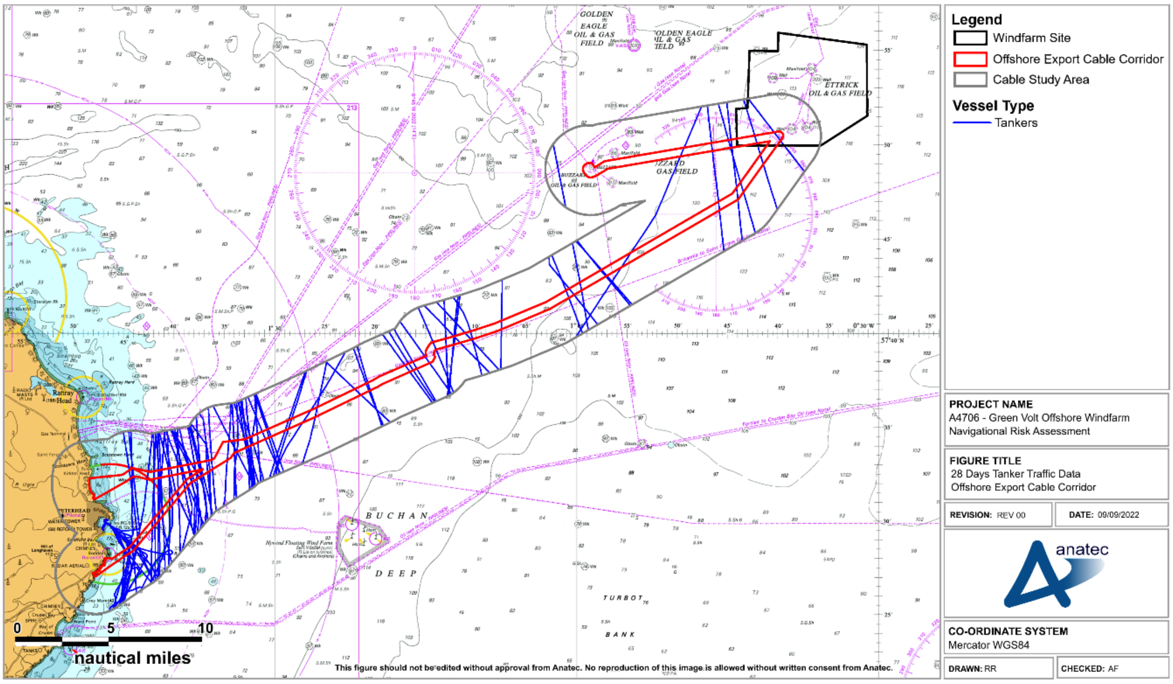


Figure 10.35: 28 Days Tanker Traffic

An average of three unique tankers per day within the Cable Study Area were recorded in both the summer and winter survey periods. The majority of transits were observed to be coastal.

10.2.2.5 Recreational Vessels

Tracks of recreational vessels recorded within the Cable Study Area during both survey periods are presented in **Figure 10.36.**

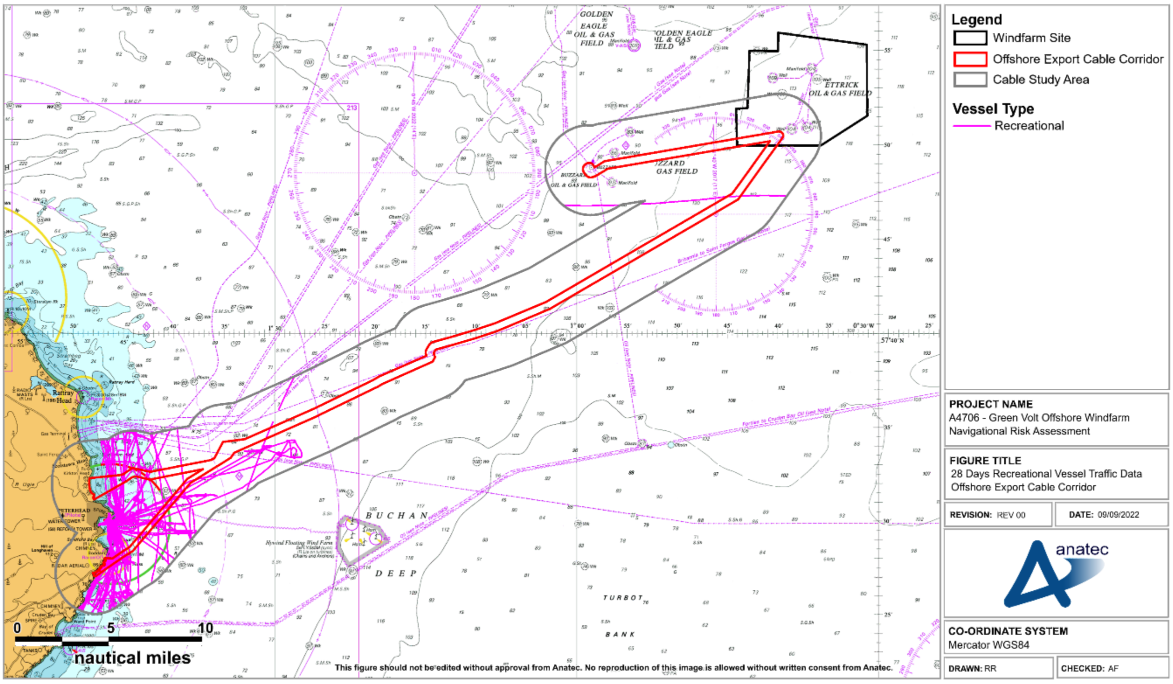


Figure 10.36: 28 Days Recreational Vessel Traffic

An average of three unique recreational vessels per day within the Cable Study Area were recorded during the summer survey period and one unique recreational vessel per day during the winter survey period. The majority of these vessels were coastal. This aligns well with the RYA Coastal Atlas (see Section 10.1.2.5) which indicates that transits further offshore are much less frequent than nearshore areas.

10.2.3 Anchored Vessels

After applying the same criteria to vessels recorded within the Cable Study Area as detailed in Section 10.1.3, no anchored vessels were identified during either survey period.

10.2.4 Vessel Size

10.2.4.1 Vessel Length

Vessel length information was available for approximately 99% of vessels recorded within the Cable Study Area. The distribution of vessel lengths recorded during both survey periods is presented in **Figure 10.37**.

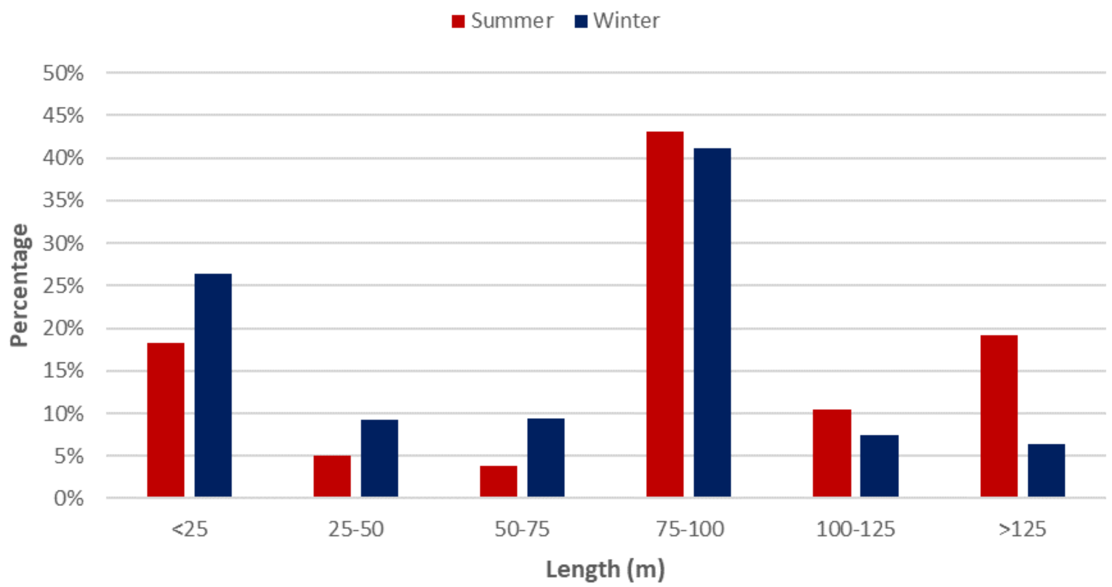


Figure 10.37: 28 Days Vessel Length Distribution

Excluding the proportion of vessels for which a length was not available the average length of vessels recorded within the Cable Study Area during the summer and winter survey periods was 97m and 70m respectively. The largest vessel recorded during the entire study period was a 348m passenger cruise liner heading to Kirkwall, UK on the 9th August 2021, and to Inverness on the 17th of August 2021.

The vessel tracks recorded during both survey periods are colour-coded by vessel length and presented in **Figure 10.38.**

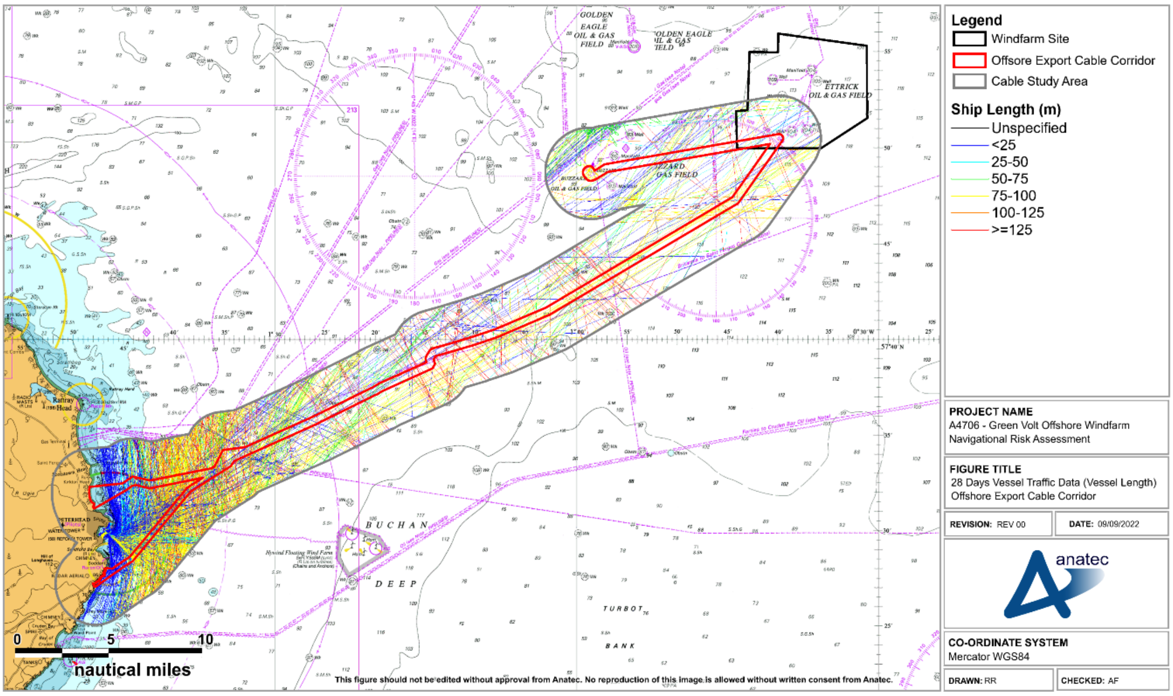


Figure 10.38: 28 Days Vessel Traffic Survey Data by Vessel Length

Vessels of larger length were typically cargo vessels were seen predominately on northwest-southeast routes distributed across the centre of the Cable Study Area. Smaller vessels were mainly fishing vessels and recreational vessels, with the majority remaining near the coast and near Peterhead Port.

10.2.4.2 Vessel Draught

Vessel draught information was available for approximately 69% of vessels recorded within the Cable Study Area. The distribution of vessel draughts recorded during both survey periods is presented in **Figure 10.39.**

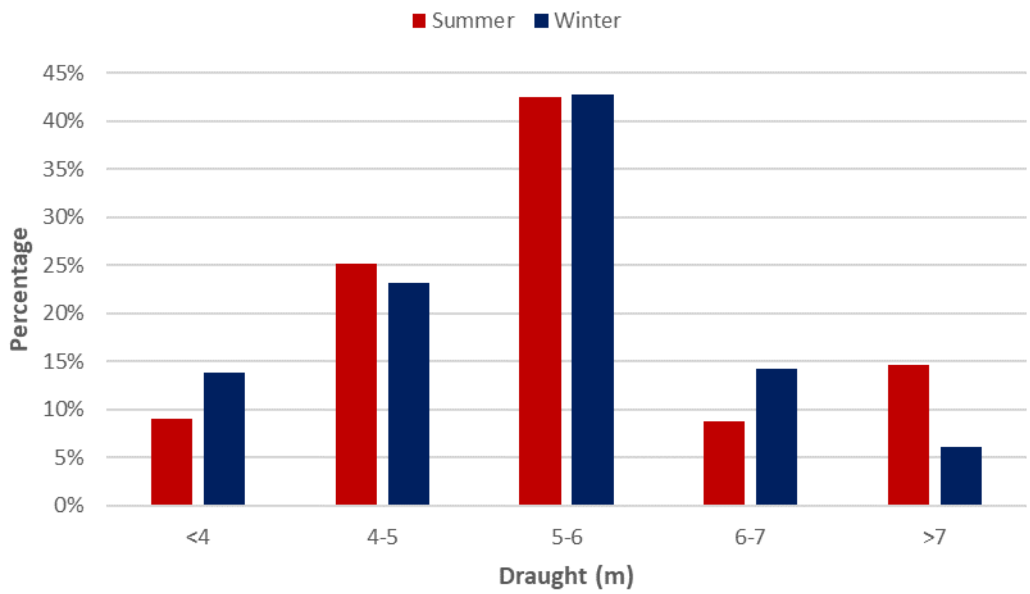


Figure 10.39: 28 Days Vessel Draught Distribution

Excluding the proportion of vessels for which a draught was not available the average draught of vessels recorded within the Cable Study Area during the summer and winter survey periods was 5.6m and 5.2m respectively. The vessel with the largest draught recorded during the entire study period was a bulk carrier, with a draught of 15m, heading to Aberdeen anchorage area on the 5th August 2021.

The vessel tracks recorded throughout both survey periods are colour-coded by vessel draught and presented in **Figure 10.40.**

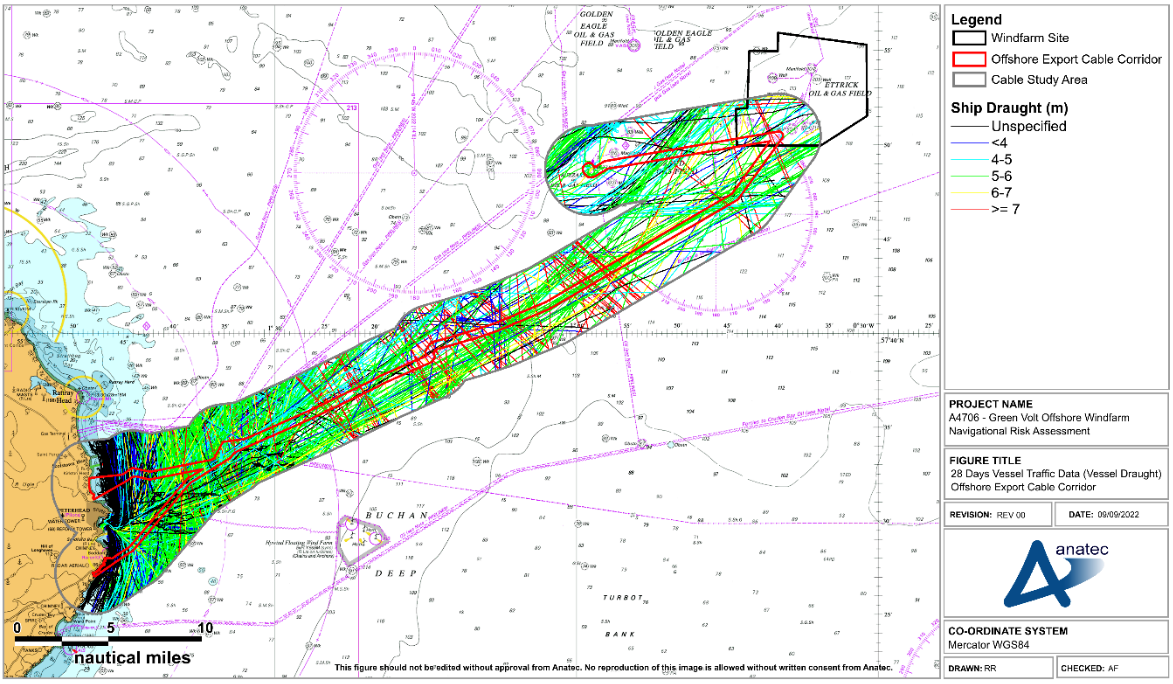


Figure 10.40: 28 Days Vessel Traffic Survey Data by Vessel Draught

Vessels of larger draught were mostly cargo vessels and were seen predominately on northwest-southeast routes distributed across the Cable Study Area. Vessels with smaller draughts were mainly fishing vessels, wind farm vessels and cargo vessels. The majority of these vessels remained coastal.

11 Base Case Vessel Routeing

11.1 Main Routes

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 can also be 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 median line of the potential shipping route as shown in **Figure 11.1.**

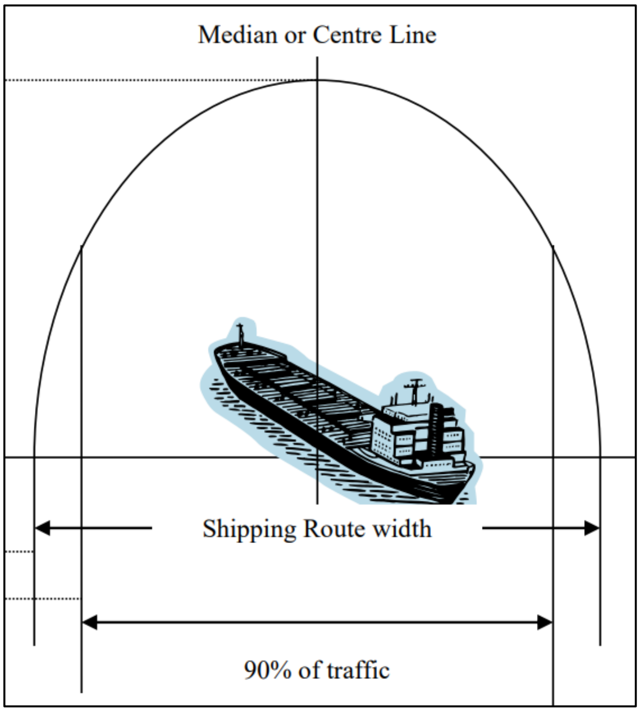


Figure 11.1: Illustration of Main Route Calculation (MCA, 2021)

A total of ten main commercial routes were identified within the study area from the vessel traffic survey data. These main commercial routes and corresponding 90th percentiles within the study area are shown relative to the Windfarm Site in **Figure 11.1**. Following this, a description of each route is provided in **Table 11.1**, including the average number of vessels per day, route terminus locations, and main vessel types. It is noted that the terminus points shown are based on the most common destinations transmitted via AIS by vessels on those routes.

Lower use or seasonally based routes have still been captured within the modelling process via both the AIS data and Anatec's ShipRoutes database (Anatec, 2022).

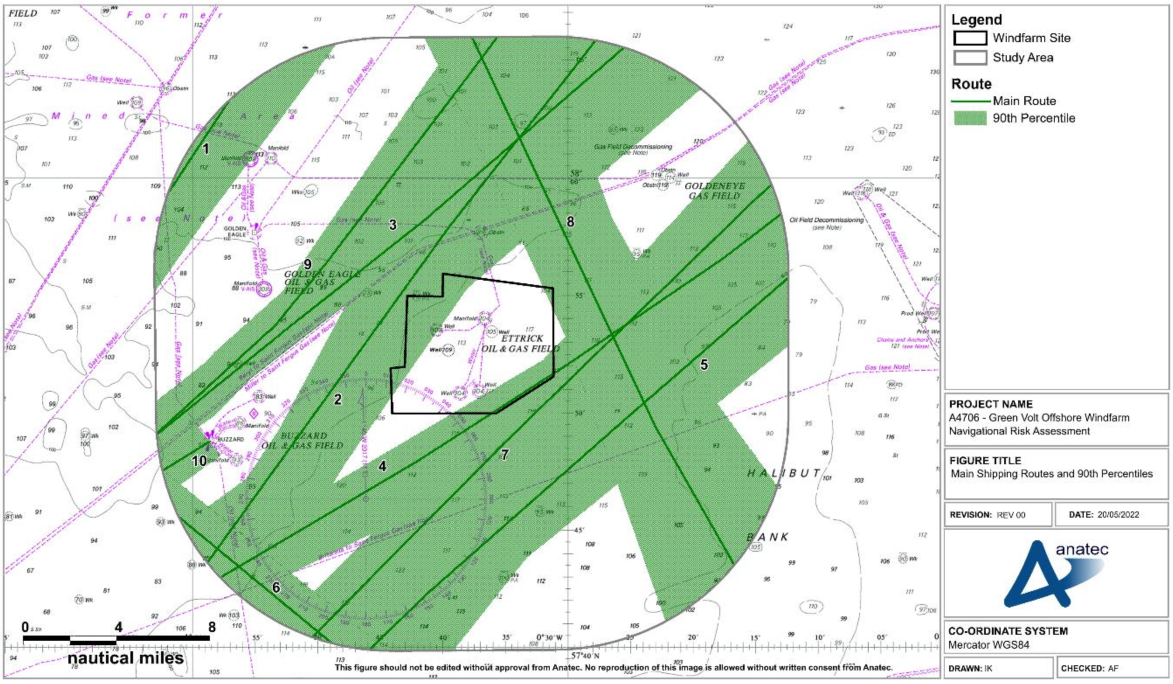


Figure 11.2: Main Commercial Routes and 90th Percentiles within Study Area

Table 11.1: Main Route Details

Route Number	Average Vessels per day	Description
1	2	**Aberdeen/Peterhead – Oil and Gas Fields.** Primarily Oil and Gas Vessels (96%)
2	1	**Aberdeen – Piper B Platform.** Primarily Oil and Gas Vessels (88%)
3	1	**Aberdeen/Peterhead – Scott Platform.** Primarily Oil and Gas Vessels (>99%)
4	1	**Peterhead – Donan Field.** Primarily Oil and Gas Vessels (96%)
5	0-1	**Aberdeen – Tiffany Field.** Primarily Oil and Gas Vessels (91%)
6	0-1	**Canadian Ports – German Ports.** Primarily Cargo Vessels (79%)
7	0-1	**Aberdeen – Brae Platforms.** Primarily Oil and Gas Vessels (93%)
8	0-1	**Sullom Voe – Rotterdam.** Primarily Tankers (56%) and Cargo Vessels (30%)
9	0-1	**Aberdeen – Harding Platform.** Primarily Oil and Gas Vessels (89%)
10	0-1	**Peterhead – Buzzard Platform.** All Oil and Gas Vessels (100%)

11.2 Adverse Weather Routeing

Adverse weather includes wind, wave, and tidal conditions as well as reduced visibility due to fog that can hinder a vessel's standard route and/or speed of navigation. Adverse weather routes taken for safety reasons 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 will depend upon various factors, including stability parameters, hull geometry, vessel type, vessel size, and speed.

General concern over adverse weather routeing was raised during consultation, including the recreational vessel outreach (Section 4.2.5), the Regular Operators outreach (Section 4.2.3), and the Hazard Workshop (Section 4.2.4). Associated discussions are provided in Section 11.2.1 for commercial vessels and Section 11.2.2 for recreational vessels.

11.2.1 Adverse Weather Routeing for Commercial Vessels

No clearly defined adverse commercial vessel weather routeing was identified within the vessel traffic survey data (Section 10) or raised during consultation (other than as a general concern). It should be considered that the data captured only covers a 28 day period as per Section 10. This does include a winter period (January 2022), however it may not be comprehensive of all adverse weather movements.

This included, Scotline who raised a general concern over loss of searoom for commercial vessels, particularly in relation to adverse weather. The tracks recorded from Scotline vessels during the 28 days of vessel traffic surveys (see Section 10) are shown in **Figure 11.3**.

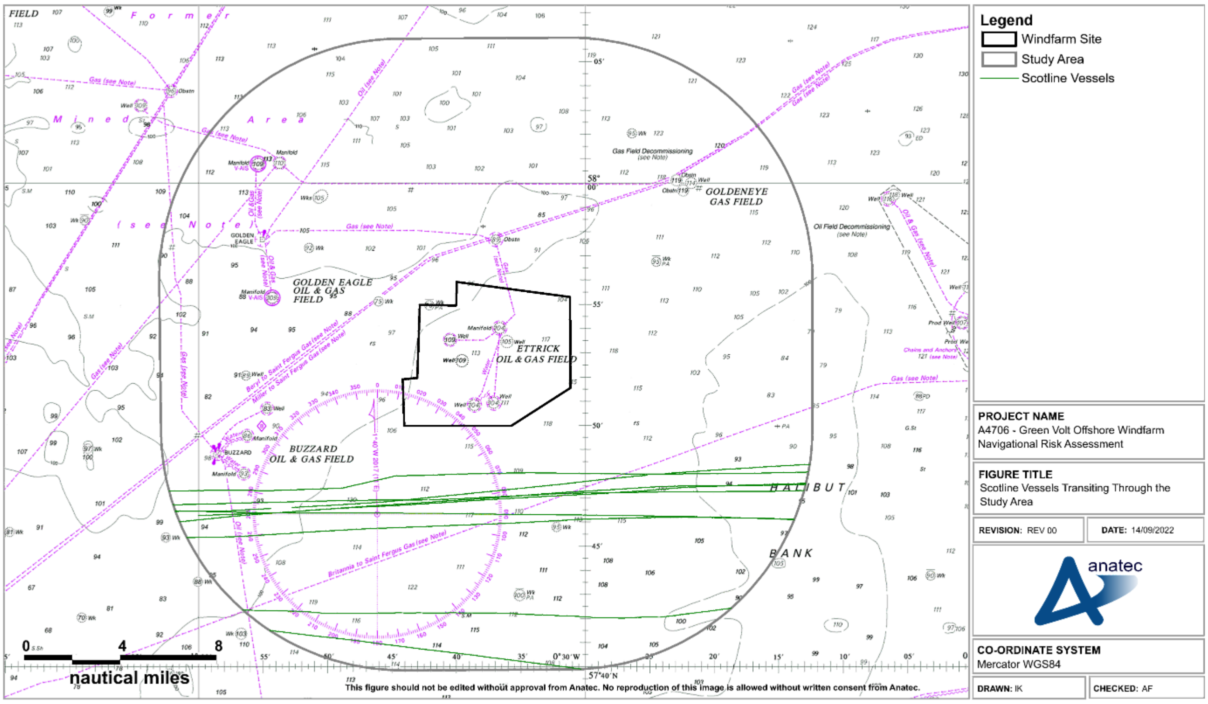


Figure 11.3: Scotline Vessels

As shown, all Scotline vessels recorded passed south of the Windfarm Site. This is likely due to these vessels choosing transit to avoid the existing surface oil and gas infrastructure, most notably that associated with the Buzzard field.

As above, it should be considered that the data may not be comprehensive of all adverse weather transits. However, it is considered unlikely that vessels would choose to pass in closer proximity to the existing surface oil and gas infrastructure in adverse weather. Post wind farm installation should commercial vessels choose to pass further south in adverse weather to increase passing distance from the structures within the Windfarm Site (and the oil and gas infrastructure), there is sufficient sea room to accommodate such transits.

11.2.2 Adverse Weather Routeing for Recreational Vessels

Recreational stakeholders noted during consultation that recreational vessels would likely avoid the Windfarm Site during periods of adverse weather. Concern was greatest for transits from mainland Europe to the UK, given that forecasts upon which advanced passage planning were based were more likely to change than for transits from the UK given distance from shore. As for commercial vessels, there is sufficient sea room to accommodate transits that pass further south to increase passing distance from the Windfarm Site. Additionally, it is noted that input received during consultation was that any users this far offshore were likely to be experienced mariners on well-equipped vessels.

12 Navigation, Communication, and Position Fixing Equipment

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 Project.

12.1 Very High Frequency Communications (including DSC)

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 VHF transceivers (including Digital Selective Calling (DSC)) when operated close to WTGs.

The WTGs 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 WTGs, then it is reasonable to assume that larger vessels with higher powered and more efficient systems would also be unaffected.

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

Furthermore, as part of SAR trials carried out at the North Hoyle Offshore Wind Farm in 2005, radio checks were undertaken between the Sea King helicopter and both Holyhead and Liverpool coastguards. The aircraft was positioned offshore of the Windfarm Site 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).

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).

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 Project is anticipated to have no significant impact upon VHF communications.

12.2 Very High Frequency Direction Finding

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

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 1 nm, the homer system operated as expected with no apparent degradation.

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

12.3 Navigational Telex System

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.

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.

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.

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 Project.

12.4 Global Positioning System

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

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).

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

12.5 Electromagnetic Interference

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 can be used to calculate heading, used with a sextant to calculate latitude, and with a marine chronometer to calculate longitude.

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.

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 Project will have a significant impact on vessel navigation. However, some smaller craft (fishing or leisure) may rely on it as their sole means of navigation.

12.5.1 Subsea Cables

The subsea cables for the Project will be Alternating Current (AC), with studies indicating 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 cables associated with the Project are not considered any further.

12.5.2 Wind Turbine Generators

MGN 654 (MCA, 2021) notes that small vessels with simple magnetic steering and hand bearing compasses should be wary of using these close to WTGs 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.

12.5.3 Experience of Operational Wind Farms

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.

12.6 Marine Radar

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, WTG technology has advanced significantly, most notably in terms of the size of WTGs available to be installed and utilised. The use of these larger WTGs allows for a greater spacing between WTGs 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.

12.6.1 Trials

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 WTGs on the use and effectiveness of marine Radar.

In 2004 trials undertaken at the North Hoyle Offshore Wind Farm (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 WTGs (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).

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 1.5 nm) 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 12.1.**

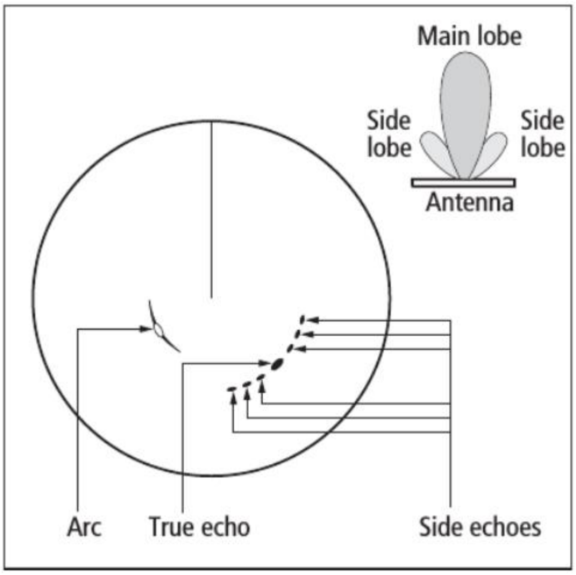


Figure 12.1: Illustration of side lobes on Radar screen

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 12.2.**

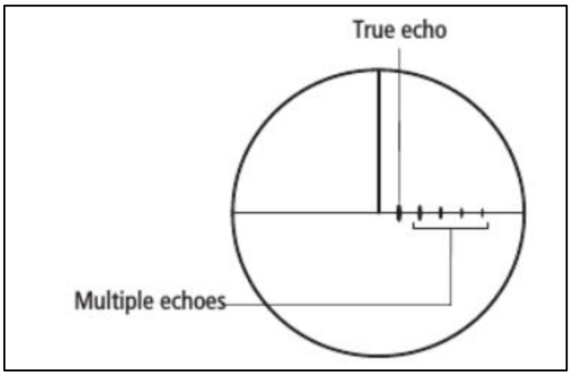


Figure 12.2: Illustration of multiple reflected echoes on Radar screen

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 more recent Shipping Route Templates, including the most recent contained within MGN 654 (MCA, 2021).

A second set of trials conducted at Kentish Flats Offshore Wind Farm in 2006 on behalf of the British Wind Energy Association (BWEA – now called RenewableUK) (BWEA, 2007) – also found that Radar antennas which are sited unfavourably with respect to components of the vessel's structure can 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.

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 WTGs than that considered within the early trials[2]. 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 WTGs and safe navigation;
- Even in the worst case with Radar operator settings artificially set to be poor, there is significant clear space around each WTG 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;

[2] 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 WTGs 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 WTGs 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 and recreational craft). It is noted that this situation would arise with or without WTGs 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.

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 can be effectively mitigated by "careful adjustment of Radar controls".

The MCA has also produced guidance to 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 12.1** are based on MGN 654 (MCA, 2021), MGN 371 (MCA, 2008), MGN 543 (MCA, 2016) and MGN 372 (MCA, 2008).

Table 12.1: Distances at which Impacts on Marine Radar Occur

Distance at Which Effect Occurs (nm)	Identified Effects
0.5	▪ Intolerable impacts can be experienced. ▪ X-Band Radar interference is intolerable under 0.25 nm. ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45 nm.

Distance at Which Effect Occurs (nm)	Identified Effects
1.5	▪ Under MGN 654, impacts on Radar are considered to be tolerable with mitigation between 0.5 and 3.5 nm. ▪ S-band Radar interference starts at 1.5 nm. ▪ Echoes develop at approximately 1.5 nm, 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 WTGs. ▪ The WTGs produce strong Radar echoes giving early warning of their presence. ▪ Target size of the WTG echo increases close to the WTG with a consequent degradation on both X and S-Band Radars.

As noted in **Table 12.1**, the onset range from the WTGs of false returns is approximately 1.5 nm, with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the Convention on 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 VTS or AIS (MCA, 2016).

12.6.2 Experience from Operational Developments

The evidence from mariners operating in proximity to existing offshore wind farms is that they quickly learn to adapt to any effects. **Figure 12.3** 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 who operate within the vicinity. The interference buffers presented in **Figure 12.3** are as per **Table 12.1**.

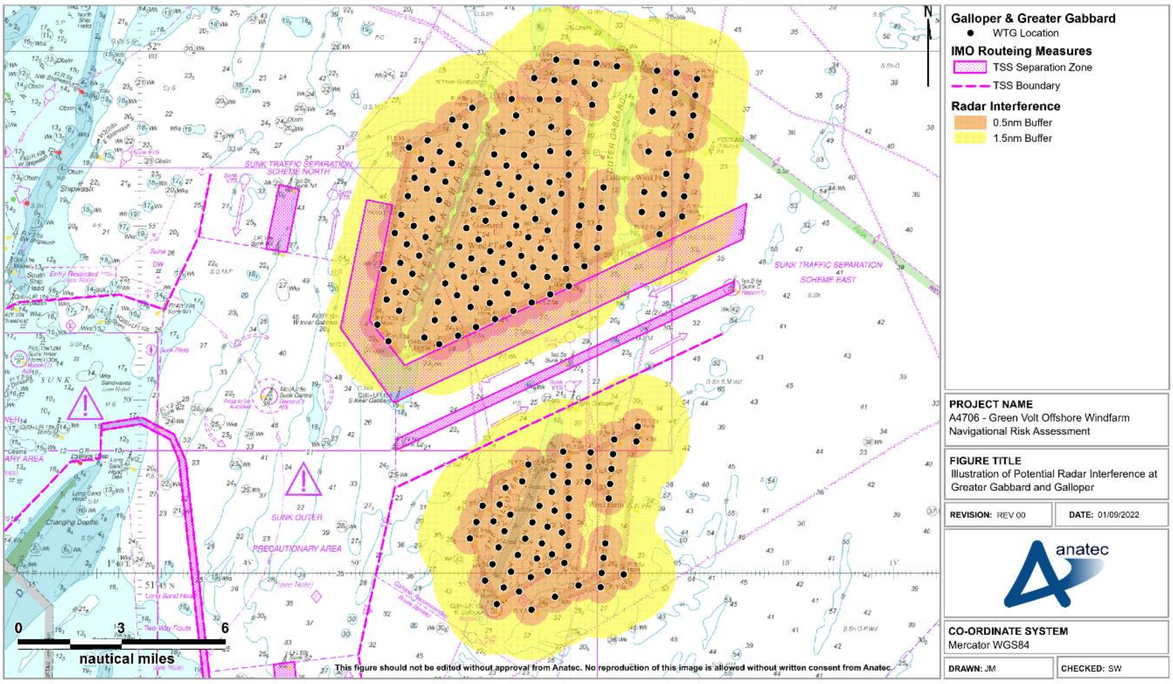


Figure 12.3: Illustration of potential Radar interference at Greater Gabbard and Galloper Offshore Wind Farms

As indicated by **Figure 12.3**, vessels utilising these TSS lanes will experience some Radar interference based on the available guidance. Both developments are operational, and each of the lanes is used by a minimum of five 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.

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.

12.6.3 Increased Radar Returns

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.

Larger WTGs (either in height or width) will 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. Therefore, increased WTG height in the Windfarm Site will not create any effects in addition to those already identified from existing operational wind farms (interfering side lobes, multiple and reflected echoes).

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 can be managed effectively.

12.6.4 Fixed Radar Antenna Use in proximity to an Operational Wind Farm

It is noted that there are multiple operational 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.

12.6.5 Application to the Project

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

Figure 12.4 presents an illustration of potential Radar interference due to the Project relative to the post wind farm routeing illustrated in Section 14.5. The Radar effects have been applied to the layout introduced in Section 6.2.1. As shown, vessels on routes closest to the Windfarm Site may pass within 1.5nm.

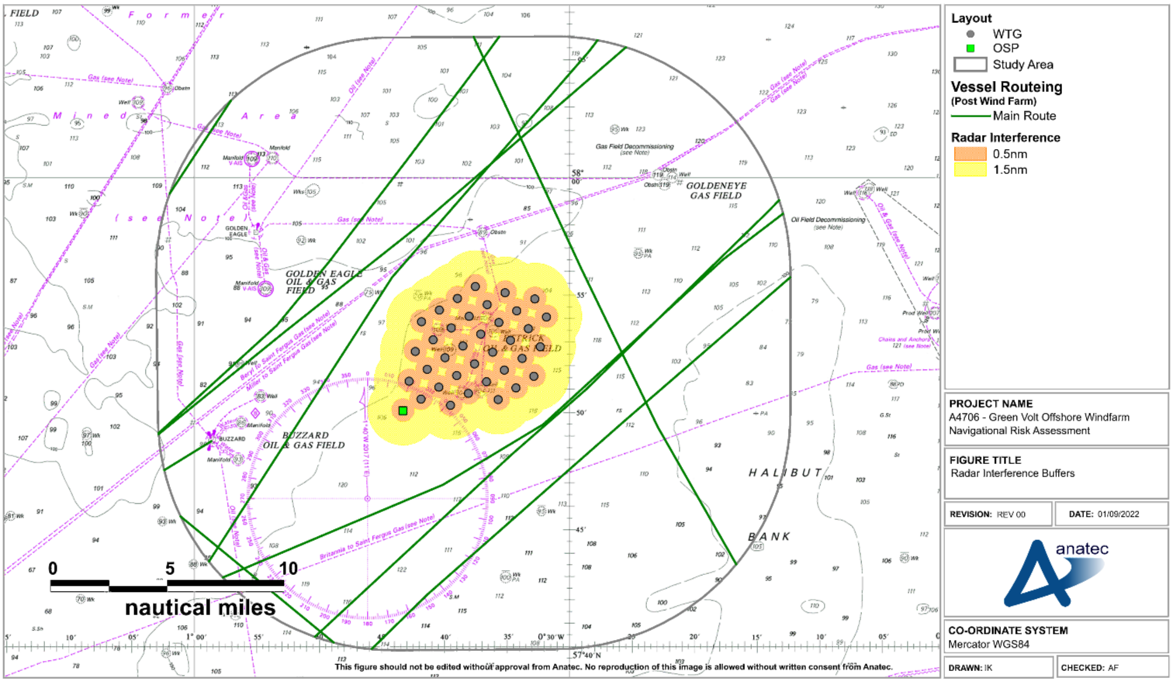


Figure 12.4: Radar Interference Illustration

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

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

12.7 Sound Navigation Ranging System

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 Project.

12.8 Noise

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.

12.9 Summary of Potential Effects on Use

Based on the detailed technical assessment of the effects due to the presence of the Project on navigation, communication and position fixing equipment in the previous subsections, **Table 12.2** summarises the assessment of frequency and consequence and the resulting risk for each component of this impact. On the basis of these findings, associated risks are screened out of the risk assessment undertaken in Sections 17, 18 and 19.

Table 12.2: Summary of risk to navigation, communication and position fixing equipment

Topic	Frequency	Consequence	Significance of Risk
VHF	Negligible	Minor	Broadly Acceptable
VHF direction finding	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

13 Cumulative and Transboundary Overview

Cumulative effects have been considered for activities in combination and cumulatively with the Project. This section provides an overview of the baseline used to inform the cumulative risk assessment, including the developments screened into the cumulative risk assessment based on the criteria outlined in Section 3.3.

The outputs of the cumulative risk assessment are then provided in Section 20.

13.1 Offshore Wind Farms

The cumulative screening process of offshore wind farms based on the criteria outlined in Section 3.3 is summarised in **Table 13.1**. Following this, **Figure 13.1** presents the screened in projects. Baseline projects within 50nm have been included for reference.

Table 13.1: Cumulative Screening Summary

Project	Status	Distance to Windfarm Site (nm)	Data Confidence	Tier
Marram	Pre-scoping	4.8	High	3
Salamander	Pre-scoping	18.0	High	3
Buchan	Pre-scoping	26.2	High	3
Mara Mhor	Pre-scoping	21.3	High	3
Broadshore	Pre-scoping	34.3	High	3
Campion	Pre-scoping	25.1	High	3

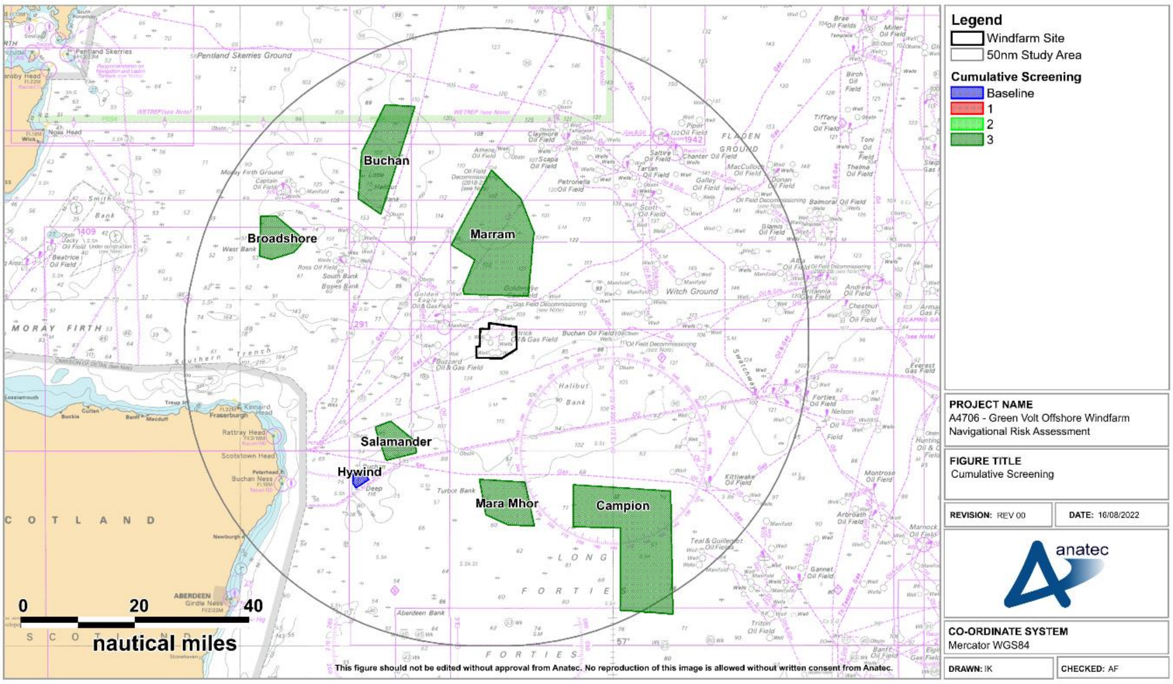


Figure 13.1: Offshore Wind Farm Cumulative Screening

13.2 Oil and Gas

The only Oil and Gas development screened into the assessment is the Acorn Carbon Capture Storage (CSS) project. This development will repurpose existing subsea infrastructure in addition to new subsea installations, and is expected to be operational by the mid 2020s. Given all new associated infrastructure is understood to be subsea, any impact on routeing will be temporary and spatially limited whenever construction or maintenance works involving surface vessel presence is being undertaken. On this basis the Acorn CCS has not been considered within the cumulative routeing assessment (see Section 14.6) however it has been considered where appropriate in the cumulative risk assessment (see Section 20).

14 Future Case Vessel Traffic

14.1 Increases in Commercial Vessel Activity

Given future commercial traffic trends are dependent on various factors, and are hence difficult to predict, the NRA has assumed potential increases of 10 and 20% within the commercial traffic allision and collision modelling. The consideration of a range of conservative values is considered as covering potential increases over the course of the Project's operational lifespan.

It should be considered that there may increases in certain vessel types associated with the Aberdeen Harbour expansion. The future case values above have been applied to all vessel types and noting a range of values has been assessed are considered as remaining conservative assumptions in this regard.

14.2 Increases in Commercial Fishing Activity

Indicative 10 and 20% increases in commercial fishing vessel transits have been considered in the modelling undertaken within the NRA. This value is used due to there being limited reliable information on future activity levels upon which any firm assumption can be made. It is noted that additional information on commercial fishing trends are contained within **Chapter 15: Commercial Fisheries.**

14.3 Increases in Recreational Activity

There are no known developments which will increase the activity of recreational vessels within the area. Therefore, as with commercial fishing activity, given the lack of reliable information relating to future trends, a range of 10% and 20% increase is considered conservative, and has therefore been applied.

14.4 Increase associated with Project Activities

The anticipated number of vessels associated with the Project during the construction and operation and maintenance phases are presented in Section 6.5.

14.5 Commercial Traffic Routeing (Project in Isolation)

14.5.1 Methodology

It is not possible to consider all potential alternative routeing options for commercial traffic and therefore alternatives have been based upon worst case assumptions to ensure exposure to wind farm structures is maximised.

Assumptions for re-routeing include:

- All alternative routes maintain a minimum mean distance of 1 nm 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 account known routeing preferences including consideration of banks/shallows and AtoNs.

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

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 1 nm 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 1 nm off established developments.

The NRA also aims to establish the MDS based on navigational safety parameters. On this basis the most conservative realistic scenario for vessel routeing is considered to be mean route positions passing 1 nm 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.

14.5.2 Main Commercial Route Deviations

An illustration of the anticipated worst case shift in the mean positions of the main commercial routes identified within the study area (see Section 11) following the development of the Project is presented in **Figure 14.1**. These deviations are based on the methodology set out within Section 14.5.1. Following this, **Table 14.1** provides the magnitude of the deviations.

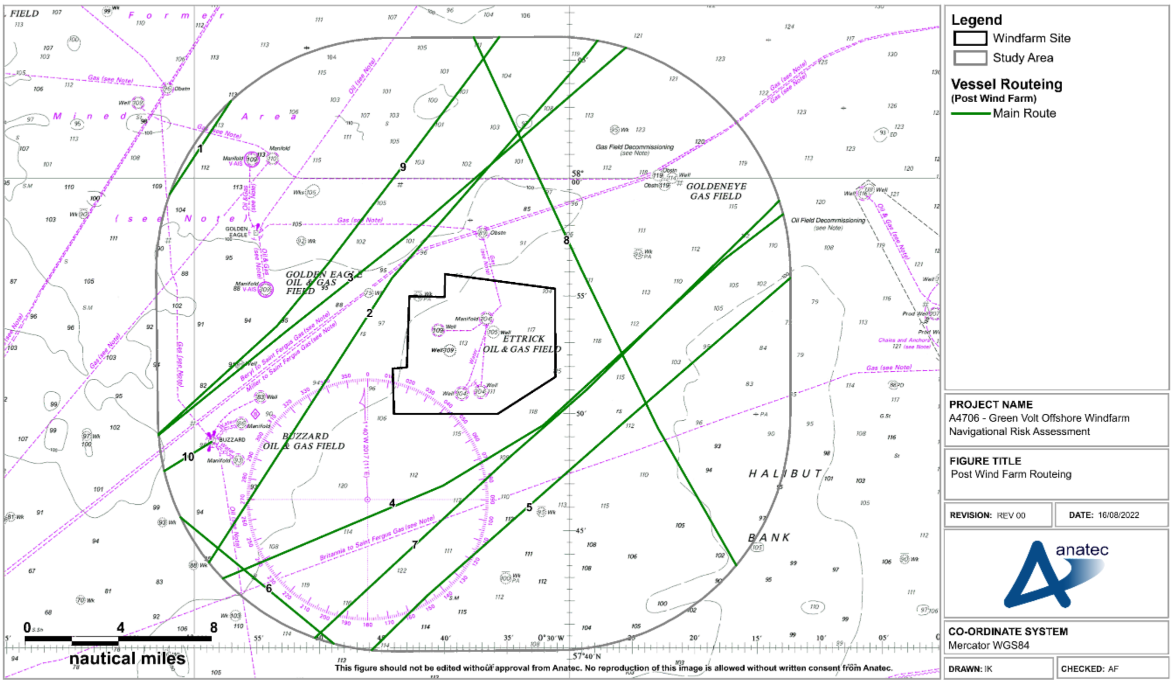


Figure 14.1: Post Wind Farm Routeing

Of the ten main routes identified, three were anticipated to require a deviation to account for the Windfarm Site (Routes 2, 4 and 7). However, as shown in **Table 14.1**, the magnitude of the deviations is low for all three routes, with the maximum percentage increase being 0.3% for Route 4. It should also be considered that the total numbers of affected vessels is also low, with each of these three routes being used by a maximum of one vessel per day.

Table 14.1: Deviation Summary

Route	Vessels per Day	Approximate Distance (nm)		Change	
		Pre Wind Farm	Post Wind Farm	Absolute (nm)	Percentage
2	1	110.2	110.3	0.1	0.1%
4	1	99.2	99.5	0.3	0.3%
7	< 1	142.0	142.0	< 0.1	< 0.1%

14.6 Commercial Traffic Routeing (Cumulative)

As per Section 13.1, five offshore wind farms have been screened into the NRA cumulative assessment, all as Tier 3 projects given none are scoped at the time of writing[3]:

- Marram;
- Salamander;
- Buchan;

[3] Sept 2022.

- Mara Mhor; and
- Broadshore.

Given the screened in developments are all Tier 3 and pre scoping, it should be considered that there is low confidence in the current publicly available site boundaries. Therefore, as per the Methodology set out in Section 3.3, qualitative assessment of potential cumulative routeing has been made.

Table 14.2 provides a summary of the screened in developments that each main route identified (see Section 11.1) has the potential to interact with assuming pre wind farm routeing patterns.

Table 14.2: Cumulative Routeing Interaction Summary

Route Number	Average Vessels per day	Green Volt	Marram	Salamander	Buchan	Mara Mhor	Broadshore	Campion
1	2	×	✓	×	×	×	×	×
2	1	✓	✓	✓	×	×	×	×
3	1	×	✓	×	×	×	×	×
4	1	✓	×	✓	×	×	×	×
5	0-1	×	×	×	×	×	×	×
6	0-1	×	×	×	×	✓	×	✓
7	0-1	✓	×	✓	×	×	×	×
8	0-1	×	✓	×	×	✓	×	✓
9	0-1	×	✓	×	×	×	×	×
10	0-1	×	×	×	×	×	×	×

Based on the cumulative routeing assessment, potential cumulative deviations of each main route are as follows:

- **Route 1:** it is considered likely vessels on this route will deviate further west to pass inshore of Marram. Noted that this route is not affected by the Project.
- **Route 2:** vessels on this route are anticipated to either pass between Green Volt and Marram, or pass offshore of Green Volt.
- **Route 3:** vessels on this route are anticipated to either pass between Green Volt and Marram, or pass offshore of Green Volt.
- **Route 4:** it is considered likely vessels on this route will make minor deviations to pass north of Salamander and south of Green Volt.

- **Route 5:** no deviations required.
- **Route 6:** vessels on this route are likely to either pass between Mara Mhor and Campion, or pass offshore of both. Noted that this route is not affected by the Project.
- **Route 7:** it is considered likely vessels on this route will make minor deviations to increase passing distances from Salamander and Green Volt.
- **Route 8:** vessels on this route may choose to deviate further east to pass offshore of Marram , Mara Mhor and Campion. Noted that these deviations are unaffected by the Project.
- **Route 9:** vessels on this route may choose to pass inshore of Marram, or may choose to pass offshore of Marram (either between Marram and Green Volt or offshore of both Projects).
- **Route 10:** no deviations required.

In summary, while certain routes are likely to require deviation on a cumulative basis, there is considered to be suitable sea room to safely accommodate the potential deviations. It is also noted that the relevant routes do not equate to a large volume of commercial traffic.

15 Allision and Collision Risk Modelling

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

15.1 Hazards under Consideration

Hazards considered in the quantitative assessment are as follows:

- Increased vessel to vessel collision risk;
- Powered vessel to structure allision risk;
- Drifting vessel to structure allision risk; and
- Fishing vessel to structure allision risk.

It is noted that additional assessment in relation to interaction with the mooring lines has also been undertaken in Section 15.6, however the associated risk has not been modelled.

15.2 Scenarios under Consideration

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

- Pre wind farm with base case traffic levels;
- Pre wind farm with future case traffic levels;
- Post wind farm with base case traffic levels; and
- Post wind farm with future case traffic levels.

15.3 Pre Wind Farm

15.3.1 Vessel to Vessel Encounters

An assessment of 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 10). The model defines an encounter as two or more vessels passing within 1 nm of each other within the same minute. This helps to illustrate where existing vessel traffic 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 accounted for.

To ensure the assessment is focused on genuine vessel encounters, certain scenarios have been removed if identified, noting that if there was doubt around whether an encounter was genuine it has been retained:

- Pair trawling;

- Towing operations; and
- Vessels stationed at O&G platforms.

A total of 66 genuine encounters were identified on this basis, equating to an average of 2-3 per day. The identified encounters are presented in **Figure 15.1** colour coded by vessel type. Following this, a heat map showing encounter density is shown in **Figure 15.2.**

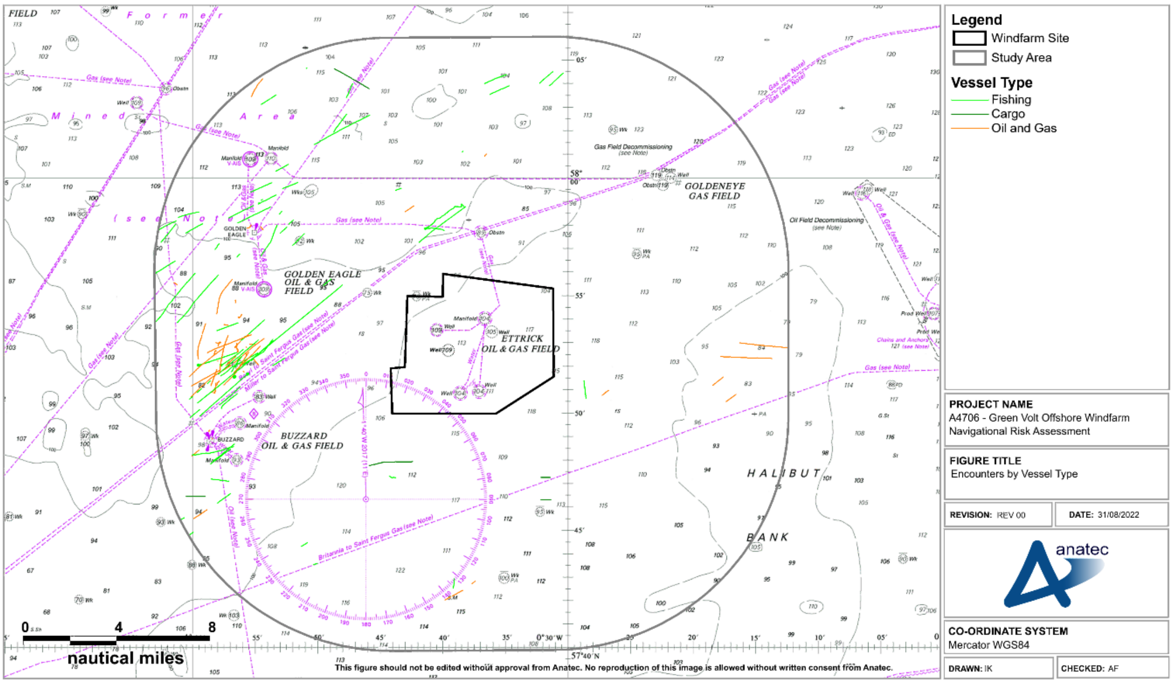


Figure 15.1: Encounters by Vessel Type

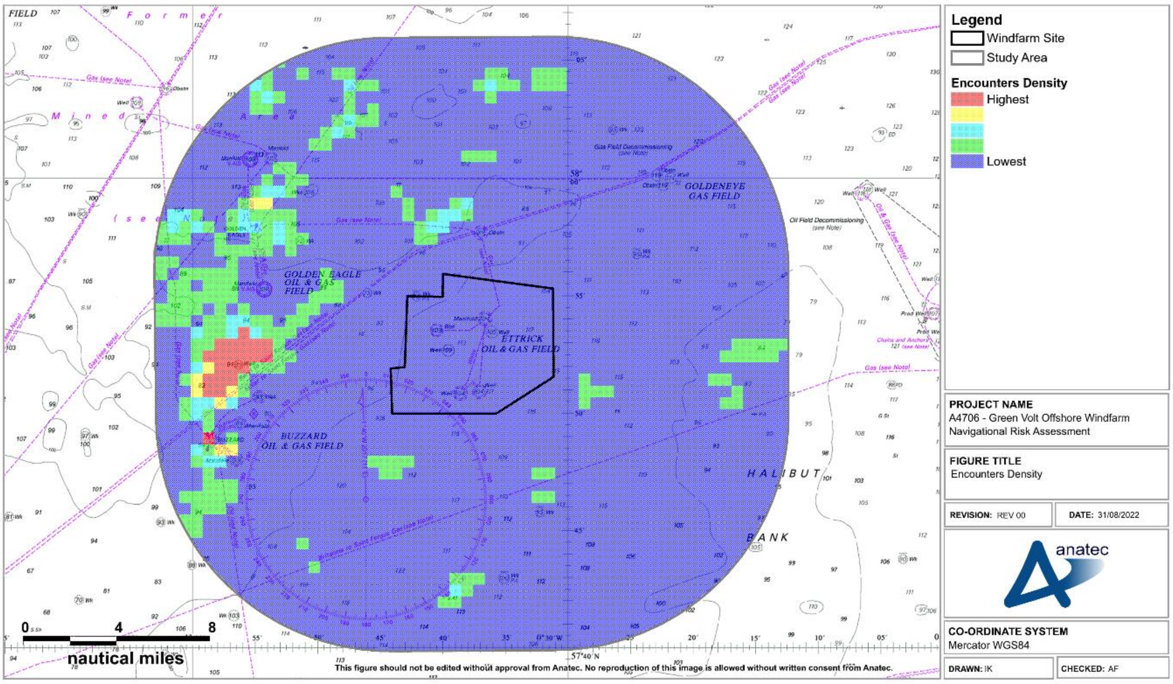


Figure 15.2: Encounter Density

High density areas in terms of encounters were observed to be largely associated with oil and gas vessels at the Buzzard and Golden Eagle fields, and fishing vessels transiting through the western extent of the study area. These vessel types accounted for the majority of vessels involved in the identified encounters, with 51% being fishing vessels and 45% being associated with Oil and Gas. The remaining 4% were cargo vessels.

15.3.2 Vessel to Vessel Collisions

Using the pre wind farm vessel routeing as input (see Section 11), Anatec's COLLRISK model has been run to estimate the existing vessel to vessel collision risk in proximity to the Windfarm Site.

A heat map based upon the geographical distribution of collision risk within a 0.5×0.5 nm grid for the base case is presented in **Figure 15.3.**

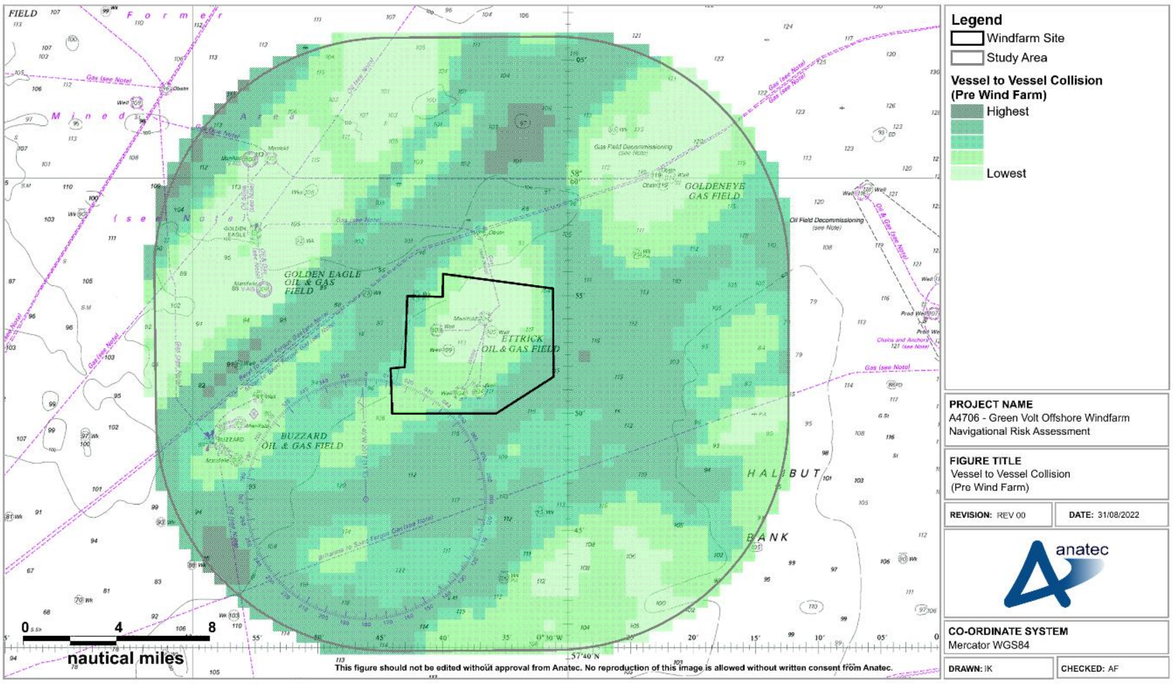


Figure 15.3: Vessel to Vessel Collision (Pre Wind Farm)

Assuming base case traffic levels, the annual frequency of a vessel being involved in a collision pre wind farm was estimated to be 2.79 x 10^{-4}, corresponding to a return period of 3,600 years. This relatively low frequency is reflective of the low levels of routed traffic in 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, such as minor impacts. Other incident data, which includes minor incidents, is presented in Section 9.

15.4 Post Wind Farm

15.4.1 Vessel to Vessel Collisions

Using the post wind farm vessel routeing as input (see Section 14.5), Anatec's COLLRISK model has been run to estimate the existing vessel to vessel collision risk in proximity to the Windfarm Site.

A heat map based upon the geographical distribution of collision risk within a 0.5×0.5 nm grid for the base case is presented in **Figure 15.4.**

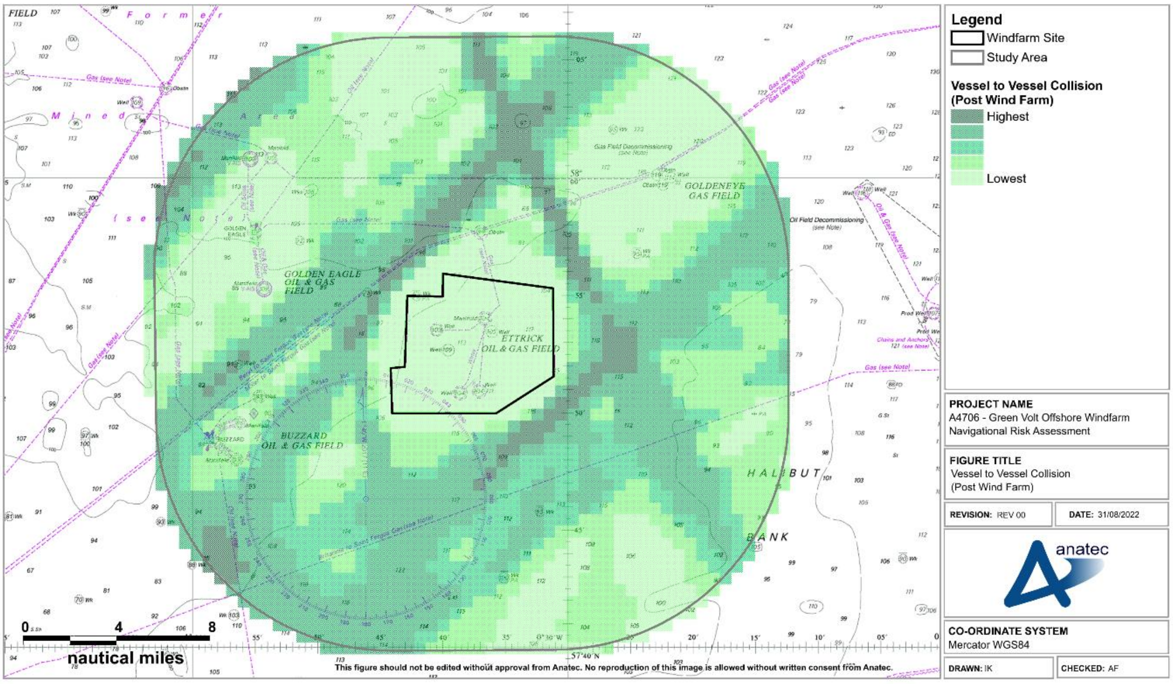


Figure 15.4: Vessel to Vessel Collision (Post Wind Farm)

Assuming base case traffic levels, the annual frequency of a vessel being involved in a collision post wind farm was estimated to be 3.30 x 10^{-4}, corresponding to a return period of approximately 3,000 years. This represents an increase of approximately 18% over the pre wind farm case (see Section 15.3.2) however is still considered low.

Noting the assumption that commercial vessels will avoid the Windfarm Site, collision frequency within the Windfarm Site was observed to decrease when compared to the pre wind farm case. Collision frequency around the Windfarm Site was observed to increase due to the displaced vessels, however as above the increase is considered low on an absolute basis.

15.4.2 Powered Vessel to Structure Allision

Based upon the vessel routeing identified in the study area, the anticipated re-routeing as a result of the presence of the Windfarm Site, and assumptions that relevant embedded mitigation measures are in place (see Section 21.1), 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 Project is considered to be low.

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 Windfarm Site.

Using the post wind farm routeing as input (see Section 14.5), in addition with the worst-case layout (Section 6.2.1) and local meteorological ocean data (Section 8), Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within the Windfarm Site whilst under power.

A plot of the annual powered allision frequency per structure for the base case is presented in **Figure 15.5.**

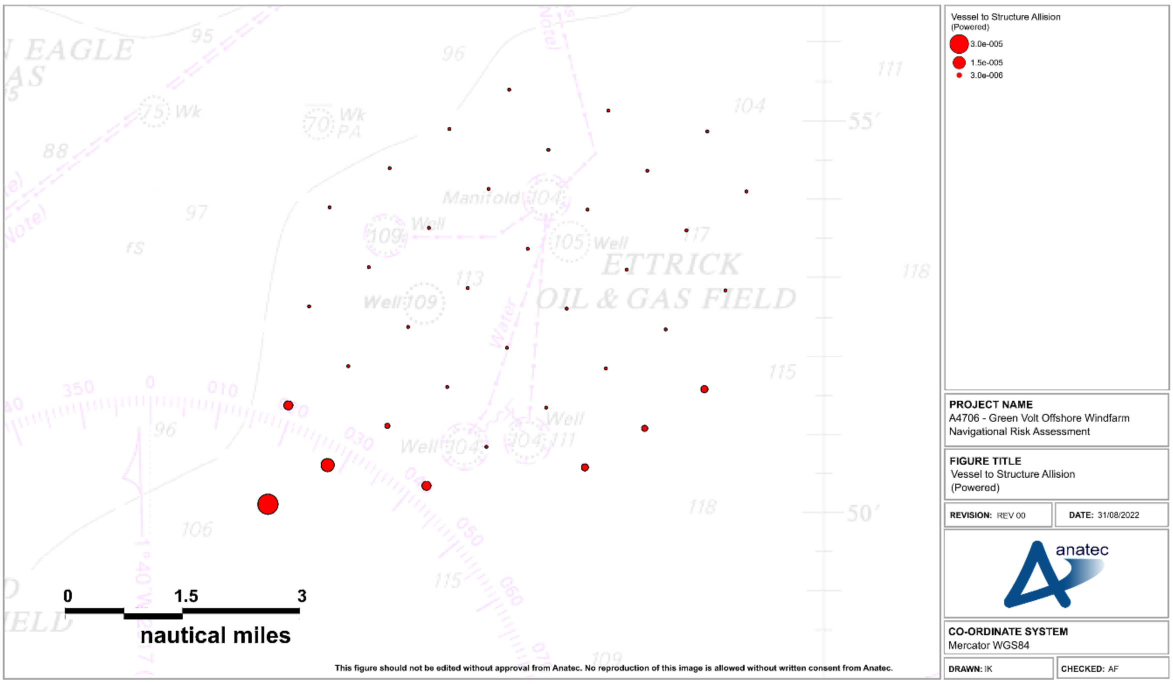


Figure 15.5: Vessel to Structure Allision (Powered)

Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 7.85×10^{-5}, corresponding to a return period of approximately one in 12,700 years. This frequency is reflective of the low traffic levels in the area.

The largest allision risk was observed to be associated with the southwest corner of the Windfarm Site, in particular the OSP. This was observed to be due to the traffic passing to the south and west of the Windfarm Site, however as alluded to above allision frequency to these individual structures including the OSP is still considered low.

15.4.3 Drifting Vessel to Structure Allision

Using the post wind farm routeing as input, together with the worst-case indicative array layout (Section 6.2.1) and local meteorological ocean data (see Section 8), Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within the Windfarm Site. 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.

The exposure times for a drifting scenario are based upon the vessel hours spent in proximity to the Windfarm Site (up to 10 nm from the Windfarm Site i.e., the study area). 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 are based upon analysis of historical incident data have been shown to influence incident rates, are taken into account for the modelling.

Using this information, the overall rate of mechanical failure in proximity to the Windfarm Site 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 meteorological ocean data as per Section 8:

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

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.

After modelling the three drifting scenarios, it was established that the weather 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 15.6.**

Figure 15.6: Vessel to Structure Allision (Drifting)

Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 1.11×10^{-5}, corresponding to a return period of approximately one in 90,000 years. This frequency is reflective of the low traffic levels in the area.

15.4.4 Fishing Vessel to Structure Allision

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 structures within the Windfarm Site.

A fishing vessel allision is classified separately from other allisions since, unlike in the case of the commercial traffic characterised using the main commercial routes (see Section 11.1), fishing vessels may be either in transit or actively fishing within the study area. Further, fishing vessels could be observed internally within the Windfarm Site in addition to externally. Anatec's COLLRISK model uses vessel numbers, sizes (length and beam), layout and structure dimensions. The likelihood of a major allision incident has been calibrated against historical maritime incident data and historical AIS marine traffic data within operational offshore wind farm arrays.

The model assumes no change in baseline fishing vessel activity i.e., vessels passing through the Windfarm Site in close proximity to structures are assumed to remain in the same locations post wind farm. This is considered a conservative assumption.

A plot of the annual fishing vessel allision frequency per structure in the Windfarm Site for the base case is presented in **Figure 15.7.**

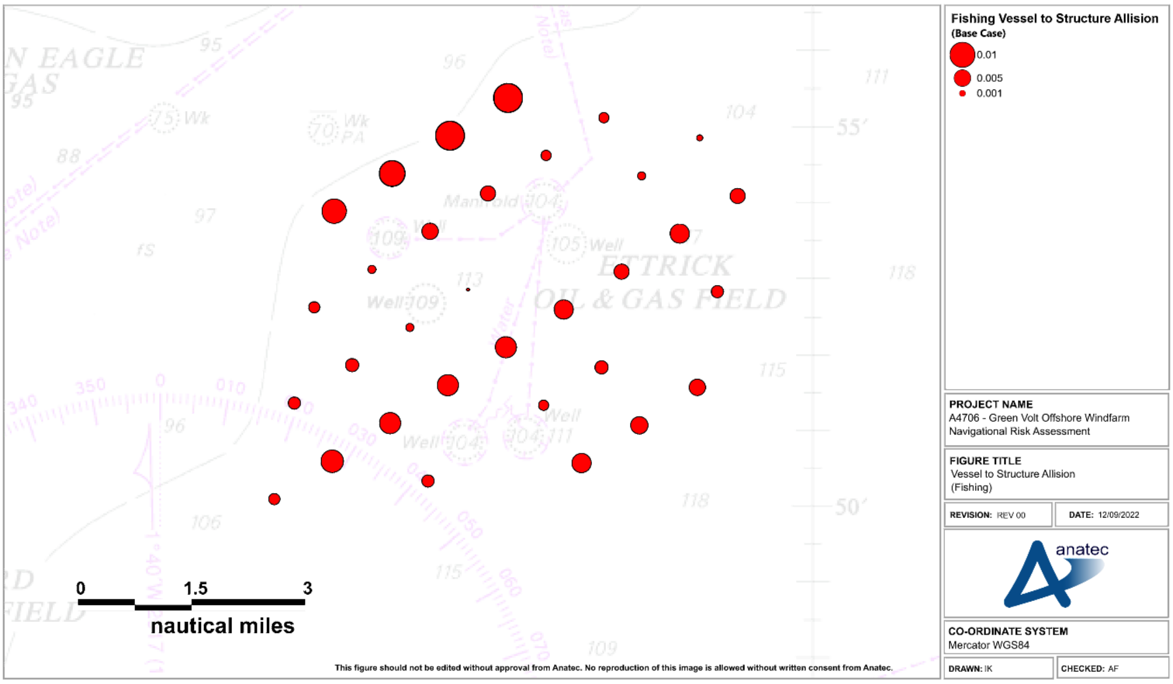


Figure 15.7: Vessel to Structure Allision (Fishing)

For the base case scenario, it was estimated that the annual fishing vessel allision frequency was 1.46 x 10^{-1}, which corresponds to a return period across all structures in the Windfarm Site of one in 6.9 years.

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). The conservatism of the model should also be considered, in particular the assumption that there will be no change to baseline activity. In reality, it is likely that vessels will increase passing distance from the floating substructures.

15.5 Risk Results Summary

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 each with future case traffic levels have also been modelled as per Section 14. **Table 15.1** summarises the results of all scenarios assessed.

Table 15.1: Risk Results Summary

Table Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	2.79×10^{-4} (3,586 years)	3.30×10^{-4} (3,030 years)	5.11×10^{-5} (19,578 years)

Table Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
	Future case (10%)	3.39×10^{-4} (2,952 years)	4.01×10^{-4} (2,493 years)	6.23×10^{-5} (16,047 years)
	Future case (20%)	3.99×10^{-4} (2,508 years)	4.70×10^{-4} (2,129 years)	7.09×10^{-5} (14,095 years)
Powered vessel to structure allision	Base case	N/A	7.85×10^{-5} (12,731 years)	7.85×10^{-5} (12,731 years)
	Future case (10%)	N/A	8.64×10^{-5} (11,574 years)	8.64×10^{-5} (11,574 years)
	Future case (20%)	N/A	9.43×10^{-5} (10,609 years)	9.43×10^{-5} (10,609 years)
Drifting vessel to structure allision	Base case	N/A	$1.11\text{x}10^{-5}$ (89,973 years)	$1.11\text{x}10^{-5}$ (89,973 years)
	Future case (10%)	N/A	$1.22\text{x}10^{-5}$ (81,794 years)	$1.22\text{x}10^{-5}$ (81,794 years)
	Future case (20%)	N/A	$1.33\text{x}10^{-5}$ (74,978 years)	$1.33\text{x}10^{-5}$ (74,978 years)
Fishing vessel to structure allision	Base case	N/A	$1.46\text{x}10^{-1}$ (6.8 years)	$1.46\text{x}10^{-1}$ (6.8 years)
	Future case (10%)	N/A	$1.61\text{x}10^{-1}$ (6.2 years)	$1.61\text{x}10^{-1}$ (6.2 years)
	Future case (20%)	N/A	$1.75\text{x}10^{-1}$ (5.7 years)	$1.75\text{x}10^{-1}$ (5.7 years)
Total	**Base case**	$2.79\text{x}10^{-4}$ (3,586 years)	$1.46\text{x}10^{-1}$ (6.8 years)	$1.46\text{x}10^{-1}$ (6.8 years)
	Future case (10%)	$3.39\text{x}10^{-4}$ (2,952 years)	$1.61\text{x}10^{-1}$ (6.2 years)	$1.60\text{x}10^{-1}$ (6.2 years)
	Future case (20%)	$3.99\text{x}10^{-4}$ (2,508 years)	$1.75\text{x}10^{-1}$ (5.7 years)	$1.75\text{x}10^{-1}$ (5.7 years)

Overall, the collision and allision frequency due to the presence of the Project was estimated to increase by approximately 1.46×10^{-1} (one incident in 6.8 years) for the base case. Increases of 1.60×10^{-1} (one incident in 6.2 years) and 1.75×10^{-1} (one incident in 5.7 years) were estimated for the 10 and 20% future cases respectively. It is noted that the significant majority of these increases was associated with allision risk to fishing vessels, and the conservative assumptions as detailed in Section 15.4.4 should be considered.

15.6 Mooring Lines

This section considers the mooring lines relative to baseline traffic volumes and draughts to determine potential risk associated with underkeel interaction. The outputs have been fed into the qualitative risk assessment of underkeel interaction undertaken in Section 18.7.1.2.

Based on operational experience of existing wind farms and consultation undertaken for the Project (see Section 4), it is likely that commercial vessels will deviate to avoid the Windfarm Site. On this basis, considering the vessel types recorded within the Windfarm Site (see Section 10.1.2), the key vessel type that must be considered is fishing. It is noted that recreational vessels were not recorded in large numbers within the vessel traffic data, however consultation indicated that such vessels may be present in the area on transits between the UK and Scandinavia. The focus of this assessment on fishing vessels is considered appropriate on the basis that they will typically have larger draughts than recreational vessels, and based on the available information and consultation are much more prevalent in the area.

15.6.1 Vessel Draught

The distribution of fishing vessel draughts recorded within the Windfarm Site during the three years of fishing vessel AIS (see Section 10.1.2.1) is presented in **Figure 15.8.**

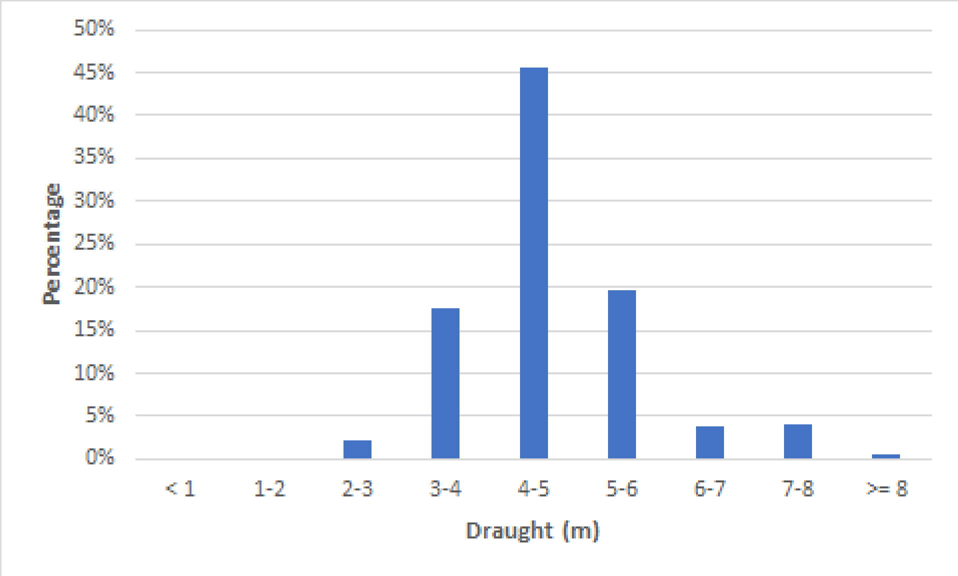


Figure 15.8: Fishing Vessels within Windfarm Site – Draught Distribution

The maximum draught recorded was 8.6m, with the average being approximately 4.5m. As shown, the significant majority of fishing vessels within the Windfarm Site had draughts of between 3 and 6m.

15.6.2 Mooring Line Interaction

Based on the substructure types and mooring line arrangements under consideration, the use of barges is considered a worst case from a mooring line perspective. If barge substructures are used, the mooring lines will connect at deck level, estimated at 5m above the waterline, with angle of descent of approximately 38° below the horizontal. Semi-submersible substructures will use mooring lines that connect at least 10m below the surface, with an angle of descent of at least 13° from the horizontal.

On this basis, the approximate descents of the mooring lines in the immediate vicinity of the substructures is shown in **Figure 15.9.** The average and maximum fishing vessel draughts recorded in the Windfarm Site are shown for reference (see Section 15.6.1). It should be considered that the values detailed above have been assumed for the purposes of this interaction assessment and that it will be necessary to assess final underkeel clearance available post installation, noting the variations that could occur based on the use of TLPs or catenary mooring lines. This is discussed further in Sections 18.7.1.2 and 21.1.2.

The assessment has been run up to a point 50m from the substructures (i.e., the mooring lines extend beyond the extent shown in **Figure 15.9**).

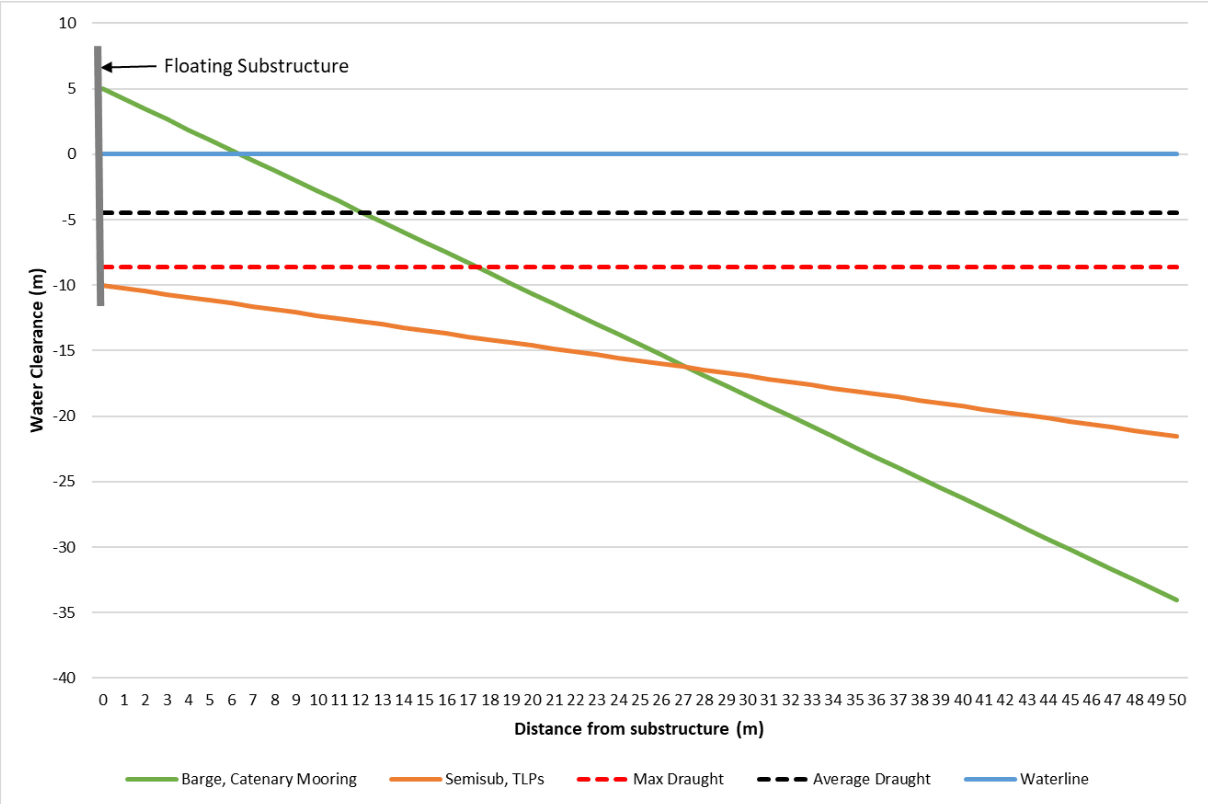


Figure 15.9: Mooring Lines relative to Maximum Vessel Draught

As shown, a fishing vessel with the maximum draught recorded would have approximately 5m of clearance assuming it stayed in excess of 25m from a barge, and 15m from a semisubmersible substructure. A vessel of average draught (4.5m) would have approximately 5m of clearance assuming it stayed in excess of 20m from a barge, and could be directly alongside a semi submersible substructure.

A summary of the available clearance between the mooring lines and the waterline at 5m intervals from the substructure types is provided in **Table 15.2**.

Table 15.2: Clearance Summary

Distance from Substructure (m)	Clearance below Mooring Line and Waterline (m)	
	Barge	Semi Sub
0	+5.0	-10
5	+1.1	-11.1
10	-2.8	-12.3
15	-6.7	-13.5
20	-10.6	-14.6
25	-14.5	-15.8

15.6.3 Approach to Risk Assessment

The potential for interaction with the mooring lines has been assessed within the risk assessment in Sections 18.7.1.2 and 18.8.1.2. The potential that the mooring system will fail leading to a loss of station incident is assessed in Section 18.9. It is noted that the relevant hazards have been assessed for the operational phase noting the risk is managed via construction and decommissioning mitigations during those phases.

16 Introduction to Risk Assessment

Sections 17 to 19 provide a qualitative and quantitative risk assessment (using the FSA as per Section 3.1) for the hazards identified due to the Project, based on baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments. It is noted that NRA considers navigational safety hazards only.

The hazards assessed are as follows:

- Vessel displacement.
- Adverse weather.
- Increased vessel to vessel collision risk between a third-party vessel and a Project vessel.
- Increased vessel to vessel collision risk between third-party vessels.
- Vessel to structure allision risk.
- Reduced access to local ports.
- Reduction of under keel clearance.
- Anchor snagging interaction.
- Loss of station of turbine due to mooring failure.
- Reduction of emergency response capability (including reduced access for SAR responders).

For each hazard, the full description of the hazard is provided in *italicised* text. This is followed by various subsections as appropriate to consider each component of the hazard, both qualitatively and quantitatively.

Within each component of an overarching hazard, embedded mitigation measures which have been identified as relevant to reducing risk are listed, with full descriptions provided in Section 21.1. This is followed by statements defining the frequency of occurrence and severity of consequence for each component of the hazard in **bold** text, as defined in Section 3.2.

At the end of the assessment of each hazard, these frequency of occurrence and severity of consequence rankings are summarised with the resulting significance of risk given in **highlighted bold** text, as defined in Section 3.2.

The risk control log (see Section 21) summarises the risk assessment and a concluding risk statement is provided (see Section 23.5).

17 Construction Phase Risk Assessment

17.1 Vessel Displacement

Construction activities associated with the installation of structures in the Windfarm Site and cables may displace existing routes/activity.

17.1.1 Qualification of Risk

Based on operational experience of constructing wind farms, it is considered likely that commercial vessels will deviate to avoid the Windfarm Site during construction (which may be marked as a buoyed construction area as directed by NLB) noting that there will be no restrictions on entry other than through any active safety zones. This aligns with input received in the Hazard Workshop from commercial vessel representation (see Section 4.2.4).

The volume of vessel traffic passing within or in proximity to the Windfarm Site has been established as per Section 10. The available datasets were assessed to identify the main routes within the study area using the principles set out in MGN 654 (MCA, 2021). A total of ten routes were identified, three of which were anticipated to potentially require deviation as a result of the Project. None of the deviations were observed to require large changes in routeing patterns, with the maximum increase in distance being 0.3nm. Further, the relevant three routes were all considered low use, each used by a maximum of one vessel per day.

Smaller vessel types (e.g., fishing, recreation) may still choose to transit through the Windfarm Site during construction, noting this would be at the discretion of individual vessels. In this regard it should be considered that there is limited experience of deployment of large scale floating projects, and as such vessels may be less likely to transit through floating structures than those on fixed foundations. However, there is considered to be sufficient searoom to accommodate any vessels that chose to avoid the Windfarm Site without unduly increasing vessel density around the Windfarm Site boundary.

There may be some displacement associated with the installation of the offshore export cables within the Offshore Export Cable Corridor, however any such displacement would be temporary and spatially limited.

The main consequence of vessel displacement will be increased journey times and distances for affected third-party vessels. However, as above any deviations are not anticipated to be large. Vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and relevant nautical charts meaning any disruption can be minimised.

17.1.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Lighting and Marking;
- MGN 654 Compliance; and
- Promulgation of information.

17.1.3 Significance of Risk

The frequency of occurrence in relation to displacement of vessel traffic is considered **reasonably probable** given that deviations are anticipated to occur albeit to a low number of vessels. Severity of consequence is considered **negligible** given any deviations will be minor and can be safely accommodated by the surrounding searoom. On this basis the significance of risk is assessed to be **broadly acceptable**.

17.2 Adverse Weather

The presence of the structures within the Windfarm Sites could restrict adverse weather routeing in the area during construction.

17.2.1 Qualification of Risk

General concerns were raised during consultation (see Section 4) around restriction of adverse weather routeing options in the area. A review of the vessel traffic survey data did not identify any adverse weather routeing occurring in the area (see Section 11.2), however it should be considered that in adverse weather conditions, vessels may choose to pass further from the ongoing construction activities in the Windfarm Site. As per Section 11.2.1, there is considered to be sea space available south of the Windfarm Site to accommodate such transits.

Details of the Project would be promulgated to facilitate advanced passage planning including in adverse conditions. Under COLREGS (IMO, 1972), vessels are also required to take appropriate measures with regards to determining a safe speed, taking into account various factors including the state of visibility, the state of the wind, sea, and current as well as the proximity of navigational hazards.

17.2.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Lighting and Marking;
- MGN 654 Compliance; and
- Promulgation of information.

17.2.3 Significance of Risk

The frequency of occurrence in relation to restriction of adverse weather routeing is considered **extremely unlikely** given there is searoom available to accommodate vessel routeing. Severity of consequence is considered **moderate**. On this basis the significance of risk is assessed to be **broadly acceptable**.

17.3 Increased vessel to vessel collision risk (third party to third party)

Displacement of third party vessels may lead to increased encounters and collision risk.

17.3.1 Quantification and Qualification of Risk

As discussed in Section 17.1, any deviations and displacement of third party traffic is anticipated to be low, both in terms of number of vessels affected and magnitude of deviations. On this basis it is considered unlikely that there will be a large increase in encounters and collision risk, noting that there is considered to be ample searoom to safely accommodate any displaced vessels.

This aligns with the findings of the vessel to vessel collision modelling (see Section 15.4.1), which indicated that collision rates would remain low post wind farm, with a vessel being estimated to be involved in a collision once every 3,000 years based on anticipated post wind farm routeing patterns. This is reflective of the anticipated deviations being minor, and the low level of vessels affected.

As per Section 17.1, smaller vessels may also choose to avoid the Windfarm Site during construction (which may be marked as a buoyed construction area as directed by NLB) which could lead to increased encounters with larger commercial vessels. However, given the limited traffic levels, searoom available, and noting such encounters would be managed via COLREGS and SOLAS, it is considered unlikely that this would lead to any notable increase in collision risk between small vessels and larger commercial vessels.

It was raised during the Hazard Workshop that towing operations (e.g., of semisubmersibles, rigs) occur in the area. Any associated encounters would be managed as above via COLREGS, SOLAS.

In the event that an encounter does occur, it is likely to be very localised and occur for only a short duration, with collision avoidance action implemented by the vessels involved, in line with the COLREGs, thus ensuring that the situation does not develop into a collision incident. This is supported by experience at previous under construction wind farms, where no collision incidents involving two third-party vessels have been reported.

Historical collision incident data also indicates that the most likely consequences will be low should a collision occur, with minor contact between the vessels resulting in minor damage and no injuries to persons, with both vessels able to resume their respective passages and undertake a full inspection at the next port. As an unlikely worst case, one of the vessels could be foundered resulting in a Potential Loss of Life (PLL) and / or pollution.

Details of the Project will be promulgated in advance, and the infrastructure will be displayed on nautical charts. This will ensure vessels can passage plan in advance to minimise disruption and deviations, which will in turn minimise collision risk.

17.3.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance; and
- Promulgation of information.

17.3.3 Significance of Risk

The frequency of occurrence in relation to third party to third party collision risk is considered **negligible** given that deviations are anticipated to occur to a low number of vessels. Severity of consequence is considered **serious.** On this basis the significance of risk is assessed to be **broadly acceptable**.

17.4 Increased vessel to vessel collision risk (third party to project vessel)

Vessels associated with construction activities for the Project may increase encounters and collision risk for other vessels already operating in the area.

17.4.1 Qualification of Risk

As per Section 6.5.1, it is anticipated that up to 16 vessels could be used during the construction phase for the Project. This is considered low by industry standards and is reflective of much of the fabrication work being undertaken onshore.

The risk of encounters and collision risk associated with Project vessels will be managed by marine coordination. This will include the application of traffic management procedures such as indicative transit routes between the Windfarm Site and the construction ports used, which will be set out in the Vessel Management Plan. 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 also be promulgated through ongoing liaison with fishing fleets including via the FLO.

An application for safety zones will also be made, which will include 500m safety zones around any structures where construction work is ongoing. These safety zones will make clear to passing third party traffic the areas which should be avoided to minimise collision risk with the construction vessels undertaking these works, noting such vessels may be Restricted in Ability to Manoeuvre (RAM). The Project may also utilise and promulgate advisory safe passing distances around ongoing works where identified as necessary via risk assessment. Details and locations of any safety zones and advisory safe passing distances will be promulgated including via Notices to Mariners and the Kingfisher Bulletin.

The Applicant will exhibit lighting and marking as required by NLB and MCA during the construction phase. This will further maximise mariner awareness when in proximity of the

Windfarm Site of the potential for ongoing sensitive operations, both in day and night conditions including in poor visibility.

Third-party vessels may experience restrictions on ability to visually identify Project vessels entering and exiting the Windfarm Site during reduced periods of visibility. However, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions, noting that Project vessels will also carry AIS regardless of size.

Based on historical incident data (see Section 9.6), there have been two instances of a third-party vessel colliding with a project vessel. In both incidents moderate vessel damage was reported with no harm to persons. It is noted that the two incidents occurred in 2011 and 2012, and awareness of offshore wind developments and application of the measures outlined above has improved and been refined considerably in the interim, with no further collision incidents reported since.

Should an encounter occur between a third-party vessel and a Project vessel, it is likely to be 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. It is noted that it was raised during the Hazard Workshop that towing operations (e.g., of semisubmersibles, rigs) occur in the area. Any associated encounters with a Project vessel would be managed as above via COLREGS, SOLAS and the marine coordination / vessel procedures in place.

Should a collision occur, the most likely consequences will be similar to that outlined for the case of a collision between two third-party vessels (see Section 17.2), namely minor contact between the vessels resulting in minor damage and no injuries to persons with both vessels able safely make their next port to undertake a full inspection. As an unlikely worst case, one of the vessels could be foundered resulting in a PLL and pollution. If pollution were to occur in proximity to the Project or involving a Project vessel, then the Marine Pollution Contingency Plan will be implemented to minimise the environmental risks.

17.4.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Application for Safety Zones;
- Display on charts;
- Guard vessels;
- Lighting and Marking;
- Marine Coordination;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance;
- Navigational Safety Plan;
- Project vessel compliance with international marine regulations;
- Promulgation of information; and
- Vessel Management Plan.

17.4.3 Significance of Risk

The frequency of occurrence in relation to third party to Project Vessel collision risk is considered **negligible** noting the marine coordination and associated procedures that will be in place. Severity of consequence is considered **serious.** On this basis the significance of risk is assessed to be **broadly acceptable**.

17.5 Vessel to Structure Allision Risk

Presence of structures in the Windfarm Site may increase powered, drifting and internal allision risk for vessels during construction.

The spatial extent of the hazard is considered small given that a vessel must be in close proximity to a structure in the Windfarm Site during construction for an allision incident to occur. The forms of allision considered are:

- Powered allision risk;
- Drifting allision risk; and
- Internal allision risk.

17.5.1 Qualification of Risk

17.5.1.1 Powered Allision Risk

As per Section 17.1, it is likely that commercial vessels will deviate to avoid the Windfarm Site (which may be marked as a buoyed construction area as directed by NLB) following commencement of construction. As such, it is likely that associated allision risk would be highest to pre-commissioned structures on the periphery of the Windfarm Site. Smaller vessels may still choose to transit through, and as such may come in proximity to internal structures.

Operational mitigations (most notably including operational lighting and marking) will not yet be active during the construction phase. However, construction phase specific mitigation measures will be implemented including promulgation of information, charting of the Windfarm Site, and temporary lighting and marking (which may include buoyage as directed by NLB). Safety zones of radius 500m will be applied for around structures where construction is underway, with 50m pre-commissioning safety zones applied for around structures where work is not underway during the construction phase. These safety zones would make clear to passing mariners the areas which should be avoided to minimise allision risk.

Where identified as necessary via risk assessment (which will include consideration of the other mitigation measures in place), a guard vessel may also be used, which will alert passing vessels to the presence of the ongoing construction.

Should an allision occur, the consequences will depend on multiple factors including the energy of the impact, structural integrity of the vessel and sea state at the time of the impact. Fishing vessels and recreational vessels are considered most vulnerable to the impact given the potential for a non-steel construction and possible internal navigation (see Section 17.5.1.3) within the Windfarm Site by such vessels. In such cases, the most likely consequences will be minor damage, with the vessel able to resume passage and undertake a full inspection at the next port. As an unlikely worst case, the vessel could be foundered resulting in a PLL and pollution. If pollution were to occur in proximity to the Project, then the Marine Pollution Contingency Plan will be implemented to minimise the environmental risks.

Additionally, commercial vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project including display of the Windfarm Site on nautical charts.

17.5.1.2 Drifting Allision Risk

As per Section 17.1 and as discussed in relation to powered allision risk in Section 17.5.1.1, it is likely that commercial vessels will deviate to avoid the Windfarm Site (which may be marked as a buoyed construction area as directed by NLB) following commencement of construction. As such, it is likely that associated allision risk would be highest to pre-commissioned structures on the periphery of the Windfarm Site. Smaller vessels may still choose to transit through, and as such may come in proximity to internal structures.

A vessel drift scenario may only develop into an allision situation if in proximity to a structure within the Windfarm Site. This would only be the case where the vessel was either located internally within or in close proximity to the Windfarm Site, and the direction of the wind and/or tide directs the vessel towards a structure. In the event that a vessel starts to drift towards the Windfarm Site, the vessel will first initiate its own procedures for such an event, which may involve dropping anchor or the use of thrusters (depending on availability and power supply). This may include an emergency anchoring event which would involve checking relevant nautical charts to ensure that deployment of the anchor will not lead to other risks (such as anchor snagging on a subsea cable) in line with emergency procedures.

Further, any Project vessels on site may be able to provide assistance in liaison with MCA and as required under SOLAS obligations (IMO, 1974).

Should a drifting allision occur, the consequences will be similar to those noted for the case of a powered allision including the unlikely worst-case of foundering and pollution. In the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the Marine Pollution Contingency Plan will minimise the environmental risk. Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel dependent on conditions, thus reducing the energy of the impact, including in the case of a recreational vessel under sail.

17.5.1.3 Internal Allision

As discussed in Section 17.1, it is likely that only smaller vessels (e.g., fishing, recreation) may choose to transit through the Windfarm Site during construction (which may be marked as a buoyed construction area as directed by NLB). On this basis it is considered very unlikely that a commercial vessel would be involved in an internal allision.

Minimum spacing between structures of 1,540m is considered sufficient for safe internal navigation i.e., keeping clear of the structures in the Windfarm Site. It is noted that this spacing is greater than that associated with many other offshore wind farms in the UK located near the coast where small vessel traffic would be expected to be of higher levels. The final layout will be agreed with both NLB and MCA, noting these discussions will include consideration of ensuring safe internal navigation.

As with any passage, any vessel navigating in or near the Windfarm Site is expected to passage plan in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information including through ongoing liaison via the FLO will ensure that such vessels have good awareness of the works being undertaken. Promulgation of information was noted as an important mitigation for both recreational and fishing vessels within the Hazard Workshop (see Section 4.2.4), in particular ensuring fishing vessels had access to plotter overlays.

The Applicant will apply for safety zones of radius 500m around structures where construction is underway, with 50m pre-commissioning safety zones applied for around structures where work is not underway during the construction phase. These safety zones would make clear to passing mariners the areas which should be avoided to minimise allision risk.

17.5.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Application for Safety Zones;
- Design Specification and Layout Plan;
- Display on charts;
- Guard vessels;
- Lighting and Marking;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance;
- Minimum blade clearance;
- Navigational Safety Plan; and
- Promulgation of information.

17.5.3 Significance of Risk

Table 17.1 summarises the significance of risk for each component of this hazard.

Table 17.1: Summary of shipping and navigation risk rankings for vessel to structure allision risk during construction phase

Hazard Component	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Powered allision risk	Negligible	Serious	**Broadly Acceptable**
Drifting allision risk	Negligible	Serious	**Broadly Acceptable**
Internal allision risk	Extremely Unlikely	Serious	**Tolerable**

Assuming the implementation of ensuring plotter overlays are made available to fishing vessels including via FLO liaison, the hazard is considered **tolerable with mitigation** for internal allision risk.

17.6 Reduced Access to local Ports

Vessels or activities associated with the construction of the Project may hinder third party traffic access to local ports / facilities.

17.6.1 Qualification of Risk

The key port in the area is Peterhead, noting that the two potential landfall options for the Offshore Export Cable Corridor are located either side of the port.

Based on the distance offshore (in excess of 30nm), there is considered to be no impact from the Windfarm Site on port access.

Vessels associated with the construction of the Project are not anticipated to notably increase overall baseline traffic levels in the area, noting number of vessels used are anticipated to be less than typical industry standards due to the majority of fabrication work being undertaken onshore. Marine coordination and vessel procedures will be in place to manage Project vessel movements and minimise disruption to third-party vessels. As such, no notable impact on port access is expected from Project vessels, noting any interactions with third party vessels would be managed via COLREGS in addition to the marine coordination procedures.

The Offshore Export Cable Corridor intersects the Peterhead Port Authority Harbour Limit (see Section 7.4.3), however is located in excess of 1nm from the port entrance. On this basis there is unlikely to be any impact to port access from cable installation activities, noting any impact would be temporary and spatially limited, with third party vessels still able to safely access Peterhead.

17.6.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Guard vessels;
- Marine Coordination;

- Project vessel compliance with international marine regulations; and
- Promulgation of information.

17.6.3 Significance of Risk

The frequency of occurrence is considered **extremely unlikely** given Project vessel movements will be managed via marine coordination. Severity of consequence is considered **minor.** On this basis the significance of risk is assessed to be **broadly acceptable**.

17.7 Reduction of emergency response capability

Increased vessel activity and personnel numbers associated with the construction of the Project may reduce emergency response capability by increasing the number of incidents, increasing consequences or reducing access for the responders.

17.7.1 Qualification of Risk

The construction of the Project will lead to an increased level of vessels and personnel in the area over baseline levels. On this basis there may be an increase in the number of incidents requiring emergency response over baseline rates.

Baseline incident rates are considered low in the area based on the data studied, with an average of between one and two incidents per year indicated within the MAIB, RNLI and helicopter taskings datasets. It is also noted that to date, there have only been 13 reported allision or collision incidents associated with offshore wind farms in the UK (see Section 9.6.1). While it should be considered that this only covers allisions and collisions, it is still not anticipated that the Project would notably increase the observed baseline incident rates.

It is noted that an average of one to two helicopter taskings per year were recorded in the study area (see Section 9.1). However, the significant majority of these were associated with rescue/recovery from the nearby Buzzard and Golden Eagle platforms. The frequency at which a helicopter tasking is required at the Project is considered likely to be less than this noting much lower personnel levels.

Further, the on-site vessels and resources associated with the Project will form additional resource to respond to any incidents in the area in liaison with the MCA, both in terms of incidents associated with the Project (i.e., self help resources), but also incidents occurring outside of the Windfarm Site to third party vessels. Any vessels at the nearby fields may also be able to assist. As required under MGN 654, the Applicant will produce and submit an ERCoP to the MCA detailing how they would cooperate and assist in the event of an incident including consideration of Project resources.

17.7.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Design Specification and Layout Plan;

- Display on charts;
- Guard vessels;
- Marine Coordination;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance; and
- Project vessel compliance with international marine regulations.

17.7.3 Significance of Risk

The frequency of occurrence in relation is considered **extremely unlikely** noting the limited anticipated effect on incidents rates and MGN 654 compliance. Severity of consequence is considered **moderate.** On this basis the significance of risk is assessed to be **broadly acceptable**.

18 Operation and Maintenance Phase Risk Assessment

18.1 Vessel Displacement

The presence of structures in the Windfarm Site may displace existing routes/activity.

18.1.1 Qualification of Risk

Based on operational experience of constructing wind farms, it is considered likely that commercial vessels will deviate to avoid the operational structures within the Windfarm Site, noting that there will be no restrictions on entry other than through any active major maintenance safety zones. This aligns with input received in the Hazard Workshop from commercial vessel representation (see Section 4.2.4). As per Section 17.1, it is anticipated that during the construction phase, commercial vessels will also have been deviating to avoid the Windfarm Site (which may be marked as a buoyed construction area as directed by NLB). It is likely that these deviations established during the construction phase would remain in place during the operational phase.

The volume of vessel traffic passing within or in proximity to the Windfarm Site has been established as per Section 10. The available datasets were assessed to identify main commercial routes using the principles set out in MGN 654 (MCA, 2021). A total of ten routes were identified, three of which were anticipated to potentially require deviation as a result of the Project. None of the deviations were observed to require large changes in routeing patterns, with the maximum increase in distance being 0.3nm. Further, the relevant three routes were all considered low use, each used by a maximum of one vessel per day.

As for the construction phase (see Section 17.1), smaller vessel types (e.g., fishing, recreation) may still choose to transit through the operational structures within the Windfarm Site, noting this would be at the discretion of individual vessels. In this regard it should be considered that there is limited experience of deployment of large scale floating projects, and as such vessels may be less likely to transit through floating structures than those on fixed foundations. However, there is considered to be sufficient searoom to accommodate any vessels that chose to avoid the Windfarm Site without unduly increasing vessel density around the Site boundary. The final layout will be agreed with the MCA and NLB post consent, and these discussions will include consideration of surface navigation.

It was noted that adverse weather routeing was raised at the Hazard Workshop, in particular that vessels may choose to avoid the Windfarm Site during periods of adverse weather. However, as in normal conditions there is considered to be sufficient searoom to accommodate adverse weather transits outside of the Windfarm Site.

There may be some displacement associated with any maintenance of the offshore export cables within the Offshore Export Cable Corridor, however any such displacement would be temporary and spatially limited.

The main consequence of vessel displacement will be increased journey times and distances for affected third-party vessels. However, as outlined above any deviations are not anticipated to be large, and third party vessels are likely to utilise routeing already established during the construction phase. Vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and relevant nautical charts meaning any disruption can be minimised. Further, as discussed above it is likely that vessels will be more familiar with the Project than during the construction phase.

18.1.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Lighting and Marking;
- MGN 654 Compliance; and
- Promulgation of information.

18.1.3 Significance of Risk

The frequency of occurrence in relation to displacement of vessel traffic is considered **remote** given that deviations will already be established with a low number of vessels impacted. Severity of consequence is considered **negligible** given any deviations will be minor and can be safely accommodated by the surrounding searoom. On this basis the significance of risk is assessed to be **broadly acceptable**.

18.2 Adverse Weather

The presence of the structures within the Windfarm Sites could restrict adverse weather routeing in the area.

18.2.1 Qualification of Risk

General concerns were raised during consultation (see Section 4) around restriction of adverse weather routeing options in the area. A review of the vessel traffic survey data did not identify any adverse weather routeing occurring in the area (see Section 11.2), however it should be considered that in adverse weather conditions, vessels may choose to pass further from the Windfarm Site. As per Section 11.2.1, there is considered to be sea space available south of the Windfarm Site to accommodate such transits.

Lighting and marking will be defined in consultation with NLB as required and this will include consideration of requirements during periods of poor visibility (e.g., sound signals). Details of the Project would be promulgated to facilitate advanced passage planning including in adverse conditions. Under COLREGS (IMO, 1972), vessels are also required to take appropriate measures with regards to determining a safe speed, taking into account various factors including the state of visibility, the state of the wind, sea, and current as well as the proximity of navigational hazards.

18.2.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Lighting and Marking;
- MGN 654 Compliance; and
- Promulgation of information.

18.2.3 Significance of Risk

The frequency of occurrence in relation to restriction of adverse weather routeing is considered **extremely unlikely** given there is searoom available to accommodate vessel routeing. Severity of consequence is considered **moderate**. On this basis the significance of risk is assessed to be **broadly acceptable**.

18.3 Increased vessel to vessel collision risk (third party to third party)

Displacement of third party vessels may lead to increased encounters and collision risk.

18.3.1 Quantification and Qualification of Risk

As discussed in Section 18.1, any deviations and displacement of third party traffic is anticipated to be low. On this basis it is considered unlikely that there will be a large increase in encounters and collision risk, noting that there is considered to be ample searoom to safely accommodate the displaced vessels.

This aligns with the findings of the vessel to vessel collision modelling (see Section 15.4.1), which indicated that collision rates would remain low post wind farm, with a vessel being estimated to be involved in a collision once every 3,000 years based on anticipated post wind farm routeing patterns. This is reflective of the anticipated deviations being minor, and the low level of vessels affected. It is also noted that any required deviations are likely to be well established by the operational phase.

As per Section 18.1, smaller vessels may also choose to avoid the Windfarm Site which could lead to increased encounters with larger commercial vessels. However, given the limited traffic levels, searoom available, and noting such encounters would be managed via COLREGS and SOLAS, it is considered unlikely that this would lead to any notable increase in collision risk between small vessels and larger commercial vessels.

In the event that an encounter does occur, it is likely to be very localised and occur for only a short duration, with collision avoidance action implemented by the vessels involved, in line with the COLREGs, thus ensuring that the situation does not develop into a collision incident.

Historical collision incident data also indicates that the most likely consequences will be low should a collision occur, with minor contact between the vessels resulting in minor damage and no injuries to persons, with both vessels able to resume their respective passages and undertake a full inspection at the next port. As an unlikely worst case, one of the vessels could be foundered resulting in a Potential Loss of Life (PLL) and / or pollution.

Details of the Project will be promulgated in advance, and the infrastructure will be displayed on nautical charts. This will ensure vessels can passage plan in advance to minimise disruption and deviations, which will in turn minimise collision risk.

18.3.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance; and
- Promulgation of information.

18.3.3 Significance of Risk

The frequency of occurrence in relation to third party to third party collision risk is considered **negligible** given that deviations are anticipated to occur to a low number of vessels. Severity of consequence is considered **serious.** On this basis the significance of risk is assessed to be **broadly acceptable**.

18.4 Increased vessel to vessel collision risk (third party to project vessel)

Vessels associated with the operation and maintenance of the Project may increase encounters and collision risk for other vessels already operating in the area.

18.4.1 Qualification of Risk

As per Section 6.5.2, it is anticipated that up to eight round trips to port per year may be needed for planned maintenance, using an onsite SOV.

As with the equivalent construction phase hazard (see Section 17.4), encounter and collision risk involving a Project vessel will be mitigated including through marine coordination, the Vessel Management Plan, carriage of AIS, compliance with Flag State regulations, and promulgation of information including to local fishing fleets via the FLO.

An application for safety zones will also be made, which will include 500m safety zones around any structures where major maintenance is ongoing. These safety zones will make clear to passing third party traffic the areas which should be avoided to minimise collision risk with the major maintenance vessels undertaking these works, noting such vessels may be RAM. The Project may also utilise and promulgate advisory safe passing distances around ongoing maintenance works where identified as necessary via risk assessment (e.g., around any vessels associated with cable maintenance). Details and locations of any safety zones and advisory safe passing distances will be promulgated including via Notices to Mariners and the Kingfisher Bulletin.

The Applicant will exhibit lighting and marking as required by NLB and MCA during the operational phase, including lights and sound signals. This will further maximise mariner awareness when in proximity of the Windfarm Site of the potential for ongoing sensitive operations, both in day and night conditions and including in poor visibility.

Third-party vessels may experience restrictions on ability to visually identify Project vessels entering and exiting the Windfarm Site during reduced periods of visibility. However, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions, noting that Project vessels will also carry AIS regardless of size.

Based on historical incident data (see Section 9.6), there have been two instances of a third-party vessel colliding with a project vessel. In both incidents moderate vessel damage was reported with no harm to persons. It is noted that the two incidents occurred in 2011 and 2012, and awareness of offshore wind developments and application of the measures outlined above has improved and been refined considerably in the interim, with no further collision incidents reported since.

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. It was also raised during the Hazard Workshop that towing operations (e.g., of semisubmersibles, rigs) occur in the area. Any associated encounters would be managed as above via COLREGS, SOLAS.

Should a collision occur, the most likely consequences will be similar to that outlined for the equivalent construction phase hazard (see Section 17.4), namely minor contact between the vessels resulting in minor damage and no injuries to persons with both vessels able safely make their next port to undertake a full inspection. As an unlikely worst case, one of the vessels could be foundered resulting in a PLL and pollution. If pollution were to occur in proximity to the Project or involving a Project vessel, then the Marine Pollution Contingency Plan will be implemented to minimise the environmental risks.

18.4.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Application for Safety Zones;
- Display on charts;
- Guard vessels;
- Lighting and Marking;
- Marine Coordination;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance;
- Navigational Safety Plan;
- Project vessel compliance with international marine regulations;
- Promulgation of information; and

- Vessel Management Plan.

18.4.3 Significance of Risk

The frequency of occurrence in relation to third party to Project Vessel collision risk is considered **negligible** noting the marine coordination and associated procedures that will be in place. Severity of consequence is considered **serious.** On this basis the significance of risk is assessed to be **broadly acceptable**.

18.5 Vessel to Structure Allision Risk

Presence of structures in the Windfarm Site may increase powered, drifting and internal allision risk for vessels.

The spatial extent of the hazard is considered small given that a vessel must be in close proximity to a structure in the Windfarm Site for an allision incident to occur. The forms of allision considered are:

- Powered allision risk;
- Drifting allision risk; and
- Internal allision risk.

18.5.1 Qualification and Quantification of Risk

18.5.1.1 Powered Allision Risk

Based on the quantitative powered allision assessment (see Section 15.4.2), it was estimated that a powered allision would occur once every 12,700 years. This is comparatively low against the allision frequencies of other UK offshore wind farm developments (based on the information provided in other publicly available NRAs) and is reflective of the low levels of traffic anticipated to be routeing in proximity to the Windfarm Site based on the baseline vessel traffic data assessment (see Section 10) and the anticipated post wind farm routeing (see Section 14.5.2).

Based on historical incident data, there have been two reported instances of a third-party vessel alliding with an operational wind farm structure in the UK (one in the Irish Sea and one in the Southern North Sea). Both of these incidents involved a fishing vessel, with an RNLI lifeboat attending on both occasions and a helicopter deployed in one case.

Should an allision occur, the consequences will depend on multiple factors including the energy of the impact, structural integrity of the vessel and sea state at the time of the impact. Fishing vessels and recreational vessels are considered most vulnerable to the impact given the potential for a non-steel construction and possible internal navigation (see Section 18.5.1.3) within the Windfarm Site by such vessels. In such cases, the most likely consequences will be minor damage with the vessel able to resume passage and undertake a full inspection at the next port. As an unlikely worst case, the vessel could be foundered resulting in a PLL and pollution. If pollution were to occur in proximity to the Project or involving a Project vessel, then the Marine Pollution Contingency Plan will be implemented to minimise the environmental risks.

Additionally, commercial vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project including display of the structure locations on nautical charts. It was noted during the Hazard Workshop (see Section 4.2.4) that mariners in this area are likely to be experienced and well equipped noting the distance offshore.

The structures will also be lit and marked as directed by the MCA and NLB to ensure passing mariner awareness (e.g., lights, sound signals).

NLB noted during the Hazard Workshop that appropriate mitigations in the form of lighting and marking may need to be implemented if a WTG displaying an AtoN was towed back to shore for maintenance. In such an event consultation would be undertaken with NLB in advance to agree appropriate mitigation, noting this is anticipated likely to be an infrequent event.

18.5.1.2 Drifting Allision Risk

Based on the quantitative drifting allision assessment (see Section 15.4.3), it was estimated that a drifting allision would occur once every 90,000 years. This is comparatively low against the allision frequencies of other UK offshore wind farm developments based on information provided in other publicly available NRAs, and is reflective of the low levels of traffic anticipated to be routeing in proximity to the Windfarm Site based on the baseline vessel traffic data assessment (see Section 10) and the anticipated post wind farm routeing (see Section 14.5.2).

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). However, it is noted that instances of machinery failure were present in proximity to the Windfarm Site within the baseline incident data studied (see Section 9).

A vessel adrift scenario may only develop into an allision situation if in proximity to a structure within the Windfarm Site. This would only be the case where the vessel was either located internally within or in close proximity to the Windfarm Site, and the direction of the wind and/or tide directs the vessel towards a structure. In the event that a vessel starts to drift towards the Windfarm Site, the vessel will first initiate its own procedures for such an event, which may involve dropping anchor or the use of thrusters (depending on availability and power supply). This may include an emergency anchoring event which would involve checking relevant nautical charts to ensure that deployment of the anchor will not lead to other risks (such as anchor snagging on a subsea cable) in line with emergency procedures.

Further, any Project vessels on site may be able to provide assistance in liaison with MCA and as required under SOLAS obligations (IMO, 1974).

Should a drifting allision occur, the consequences will be similar to those noted for the case of a powered allision including the unlikely worst-case of foundering and pollution. In the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the Marine Pollution Contingency Plan will minimise the environmental risk. Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel dependent on conditions, thus reducing the energy of the impact, including in the case of a recreational vessel under sail.

18.5.1.3 Internal Navigation Risk

As discussed in Section 18.1, it is likely that only smaller vessels (e.g., fishing, recreation) will transit through the Windfarm Site. On this basis it is considered very unlikely that a commercial vessel would be involved in an internal allision.

The base case annual fishing vessel to structure internal allision frequency is estimated to be 1.46×10^{-1}, corresponding to a return period of approximately one in seven years. This is a high return period compared to that estimated for certain other UK offshore wind farm developments (based on information provided in other publicly available NRAs) and is reflective of the volume of fishing vessel traffic in the area and the large worst case size at water level of the floating substructures. As discussed in Section 15.4.4, it is important to note that this is based on a worst case conservative assumption that baseline activity will remain unchanged once the structures are in place i.e., no account is made for fishing vessels choosing to pass further from the structures or choosing to avoid the Windfarm Site altogether.

In this regard it is noted that the minimum spacing between structures of 1,540m is considered sufficient for safe internal navigation i.e., keeping clear of the structures in the Windfarm Site. It is noted that this spacing is greater than that associated with many other offshore wind farms in the UK located near the coast where small vessel traffic would be expected to be of higher levels. The final layout will be agreed with both NLB and MCA, noting these discussions will include consideration of ensuring safe internal navigation

As with any passage, any vessel navigating within the Windfarm Site is expected to passage plan in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information including through ongoing liaison via the FLO will ensure that such vessels have good awareness of any maintenance works being undertaken. Promulgation of information was noted as an important mitigation for both recreational and fishing vessels within the Hazard Workshop (see Section 4.2.4), in particular ensuring fishing vessels had access to plotter overlays.

The Applicant will exhibit lights, marks, sounds, signals and other aids to navigation as required by NLB and MCA. This will include unique identification marking of each structure in the Windfarm Site in an easily understandable pattern to minimise the risk of a mariner navigating internally becoming disoriented. The use of safety zones to minimise allision risk will also be discussed with MCA, NLB and MS-LOT.

Should a recreational vessel under sail enter the proximity of a WTG, 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 WTGs do reduce wind velocity downwind of a WTG (MCA, 2008) but that no negative effects on recreational craft have been reported on the basis of the limited spatial extent of the effect 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. For recreational vessels with a mast there is an additional allision risk when navigating internally associated with the WTG blades. However, the minimum blade tip clearance is 22m which is aligned with the minimum clearance the RYA recommend for minimising allision risk (RYA, 2019).

18.5.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Application for Safety Zones;
- Design Specification and Layout Plan;
- Display on charts;
- Guard vessels;
- Lighting and Marking;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance;
- Minimum blade clearance;
- Navigational Safety Plan; and
- Promulgation of information.

18.5.3 Significance of Risk

Table 18.1 summarises the resulting significance of risk for each component of this hazard.

Table 18.1: Summary of shipping and navigation risk rankings for vessel to structure allision risk during operation and maintenance phase

Hazard Component	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Powered allision risk	Negligible	Serious	**Broadly Acceptable**
Drifting allision risk	Negligible	Serious	**Broadly Acceptable**
Internal allision risk	Extremely Unlikely	Serious	**Tolerable**

Assuming the implementation of ensuring plotter overlays are made available to fishing vessels including via FLO liaison, the hazard is considered **tolerable with mitigation** for internal allision risk.

18.6 Reduced Access to Local Ports

Vessels or activities associated with the operation and maintenance of the Project may hinder third party traffic access to local ports / facilities.

18.6.1 Qualification of Risk

The key port in the area is Peterhead, noting that the two potential landfall options for the Offshore Export Cable Corridor are located either side of the port.

Based on the distance offshore (in excess of 30nm), there is considered to be no impact from the structures in the Windfarm Site on port access.

Vessels associated with the operation and maintenance of the Project are not anticipated to notably increase overall baseline traffic levels in the area, and are likely to be less than during the construction phase. Marine coordination and vessel procedures will be in place to manage Project vessel movements and minimise any disruption to third-party vessels.

As such, no notable impact on port access is expected from Project vessels, noting any interactions with third party vessels would be managed via COLREGS in addition to the marine coordination procedures.

The Offshore Export Cable Corridor intersects the Peterhead Port Authority Harbour Limit (see Section 7.4.3), however is located in excess of 1nm from the port entrance. On this basis there is unlikely to be any impact to port access from cable maintenance activities, noting any impact would be temporary, infrequent, and spatially limited, with third party vessels still able to safely access Peterhead.

18.6.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Guard vessels;
- Marine Coordination;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

18.6.3 Significance of Risk

The frequency of occurrence is considered **extremely unlikely** given Project vessel movements will be managed via marine coordination. Severity of consequence is considered **minor.** On this basis the significance of risk is assessed to be **broadly acceptable**.

18.7 Reduction of Underkeel Clearance

Any changes in under keel clearance as a result of the Project infrastructure could lead to risk to passing vessels of under keel interaction.

18.7.1 Qualification of Risk

In terms of underkeel clearance, a risk may arise where any Project infrastructure not visible from the surface reduces water depths. The relevant infrastructure is therefore the subsea cables, the mooring lines, and the subsea sections of the floating substructures.

18.7.1.1 Subsea Cables

Where suitable burial is not possible, external remedial protection will be utilised where needed based on the cable burial risk assessment process. It is anticipated that this will be by either rock placement or concrete mattresses. It is estimated that up to 3km of the export cable to shore may need external protection, and up to 1km of the cable to Buzzard, noting that actual extents will be confirmed via the cable burial risk assessment process.

In line with MGN 654, where any depth reduction exceeded 5%, the Applicant will undertake further assessment and consult with the MCA to determine whether any additional mitigation is required to ensure safety of navigation.

The key areas of risk are likely to be in areas where water depths are shallow i.e., the coastal / nearshore areas where only smaller vessels would be expected to transit. Input received at the Hazard Workshop was that concern over underkeel risk to recreational vessels was limited given the cable locations will be charted.

It is noted that there will be sections of cables between the seabed and the floating substructures. Interaction with these sections is considered an unlikely event given the surface presence of infrastructure.

Should an underwater allision occur, minor damage incurred is the most likely consequence, and foundering of the vessel resulting in a PLL and pollution the unlikely worst case consequences.

18.7.1.2 Floating Substructures and Mooring Lines

Vessels navigating in proximity to the floating substructures may be at risk of interaction with either the mooring lines, or any underwater elements of the floating substructures not visible from the surface including the subsea cables. The level of risk will depend on the clearance available above the subsea elements of the substructures (in particular the mooring lines).

There will be up to six mooring lines per floating substructure used to secure the substructures to the seabed. There are two substructures under consideration, namely barges and semi submersible. The highest risk areas in terms of potential underkeel clearance interaction will be the areas in the immediate vicinity of the floating substructures where the mooring lines are closest to the surface. The same applies for the subsea cables. Assuming semisubmersible floating substructures, the mooring lines will connect at a point at least 10m below the waterline. If barges are used, then the mooring lines will connect above the waterline.

As per Section 18.1, it is likely that larger commercial vessels will not enter into the Windfarm Site. Further, input received during the hazard Workshop was that commercial vessels would likely view a floating development as higher risk than fixed foundation projects. On this basis, taking into consideration the baseline and anticipated post wind farm vessel routeing, it is considered unlikely that a commercial vessel would pass in close proximity to the floating substructures and hence be at risk of subsea interaction.

Therefore, it is likely that any vessels in proximity to the substructures will be small (e.g., fishing, recreation), noting that such vessels will typically have smaller draughts than larger commercial vessels. An assessment of fishing vessel draughts relative to the predicted mooring line descents showed that a typical fishing vessel in the area would have approximately 5m clearance assuming it remained in excess of 20m from the worst case substructure (the barge). This increased to 25m assuming the maximum fishing vessel draught recorded within the data. It is considered likely that any vessels passing in that close a proximity to the substructures will be transiting with caution noting that the surface section of the mooring lines will be visible above the waterline, and the relevant infrastructure will be charted. It will be necessary to confirm available underkeel clearance from the mooring lines post installation, in particular if catenary mooring lines are used. The confirmed available clearance should be discussed with the MCA and NLB post installation to determine if any additional mitigation is required.

There is limited experience of deployment of large scale floating offshore wind projects in UK waters, however it is noted that the Hywind and Kincardine floating projects are both located off the Eastern Scottish Coast. To date there have been no reported underkeel interactions between passing vessels and the components associated with these projects. Further, input from the Hazard Workshop was that vessels do fish in proximity to oil and gas floating infrastructure mooring lines / chains, and therefore will be familiar at an industry level of the proper procedures, assuming they are aware of the locations of the mooring lines.

Details of the infrastructure including the floating substructures, mooring lines and subsea cables will be promulgated to maximise awareness of the Project and any potential underkeel interaction risk. The locations of the floating substructures would be clearly shown on appropriate nautical charts, and the Applicant will also provide the locations of the anchors and mooring lines to the UKHO for charting purposes. Promulgation of information was noted as an important mitigation for fishing vessels within the Hazard Workshop (see Section 4.2.4), in particular ensuring fishing vessels had access to plotter overlays. This would ensure fishing vessels were aware of the locations of the mooring lines.

18.7.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Cable burial risk assessment;
- Display on charts;
- MGN 654 Compliance; and

- Promulgation of information.

18.7.3 Significance of Risk

Table 18.1 summarises the resulting significance of risk for each component of this hazard.

Table 18.2: Summary of shipping and navigation risk rankings for reduction in underkeel clearance during operation and maintenance phase

Hazard Component	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Subsea Cables	Negligible	Serious	**Broadly Acceptable**
Floating Substructures and Mooring Lines	Extremely Unlikely	Serious	**Tolerable**

Assuming the confirmation of available underkeel clearance in agreement with MCA and NLB post installation, and the implementation of ensuring plotter overlays are made available to fishing vessels including via FLO liaison the hazard is considered **tolerable with mitigation**.

18.8 Anchor Snagging Interaction

The presence of floating WTGs with mooring systems, interconnector cables, and inter-array/ offshore export cables may cause anchor snagging risk to passing vessels.

18.8.1 Qualification of Risk

Scenarios which may lead to anchor interaction with Project infrastructure include:

- Vessel dragging anchor over subsea cable following anchor failure;
- Vessel anchoring in an emergency over cable (e.g., to avoid drifting into a structure, of into an area of busy traffic);
- Vessel dropping anchor inadvertently (e.g., mechanical failure); or
- Planned anchoring where vessel unaware of presence of infrastructure.

Based on the vessel traffic assessment, baseline anchoring activity is low, with no vessels identified as being at anchor over the 28 days studied in proximity to the Windfarm Site or Offshore Export Cable Corridor (see Section 10). It is noted that the data collected is not comprehensive of non AIS vessels in the Cable Study Area, however no anchorage areas in proximity were identified in the navigational features assessment (see Section 7.5). On this basis it is considered that anchoring in the area is limited.

In line with Regulation 34 of SOLAS (IMO, 1974), the charted location of any hazards should be taken into consideration as part of the decision making process of where to anchor. The locations of cables, structure locations and mooring lines will be provided to the UKHO for charting purposes, and as such mariners will be able to include the infrastructure within their decision making processes. Input at the Hazard Workshop was that there was limited concern for recreational vessel anchors interacting with nearshore areas of cable given they will be displayed on charts.

18.8.1.1 Subsea Cables

Should an anchor interaction incident occur with the cables, the most likely consequences will be low based on historical anchor interaction incidents, with no damage incurred to the cable or the vessel. As an unlikely worst case, a snagging incident could occur and/or the vessel's anchor and the cable could be damaged. However, with the mitigation measures above in place, this risk will be minimised. For commercial fishing vessels or recreational vessels the consequences may also include compromised stability of the vessel.

The cables would be protected via either burial or remedial external protection. The protection required will be assessed as part of the cable burial risk assessment process which will consider baseline traffic patterns over the cables, and ensure protection is suitable for the expected vessel types, sizes and numbers in the area.

It is noted that there will be sections of cables between the seabed and the floating substructures. Interaction with these sections is considered an unlikely event given water depths and the presence of infrastructure means anchoring is unlikely to be attempted in the vicinity of the Windfarm Site.

18.8.1.2 Mooring Lines and Floating Substructures

There is limited data available with regards to anchor interaction with mooring lines and floating substructures, however consequences are likely to be similar to that of the cables. Regardless, given water depths in the vicinity of the Windfarm Site and noting the visible presence of the surface aspects of the floating substructures and display on charts, it is considered unlikely that vessels would attempt to anchor in the vicinity of the mooring lines. This aligns with the findings of the baseline assessment which indicated baseline anchoring volumes were low.

18.8.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Cable burial risk assessment;
- Display on charts;
- MGN 654 Compliance; and
- Promulgation of information.

18.8.3 Significance of Risk

The frequency of occurrence in relation to the risk of anchor interaction is considered **extremely unlikely** baseline anchoring is low and the cable burial risk assessment process will ensure the cables are protected. Severity of consequence is considered **moderate.** On this basis the significance of risk is assessed to be **broadly acceptable**.

18.9 Loss of Station

In the event that the mooring system holding a floating substructure fails, the floating substructure may suffer loss of station and become a floating hazard to passing vessels.

18.9.1 Qualification of Risk

The MCA require under their Regulatory Expectations on Moorings for Floating Wind and Marine Devices (MCA & HSE, 2017) that developers arrange Third Party Verification (TPV) of the mooring systems by an independent and competent person / body. The Regulatory Expectations state that TPV is a "continuous activity", and that any modifications to a system or if new information becomes available with regard to its reliability, additional TPV would be required.

On this basis, a loss of station is considered likely to represent a low frequency event, noting that for a total loss of station, all moorings would be required to fail (based on current envelope there will be between three and six depending on the design chosen).

The Regulatory Expectations also require the provision of continuous monitoring either by GPS or other suitable means, The Applicant will put such a system in place, with each WTG continuously monitored, and with capability of being tracked via AIS in the event of a loss of station as detailed in MGN 654. Each WTG will also have an alarm system in place, whereby an alert will be provided to the Marine Coordination Centre in the event that any floating substructure leaves a pre-defined ringfenced alarm zone. This means in the unlikely event that a floating substructure suffers total loss of station and drifts outside of its alarm zone, the Applicant would be made aware, and would be able to track its position and make the necessary emergency arrangements.

18.9.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Lighting and Marking;
- MCA & HSE Regulatory Expectations Compliance;
- MGN 654 Compliance; and
- Promulgation of information.

18.9.3 Significance of Risk

The frequency of occurrence in relation to the risk of loss of station is considered **negligible** noting the third party verification and associated requirements under the MCA regulatory expectations. Severity of consequence is considered **serious.** On this basis the significance of risk is assessed to be **broadly acceptable**.

18.10 Reduction of emergency response capability

Presence of structures in the Windfarm Site and increased vessel activity and personnel numbers may reduce emergency response capability by increasing the number of incidents, increasing consequences or reducing access for the responders.

18.10.1 Qualification of Risk

The operation of the Project will lead to an increased level of vessels and personnel in the area over baseline levels, however it is likely to be less than during the construction phase. On this basis there may be an increase in the number of incidents requiring emergency response over baseline rates.

Baseline incident rates are considered low in the area based on the data studied, with an average of between one and two incidents per year indicated within the MAIB, RNLI and helicopter taskings datasets. It is also noted that to date, there have only been 13 reported allision or collision incidents associated with offshore wind farms in the UK (see Section 9.6). While it should be considered that this only covers allisions and collisions, it is still not anticipated that the Project would notably increase the observed baseline incident rates.

It is noted that an average of one to two helicopter taskings per year were recorded in the study area (see Section 9.1). However, the significant majority of these were associated with rescue/recovery from the nearby Buzzard and Golden Eagle platforms. The frequency at which a helicopter tasking is required at the Project is considered lower probability based on the lower personnel numbers that are likely to be on vessels within the Windfarm Site.

Further, the on-site vessels and resources associated with the Project will form additional resource to respond to any incidents in the area in liaison with the MCA, both in terms of incidents associated with the projects (i.e., self help resources), but also incidents occurring outside of the Windfarm Site to third party vessels. Any vessels at the nearby fields may also be able to assist. As required under MGN 654, the Applicant will produce and submit an ERCoP to the MCA detailing how they would cooperate and assist in the event of an incident including consideration of Project resources.

The final layout will be agreed with the MCA post consent and will comply with the requirements of MGN 654 ensuring suitable SAR access is maintained. As detailed above, the majority of helicopter taskings were associated with the Buzzard and Golden Eagle platforms, inshore of the Project.

18.10.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Design Specification and Layout Plan;
- Display on charts;
- Guard vessels;
- Marine Coordination;

- Marine Pollution Contingency Plan;
- MGN 654 Compliance; and
- Project vessel compliance with international marine regulations.

18.10.3 Significance of Risk

The frequency of occurrence in relation is considered **extremely unlikely** noting the limited anticipated effect on incidents rates and MGN 654 compliance including in relation to layout design and SAR access. Severity of consequence is considered **moderate.** On this basis the significance of risk is assessed to be **broadly acceptable**.

19 Decommissioning Phase Risk Assessment

This section assesses potential hazards associated with the decommissioning phase. It is noted that as per Section 6.6, the Project will also follow the requirements in place at the time of decommissioning from the relevant guidance which currently has a presumption for full removal with any exceptions requiring justification. Potentially, fully-buried cables may be left in areas where sediment is stable so that they are likely to remain buried.

19.1 Vessel Displacement

Decommissioning activities associated with the removal of structures and cables may displace existing routes/activity.

19.1.1 Qualification of Risk

It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 17.1) on the basis that the methods used to remove infrastructure are expected to be similar to those used for installation.

Therefore, route deviations will be similar to those established during the construction phase. As per Section 17.1, these deviations are anticipated to be minor, with only a limited number of vessels requiring to deviate.

As such, it is considered that risk will be within levels observed during the construction phase.

19.1.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Lighting and Marking;
- MGN 654 Compliance; and
- Promulgation of information.

19.1.3 Significance of Risk

On the basis of the risk qualification undertaken the significance of risk is assessed to be equivalent to the construction phase and is therefore **broadly acceptable**.

19.2 Adverse Weather

The presence of the structures within the Windfarm Sites could restrict adverse weather routeing in the area during decommissioning.

19.2.1 Qualification of Risk

General concerns were raised during consultation (see Section 4) around restriction of adverse weather routeing options in the area. A review of the vessel traffic survey data did not identify any adverse weather routeing occurring in the area (see Section 11.2), however it should be considered that in adverse weather conditions, vessels may choose to pass further from the ongoing construction activities in the Windfarm Site. As per Section 11.2.1, there is considered to be sea space available south of the Windfarm Site to accommodate such transits.

Details of the Project would be promulgated to facilitate advanced passage planning including in adverse conditions. Under COLREGS (IMO, 1972), vessels are also required to take appropriate measures with regards to determining a safe speed, taking into account various factors including the state of visibility, the state of the wind, sea, and current as well as the proximity of navigational hazards.

19.2.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Lighting and Marking;
- MGN 654 Compliance; and
- Promulgation of information.

19.2.3 Significance of Risk

The frequency of occurrence in relation to restriction of adverse weather routeing is considered **extremely unlikely** given there is searoom available to accommodate vessel routeing. Severity of consequence is considered **moderate**. On this basis the significance of risk is assessed to be **broadly acceptable**.

19.3 Increased vessel to vessel collision risk (third party to third party)

Vessel displacement of third party vessels may lead to increased encounters and collision risk.

19.3.1 Quantification and Qualification of Risk

As discussed in Section 19.1, any deviations and displacement of third party traffic is anticipated to be low during the decommissioning phase, with vessels likely transiting as per the routeing established during the construction and operational phases. Any increase in collision risk is therefore also likely to be similar, and as per Section 18.3 these are expected to be low.

Similar to the construction phase, smaller vessels may also choose to avoid the Windfarm Site which could lead to increased encounters with larger commercial vessels. However, given the limited traffic levels, searoom available, and noting such encounters would be managed via COLREGS and SOLAS, it is considered unlikely that this would lead to any notable increase in collision risk.

Details of the Project decommissioning will be promulgated in advance, ensuring vessels can passage plan to minimise disruption and deviations, which will in turn minimise collision risk.

As such, it is considered that risk will be within levels observed during the construction phase.

19.3.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance; and
- Promulgation of information.

19.3.3 Significance of Risk

On the basis of the risk qualification undertaken the significance of risk is assessed to be equivalent to the construction phase and is therefore **broadly acceptable**.

19.4 Increased vessel to vessel collision risk (third party to project vessel)

Vessels associated with construction activities for the Project may increase encounters and collision risk for other vessels already operating in the area.

19.4.1 Qualification of Risk

It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 17.1) on the basis that the methods and vessels used to remove infrastructure are expected to be similar to those used for installation.

As for the other phases, the risk of encounters and collision risk associated with Project vessels will be managed by marine coordination. An application for safety zones during decommissioning will also be made, and advisory safe passing distances will be used where necessary to ensure the area around sensitive operations is made clear to passing vessels.

As such, it is considered that risk will be within levels observed during the construction phase.

19.4.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Application for Safety Zones;
- Display on charts;
- Guard vessels;
- Lighting and Marking;
- Marine Coordination;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

19.4.3 Significance of Risk

On the basis of the risk qualification undertaken the significance of risk is assessed to be equivalent to the construction phase and is therefore **broadly acceptable**.

19.5 Vessel to Structure Allision Risk

Presence of structures in the Windfarm Site may increase powered, drifting and internal allision risk for vessels during decommissioning.

19.5.1 Qualification of Risk

Allision risk during decommissioning is likely to be similar to that during the construction phase (see Section 17.5) noting similar activities will be occurring and mitigations in place. Vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the decommissioning of the Project meaning allision risk will be minimised.

As such, it is considered that risk will be within levels observed during the construction phase.

19.5.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Application for Safety Zones;
- Display on charts;
- Guard vessels;
- Lighting and Marking;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance;
- Minimum blade clearance; and
- Promulgation of information.

19.5.3 Significance of Risk

On the basis of the risk qualification undertaken the significance of risk is assessed to be equivalent to the construction phase and is therefore **tolerable with mitigation**.

19.6 Reduced Access to local Ports

Vessels or activities associated with the decommissioning of the Project may hinder third party traffic access to local ports / facilities.

19.6.1 Qualification of Risk

It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 17.1) on the basis that the methods and vessels used to remove infrastructure are expected to be similar to those used for installation.

On this basis as discussed in Section 17.6, vessels associated with the decommissioning of the Project and the associated activities are not anticipated to notably impact port access, noting marine coordination will be in place. The Windfarm Site is in excess of 30nm from shore and as such will also not impact port access.

As such, it is considered that risk will be within levels observed during the construction phase.

19.6.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Display on charts;
- Guard vessels;
- Marine Coordination;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

19.6.3 Significance of Risk

On the basis of the risk qualification undertaken the significance of risk is assessed to be equivalent to the construction phase and is therefore **broadly acceptable**.

19.7 Reduction of emergency response capability

Increased vessel activity and personnel numbers associated with the decommissioning of the Project may reduce emergency response capability by increasing the number of incidents, increasing consequences or reducing access for the responders.

19.7.1 Qualification of Risk

It is anticipated that this hazard will be similar in nature to the equivalent construction phase hazard (see Section 17.1) on the basis that the methods and vessels used to remove infrastructure are expected to be similar to those used for installation, including in relation to increased personnel on site. This includes the assumption that the vessels on site associated with decommissioning will form additional resource to respond to any incidents in the area in liaison with the MCA, both in terms of incidents associated with the projects (i.e., self help resources), but also incidents occurring outside of the Windfarm Site to third party vessels.

As required under MGN 654, the Applicant will produce and submit an ERCoP to the MCA detailing how they would cooperate and assist in the event of an incident including during the decommissioning phase.

As such, it is considered that risk will be within levels observed during the construction phase.

19.7.2 Relevant Mitigation Measures

The embedded mitigation measures which have been identified as relevant are as follows (further detail on embedded mitigation is included in Section 21):

- Design Specification and Layout Plan;
- Display on charts;
- Guard vessels;
- Marine Coordination;
- Marine Pollution Contingency Plan;
- MGN 654 Compliance; and
- Project vessel compliance with international marine regulations.

19.7.3 Significance of Risk

On the basis of the risk qualification undertaken the significance of risk is assessed to be equivalent to the construction phase and is therefore **broadly acceptable**.

20 Cumulative Risk Assessment

This section assesses relevant hazards on a cumulative basis. **Table 20.1** provides a summary of which hazards have been screened into the cumulative risk assessment, with rationale behind the screening for each included.

Table 20.1: Cumulative Risk Assessment Screening

Hazard	Screened In	Rationale
Vessel Displacement	Yes	As per the cumulative routeing assessment (see Section 14.6), cumulative deviations are anticipated.
Increased Vessel to Vessel Collision Risk (third party to third party)	Yes	As per the cumulative routeing assessment (see Section 14.6), cumulative deviations are anticipated, and as such there may be a cumulative increase in collision risk.
Increased Vessel to Vessel Collision Risk (third party to Project vessel)	Yes	There may be a cumulative increase in vessels associated with cumulative developments in the area.
Vessel to structure allision risk	Yes	There may be a cumulative increase in allision risk associated with other developments.
Reduced Access to local ports	No	There is anticipated to be limited impact on port access from the Project in isolation on the basis of anticipated Project vessel levels and as such no cumulative increases associated with the Project are expected.
Reduction of underkeel clearance	No	Hazard is localised to the area in the vicinity of each individual development.
Anchor snagging interaction	No	Hazard is localised to the area in the vicinity of each individual development.
Loss of station	No	Managed via Regulatory Expectations which will apply to all developers.
Reduction of emergency response capability	Yes	There may be a cumulative increase in incident rates associated with the cumulative developments.

The cumulative risk assessment takes the same approach as that detailed for the Project in isolation (see Section 16).

20.1 Vessel Displacement

The presence of structures in the Windfarm Site may displace existing routes/activity on a cumulative basis.

The assessment of cumulative routeing (see Section 14.6) showed that certain main routes in the area are likely to require deviations on a cumulative basis. However, there is searoom available to accommodate the deviations, and only low volumes of traffic would be affected. The closest project to the Windfarm Site is Marram, located 5nm to the north. Vessels may choose to pass between the two projects, however there is considered to be sufficient room to accommodate such transits.

There may be some minor deviations required to avoid any construction or maintenance works associated with the Acorn CCS project to the north, however any impact would be temporary and spatially limited (all associated infrastructure is subsea, and as such there will be no deviations during normal operations).

On this basis, considering the size of the cumulative area assessed, cumulative displacement is assessed as being of **negligible** consequence in terms of navigational safety but of **reasonably probable** occurrence, meaning significance is **broadly acceptable** and ALARP.

20.2 Increased vessel to vessel collision risk (third party to third party)

Cumulative vessel displacement of third party vessels may lead to increased encounters and collision risk.

As per Section 14.6, deviations on a cumulative basis are anticipated to occur. However, only a limited volume of traffic is expected to be impacted and as such a notable increase in collision rates is not anticipated. Further, there is searoom available to safely accommodate any increases in vessel density associated with the anticipated deviations. This includes the area between Marram and the Windfarm Site, with the spacing between the projects being 5nm.

On this basis, considering the size of the cumulative area assessed, cumulative increase in collision risk is assessed as being of **serious** consequence in terms of navigational safety but of **negligible** occurrence, meaning significance is **broadly acceptable** and ALARP.

20.3 Increased Vessel to Vessel Collision Risk (third party to Project vessel)

Vessels associated with the of the Project may increase encounters and collision risk for other vessels already operating in the area on a cumulative basis.

There is the potential that similar ports could be used by developments in terms of mobilising construction and / or maintenance vessels. On this basis, there may be a cumulative increase in project vessels within the general area, and as such the potential for increased encounters and collision risk. However, all developers should be establishing appropriate vessel management systems (e.g., marine coordination) and as such any encounters will be managed, including by COLREGS and SOLAS.

It is noted that there is already oil and gas vessel activity regularly occurring in the general area, and as such passing vessels will be familiar with ongoing operations being undertaken.

On this basis, taking into considering the size of the cumulative area assessed, cumulative increase in collision risk (third party to project vessel) is assessed as being of **serious** consequence in terms of navigational safety but of **negligible** occurrence, meaning significance is **broadly acceptable** and ALARP.

20.4 Vessel to Structure Allision Risk

Presence of structures in the Windfarm Site may increase cumulative allision risk for passing vessels.

The nearest screened in cumulative development is Marram, located approximately 5nm to the north. As per the cumulative routeing assessment (see Section 14.6), certain vessels may choose to pass between the Windfarm Site and Marram and as such may experience increased cumulative allision risk at a localised level. All other screened in developments are at least 18nm from the Windfarm Site and as such are unlikely to lead to notably increased cumulative allision risk given the localised spatial are of relevance of the hazard.

For vessels passing in between Marram and the Windfarm Site, there is considered to be sufficient searoom between the boundaries to safely accommodate vessel transits, with enough space for vessels to pass a safe distance from both developments.

All developments will be required to implement lighting and marking in agreement with NLB and in compliance with IALA G1162/O-139 (IALA, 2021). For each development these discussions will include consideration of the current cumulative understanding, thus minimising allision risk on a cumulative basis. Further, the developer of Marram will be required to agree layout with the MCA and NLB, with these agreements including consideration of navigational safety.

Allision hazards associated with internal navigation is localised to each individual development, however given the proximity of Marram, there may be increased cumulative allision risk.

On this basis, taking into consideration the size of the cumulative area assessed, cumulative increase in allision risk is assessed as being of **serious** consequence in terms of navigational safety but of **extremely unlikely** occurrence, meaning significance is **tolerable**.

20.5 Reduction of emergency response capability

Increased vessel activity and personnel numbers associated with the Project may reduce emergency response capability by increasing the number of incidents, increasing consequences or reducing access for the responders on a cumulative basis.

Given the low baseline incident rates, and noting the additional resources that would be available at other projects (including both wind farms and oil and gas), there is not considered likely to be a notable effect on emergency response resources on a cumulative level. This takes account of historical data showing that allisions and collisions caused by wind farms do not occur at a high frequency (see Section 9.6.1).

All wind farm developments will be required to agree a layout with the MCA and considering the requirements of MGN 654, ensuring suitable SAR access is available. Regardless, SAR operations within a given development will be localised to the area of the operation. As such no cumulative impact on SAR access is anticipated.

The frequency of occurrence in relation is considered **extremely unlikely** noting the limited anticipated effect on incidents rates and MGN 654 compliance including in relation to layout design and SAR access. Severity of consequence is considered **moderate.** On this basis the significance of risk is assessed to be **broadly acceptable**.

21 Risk Control Log

21.1 Mitigation Measures

21.1.1 Embedded Mitigation

Embedded mitigations adopted for the purposes of reduce the risks of the identified hazards associated with the construction, operation and decommissioning of the Project are summarised in **Table 21.1.** Details of how each are secured are included in **Chapter 16: Shipping and Navigation**.

Table 21.1: Embedded Mitigation Measures

Mitigation Measure	Description
Application for Safety Zones	Application to Marine Scotland for safety zones around structures as per relevant legislation (Energy Act 2004 and Electricity Regulations 2007). The application will include 500m safety zones around structures where construction or major maintenance is ongoing, and 50m pre-commissioning safety zones around partially completed or completed structures prior to commissioning of the Project. The Applicant will consider relevant operations required for and risks associated with a floating project to determine what will be applied for post consent including which activities may require safety zones and which vessels will trigger their use. Consultation will be undertaken with MCA, NLB and MS-LOT as part of this process to agree what mitigation are necessary for a large scale floating project.
Cable burial risk assessment	Implementation and monitoring of cable protection. This will include via burial, or external protection where adequate burial depth as identified via risk assessment is not feasible.
Design Specification and Layout Plan	The layout of structures will be agreed with MCA and NLB as part of the DSLP process. This will include consideration of SAR and surface navigation.
Display on charts	Appropriate marking of Project infrastructure on appropriate UKHO Admiralty Charts.
Guard vessels	Use of guard vessel(s) where necessary as identified by risk assessment.

Mitigation Measure	Description
Lighting and Marking Plan	Lighting and Marking Plan setting out how the Project will be lit and marked in agreement with NLB and in line with IALA Guidance G1162/R139 (IALA, 2021). This will include agreement on any construction buoyage requirements.
Marine Coordination	Marine coordination and communication for the purposes of managing project vessel movements.
Marine Pollution Contingency Plan	Implementation of a Marine Pollution Contingency Plan.
MCA & HSE Regulatory Expectations Compliance	Compliance with the Regulatory Expectations on Moorings for Floating Wind and Marine Devices, in particular independent TPV and monitoring / tracking.
MGN 654 Compliance	Compliance with MGN 654 and its annexes including SAR annex 5 (MCA, 2021) and completion of a SAR checklist.
Minimum blade clearance	Minimum blade clearance of 22 m above MSL (in line with RYA policy (RYA, 2019) and MGN 654 (MCA, 2021)).
Navigational Safety Plan	Implementation of a Navigational Safety Plan setting out the navigational safety measures that will be in place during the construction and operational phases.
Project vessel compliance with international marine regulations	Compliance of all project vessels with international marine regulations as adopted by the Flag State, notably COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974).
Promulgation of information	Promulgation of information via all usual means (e.g., Kingfisher bulletins, Notifications to Mariners).
Vessel Management Plan	Implementation of a Vessel Management Plan to ensure Project vessel movements are managed to minimise disruption to third party vessels.

21.1.2 Additional Mitigation

Based on the findings of the modelling and the outputs of the Hazard Workshop, it was determined that additional mitigation was necessary to ensure that hazards associated with internal allision risk and underkeel interaction with the floating substructures and mooring lines were ALARP. The necessary additional mitigation is as follows:

- Targeted promulgation of information to the fishing industry including via the FLO, with the relevant information being:
  - Provision of plotter overlay data including where this was available;
  - Clear guidance around how the plotter overlays should be used; and
- Confirmation of final underkeel clearance available post installation and agreement with MCA and NLB on any necessary mitigation.

21.2 Risk Control Log

Table 21.2 presents a summary of the assessment of shipping and navigation hazards scoped into the risk assessment. This includes the proposed embedded mitigation measures, frequency of occurrence, severity of consequence and significance of risk for each hazard. For risks where multiple components were assessed (e.g., powered, drifting and internal allision risk) the component(s) resulting in the worst-case risk is presented.

Table 21.2: Risk Control Log

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
Construction	Vessel Displacement	▪ Display on charts; ▪ Lighting and Marking; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Reasonably Probable**	**Negligible**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Restriction of Adverse Weather Routeing	▪ Display on charts; ▪ Lighting and Marking; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Extremely Unlikely**	**Moderate**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Third Party to Third Party Vessel Collision	▪ Display on charts; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; and ▪ Promulgation of information	**Negligible**	**Serious**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Third party to Project Vessel Collision	▪ Application for Safety Zones; ▪ Display on charts; ▪ Guard vessels; ▪ Lighting and Marking; ▪ Marine Coordination; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance;	**Negligible**	**Serious**	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
		▪ Navigational Safety Plan; ▪ Project vessel compliance with international marine regulations; ▪ Promulgation of information; and ▪ Vessel Management Plan.					
	Vessel to Structure Allision	▪ Application for Safety Zones; ▪ Design Specification and Layout Plan; ▪ Display on charts; ▪ Guard vessels; ▪ Lighting and Marking; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; ▪ Minimum blade clearance; ▪ Navigational Safety Plan; and ▪ Promulgation of information.	**Extremely Unlikely**	**Serious**	**Tolerable**	Vessel plotter overlay provision and guidance.	**Tolerable with mitigation**
	Reduced Port Access	▪ Display on charts; ▪ Guard vessels; ▪ Marine Coordination;	**Extremely Unlikely**	**Minor**	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
		▪ Project vessel compliance with international marine regulations; and ▪ Promulgation of information.					
	Reduction of Emergency Response Capability	▪ Design Specification and Layout Plan; ▪ Display on charts; ▪ Guard vessels; ▪ Marine Coordination; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; and ▪ Project vessel compliance with international marine regulations.	**Extremely Unlikely**	**Moderate**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Operations and Maintenance	Vessel Displacement	▪ Display on charts; ▪ Lighting and Marking; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Remote**	**Negligible**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Restriction of Adverse Weather Routeing	▪ Display on charts; ▪ Lighting and Marking; ▪ MGN 654 Compliance; and	**Extremely Unlikely**	**Moderate**	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
		▪ Promulgation of information.					
	Third Party to Third Party Vessel Collision	▪ Display on charts; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Negligible**	**Serious**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Third Party to Project Vessel Collision	▪ Application for Safety Zones; ▪ Display on charts; ▪ Guard vessels; ▪ Lighting and Marking; ▪ Marine Coordination; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; ▪ Navigational Safety Plan; ▪ Project vessel compliance with international marine regulations; and ▪ Promulgation of information; and ▪ Vessel Management Plan.	**Negligible**	**Serious**	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
	Vessel to Structure Allision	▪ Application for Safety Zones; ▪ Design Specification and Layout Plan; ▪ Display on charts; ▪ Guard vessels; ▪ Lighting and Marking; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; ▪ Minimum blade clearance; ▪ Navigational Safety Plan; and ▪ Promulgation of information.	**Extremely Unlikely**	**Serious**	**Tolerable**	Vessel plotter overlay provision and guidance.	**Tolerable with mitigation**
	Reduced Port Access	▪ Display on charts; ▪ Guard vessels; ▪ Marine Coordination; ▪ Project vessel compliance with international marine regulations; and ▪ Promulgation of information.	**Extremely Unlikely**	**Minor**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Reduction of Under Keel Clearance	▪ Cable burial risk assessment; ▪ Display on charts; ▪ MGN 654 Compliance; and	**Extremely Unlikely**	**Serious**	**Tolerable**	Post construction validation of available underkeel	**Tolerable with mitigation**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
		▪ Promulgation of information.				clearance available over mooring lines in liaison with MCA and NLB. Vessel plotter overlay provision and guidance.	
	Anchor Snagging Interaction	▪ Cable burial risk assessment; ▪ Display on charts; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Negligible**	**Minor**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Loss of Station	▪ Display on charts; ▪ Lighting and Marking; ▪ MCA & HSE Regulatory Expectations Compliance; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Negligible**	**Serious**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Reduction of Emergency Response Capability	▪ Design Specification and Layout Plan; ▪ Display on charts; ▪ Guard vessels; ▪ Marine Coordination;	**Extremely Unlikely**	**Moderate**	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
		▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; and ▪ Project vessel compliance with international marine regulations.					
Decommissioning	Vessel Displacement	▪ Display on charts; ▪ Lighting and Marking; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Reasonably Probable**	**Negligible**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Restriction of Adverse Weather Routeing	▪ Display on charts; ▪ Lighting and Marking; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Extremely Unlikely**	**Moderate**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Third Party to Third Party Vessel Collision	▪ Display on charts; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Negligible**	**Serious**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Third party to Project	▪ Application for Safety Zones; ▪ Display on charts; ▪ Guard vessels;	**Negligible**	**Serious**	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
	Vessel Collision	▪ Lighting and Marking; ▪ Marine Coordination; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; ▪ Project vessel compliance with international marine regulations; and ▪ Promulgation of information.					
	Vessel to Structure Allision	▪ Application for Safety Zones; ▪ Display on charts; ▪ Guard vessels; ▪ Lighting and Marking; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; ▪ Minimum blade clearance; and ▪ Promulgation of information.	**Extremely Unlikely**	**Serious**	**Tolerable**	Vessel plotter overlay provision and guidance.	**Tolerable with mitigation**
	Reduced Port Access	▪ Display on charts; ▪ Guard vessels; ▪ Marine Coordination;	**Extremely Unlikely**	**Moderate**	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
		▪ Project vessel compliance with international marine regulations; and ▪ Promulgation of information.					
	Reduction of Emergency Response Capability	▪ Design Specification and Layout Plan; ▪ Display on charts; ▪ Guard vessels; ▪ Marine Coordination; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; and ▪ Project vessel compliance with international marine regulations.	**Extremely Unlikely**	**Moderate**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
Cumulative	Vessel Displacement	▪ Display on charts; ▪ Lighting and Marking; ▪ MGN 654 Compliance; and ▪ Promulgation of information.	**Reasonably Probable**	**Negligible**	**Broadly Acceptable**	**n/a**	**Broadly Acceptable**
	Third Party to Third Party Vessel Collision	▪ Display on charts; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; and	**Negligible**	**Serious**	**Broadly Acceptable**	n/a	**Broadly Acceptable**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
		▪ Promulgation of information					
	Third party to Project Vessel Collision	▪ Application for Safety Zones; ▪ Display on charts; ▪ Guard vessels; ▪ Lighting and Marking; ▪ Marine Coordination; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; ▪ Navigational Safety Plan; ▪ Project vessel compliance with international marine regulations; ▪ Promulgation of information; and ▪ Vessel Management Plan.	**Negligible**	**Serious**	**Broadly Acceptable**	n/a	**Broadly Acceptable**
	Vessel to Structure Allision	▪ Design Specification and Layout Plan; ▪ Display on charts; ▪ Guard vessels; ▪ Lighting and Marking; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance;	**Extremely Unlikely**	**Serious**	**Tolerable**	Vessel plotter overlay provision and guidance.	**Tolerable with mitigation**

Project Phase	Hazard	Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation	Residual Risk
		▪ Minimum blade clearance; and ▪ Promulgation of information.					
	Reduction of Emergency Response Capability	▪ Design Specification and Layout Plan; ▪ Display on charts; ▪ Guard vessels; ▪ Marine Coordination; ▪ Marine Pollution Contingency Plan; ▪ MGN 654 Compliance; and ▪ Project vessel compliance with international marine regulations.	**Extremely Unlikely**	**Moderate**	**Broadly Acceptable**	n/a	**Broadly Acceptable**

22 Through Life Safety Management

Health, Safety and Environment Quality, (HSEQ) documentation including a Safety Management System (SMS) will be in place for the Project and will be continually updated throughout the development process. The following subsections provide an overview of this documentation and how it will be maintained and reviewed with reference, where required, to specific marine documentation.

Monitoring, reviewing, and auditing will be carried out on all procedures and activities and feedback actively sought. Any designated person (identified in HSEQ documentation), managers, and supervisors are to maintain continuous monitoring of all marine operations and determine if all required procedures and processes are being correctly implemented.

22.1 Incident Reporting

After any incidents, including near misses, an incident report form will be completed in line with the Project HSEQ documentation. This will then be assessed for relevant outcomes and reviewed for possible changes required to operations.

The Applicant will maintain records of investigation and analyse incidents in order to:

- Determine underlying deficiencies and other factors that may be causing or contributing to the occurrence of incidents;
- Identify the need for corrective action;
- Identify opportunities for preventative action;
- Identify opportunities for continual improvement; and
- Communicate the results of such investigations.

All investigations shall be performed in a timely manner.

A database (lessons learnt) of all marine incidents will be developed. It will include the outcomes of investigations and any resulting actions. The Applicant will promote awareness of their potential occurrence and provide information to assist monitoring, inspection and auditing of documentation.

When appropriate, the designated person (noted within the ERCoP) should inform the MCA of any exercise or incidents including any implications on emergency response. If required, the MCA should be invited to take part in incident debriefs.

22.2 Review of Documentation

The Applicant will be responsible for reviewing and updating all documentation including the risk assessments, ERCoP, SMS and, if required, will convene a review panel of stakeholders to quantify risk.

Reviews of the risk register should be made after any of the following occurrences:

- Changes to the Project, conditions of operation and prior to decommissioning;

- Planned reviews; and
- Following an incident or exercise.

A review of potential risks should be carried out annually. A review of the response charts should be undertaken annually to ensure that response procedures are up to date and should include any amendments from audits, incident reports and identified deficiencies

22.3 Inspection of Resources

All vessels, facilities, and equipment necessary for marine operations associated with the Project are to be subject to appropriate inspection and testing to determine fitness for purpose and availability in relation to their performance standards. This will include monitoring and inspection of all AtoN to determine compliance with the performance standards specified by NLB.

22.4 Audit Performance

Auditing and performance review are the final steps in HSEQ management systems. The feedback loop enables an organisation to reinforce, maintain and develop its ability to reduce risks to the fullest extent, and to ensure the continued effectiveness of the system. The Applicant will carry out audits and periodically evaluate the efficiency of the marine safety documentation.

The audits and possible corrective actions should be undertaken in accordance with standard procedures and results of the audits and reviews should be brought to the attention of all personnel having responsibility in the area involved.

22.5 Safety Management System

The Applicant will manage the risk associated with the activities undertaken at the Project. An integrated SMS, which ensures that the safety and environmental risks of those activities are ALARP, will be established. This includes the use of remote monitoring and switching for aids to navigation to ensure that if a light is faulty a quick fix can be instigated, which will allow IALA availability requirements to be met.

22.6 Cable Monitoring

The subsea cable routes will be subject to periodic inspection post-construction to monitor the cable protection, including burial depths. Maintenance of the protection will be undertaken as necessary.

If exposed cables or ineffective protection measures are identified during post-construction monitoring, these would be promulgated to relevant sea users including via Notice to Mariners and Kingfisher Bulletins. Where immediate risk was observed, the Applicant would also employ additional temporary measures (such as a guard vessel or temporary buoyage) until such time as the risk was permanently mitigated.

Details will be included in full within the assessment of cable burial and protection document, to be produced post-consent.

22.7 Hydrographic Surveys

As required by Annex 4 of MGN 654, detailed and accurate hydrographic surveys will be undertaken periodically at intervals agreed with the MCA.

22.8 Decommissioning Plan

A Decommissioning Plan will be developed post consent. With regards to hazards to shipping and navigation, this will also include consideration of the scenario where upon decommissioning and completion of removal operations, an obstruction is left on-site (attributable to the Project) which is considered to be a danger to navigation and which it has not proved possible to remove. Such an obstruction may require marking until such time as it is either removed or no longer considered a danger to navigation, the continuing cost of which would need to be met by the Applicant.

23 Summary

23.1 Consultation

The NRA process has included consultation with stakeholders of relevance to shipping and navigation. This has included consideration of the outputs of the scoping process, direct liaison with key stakeholders (both statutory and non-statutory), outreach to Regular Operators of the area, a recreational outreach, and a Hazard Workshop process. Key stakeholders consulted include:

- MCA;
- NLB;
- UK CoS;
- RYA Scotland;
- Cruising Association;
- RNLI;
- Local harbours and ports; and
- Regular operators of the area.

23.2 Existing Environment

23.2.1 Navigational Features

Within the study area there is six oil and gas platforms, four associated with the Buzzard Complex, and two with the Golden Eagle Complex.

Within proximity to the Windfarm Site, there are four AtoN all positioned on operational oil and gas structures in the area with the closest located 7nm northwest on the Golden Eagle platform. Six AtoN are positioned within Peterhead Bay, all associated with Peterhead Port, and are positioned between the two landfall options of the Offshore Export Cable Corridor. Peterhead Port is the closest port or harbour to the Offshore Development Area, approximately 39nm from the Windfarm Site boundary with Aberdeen and Fraserburgh Harbours being close by.

There are 11 charted wrecks and obstructions within the study area, noting none are within the Windfarm Site itself.

The export power cable for the Hywind offshore wind farm intersects the south Offshore Export Cable Corridor landfall option at approximately 3nm offshore.

There are three spoil grounds located in proximity to the Offshore Export Cable Corridor with the closest, and largest, approximately 500m north of the south landfall option and is also directly north of the only foul area in the Offshore Development Area, approximately 0.7nm from the coast.

There is no IMO routeing measures, military practice and exercise areas, or charted anchorages within or near the Offshore Development Area.

23.2.2 Maritime Incidents

From MAIB incident data analysed over a 10-year period, an average of one unique incident per year occurred within the study area. One incident was reported to the MAIB within the Windfarm Site – a collision involving two offshore supply vessels.

A total of ten SAR helicopter taskings were undertaken for incidents within the study area between April 2015 and March 2021, corresponding to an average of between one and two taskings per year. All taskings were "*rescue/recovery*" and none were inside the Windfarm Site.

From RNLI incident data analysed over a 10-year period from 2010-2019, ten RNLI lifeboat launches were reported within the study area. One incident was reported to the MAIB within the Windfarm Site – a 'person in danger'.

23.2.3 Vessel Traffic Movements

The Windfarm Site vessel traffic survey consist of 28 days AIS and Radar data recorded during surveys between 5th and 18th August 2021 (14 days summer) and 5th and 18th January 2022 (14 days winter). The surveys were carried out by ERRV *Fastnet Sentinel*.

The Offshore Export Cable Corridor vessel traffic survey consisted of 28 days AIS data recorded during the same periods as the Windfarm Site vessel traffic surveys. The survey consists of shore based AIS survey data combined with the Windfarm Site traffic survey data.

The data was assessed to identify the main user types and operators within the Windfarm Site and Offshore Export Cable Corridor and their surrounding shipping and navigation study areas.

23.2.3.1 Windfarm Site

For the 14 days analysed in summer 2021 there was an average of 22 unique vessels per day passing within the study area. In terms of vessels intersecting the Windfarm Site, there was an average of between three and four unique vessels per day. For the 14 days analysed in winter 2022 there was an average of 14 unique vessels per day passing within the study area with an average of three unique vessels per day intersecting the Windfarm Site. Throughout the summer period, the majority of tracks were fishing vessels (56%) and oil and gas vessels (32%). Throughout the winter period the majority of tracks were oil and gas vessels (62%) and fishing vessels (22%).

23.2.3.2 Offshore Export Cable Corridor

AIS data collected for the Offshore Export Cable Corridor was analysed separately. An average of 52 unique vessels per day passing within study area during the summer survey period and in terms of vessels intersecting the Offshore Export Cable Corridor, there was an average of

45 unique vessels per day. During the winter period, an average of 41 unique vessels per day were within study area with an average of 36 unique vessels per day intersecting the Offshore Export Cable Corridor. Throughout the summer period in the study area, the majority of tracks were fishing vessels (28%), oil and gas vessels (27%) and cargo vessels (20%). During the winter period the majority of tracks were oil and gas vessels (36%) and fishing vessels (30%).

No vessels were identified at anchor within the entire Offshore Development Area during the survey periods.

23.3 Future Case Vessel Traffic

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 vessels involved in the construction and operation and maintenance of the Project have been considered.

Deviations could be required for three out of the ten main commercial routes identified, however none are considered large, with the greatest absolute deviation being an additional 0.3nm to total journey distance.

23.4 Collision and Allision Risk Modelling

The annual vessel to vessel collision risk in proximity to the Windfarm Site was estimated to be 3.30×10^{-4}, corresponding to a return period of approximately 3,000 years. This represents an increase of approximately 18% over the pre wind farm case.

Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 7.85×10^{-5}, corresponding to a return period of approximately one in 12,700 years. the annual drifting allision frequency was estimated to be 1.11×10^{-5}, corresponding to a return period of approximately one in 90,000 years.

The annual fishing vessel to structure allision risk was estimated to be 1.46×10^{-1}, corresponding to a return period of approximately one in 6.9 years.

23.5 Risk Statement

Using the baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments, various shipping and navigation hazards associated with the Project have been risk assessed in line with the FSA approach as required by the MCA under MGN 654 (MCA, 2021). The full risk control log including details of hazards, proposed embedded mitigation measures and significance of risk is presented in Section 21.2.

The significance of risk has been determined as either **Broadly Acceptable** or **Tolerable with mitigation** for all hazards assessed. The implementation of additional mitigation as set out in Section 21.1.2 ensures the risk of all hazards is ALARP.

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Appendix A MGN 654 Checklist

The MGN 654 Checklist can be divided into two distinct checklists, one considering the main MGN 654 guidance document and one considering the Methodology for Assessing Marine Navigational Safety and Emergency Response Risks of OREIs (MCA, 2021) which serves as Annex 1 to MGN 654.

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

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 within the study 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 August 2021 and January 2022 has been assessed within the study area.
Multiple data sources.	✓	**Section 5: Data Sources** The vessel traffic survey data includes AIS, Radar and visual observations to maximise coverage of vessels not broadcasting on AIS. Additional data sources including VMS data, Anatec's ShipRoutes database, long term fishing vessel AIS, and the RYA Coastal Atlas have also been considered.
Seasonal variations.	✓	**Section 5: Data Sources** A total of 28 full days of vessel traffic survey data from August 2021 and January 2022 has been assessed within the study area to cover seasonal variation.
MCA consultation.	✓	**Section 4: Consultation** The MCA has been consulted as part of the NRA process including through the Hazard Workshop.
General Lighthouse Authority (GLA) consultation.	✓	**Section 4: Consultation** NLB has been consulted as part of the NRA process including through the Hazard Workshop.

Issue	Compliance	Comments
UK CoS consultation.	✓	**Section 4: Consultation** The UK CoS has been consulted as part of the NRA process.
Recreational and fishing vessel organisations consultation.	✓	**Section 4: Consultation** RYAS and CA has been consulted as part of the NRA process through the Hazard Workshop, and additional recreational outreach has been undertaken. The FLO provided input into the Hazard Workshop, and fishing representatives were also invited to attend. Additional relevant consultation is provided in **Chapter 15 Commercial Fisheries.**
Port and navigation authorities consultation, as appropriate.	✓	**Section 4: Consultation** Various ports and harbours including Peterhead and Aberdeen were invited to comment on the Project. Aberdeen Harbour Board attended the Hazard Workshop.
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 Windfarm Site has been analysed. **Section 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase – Sections 17 to 19. **Section 20: Cumulative Risk Assessment** The hazards due to the Project have been assessed on a cumulative basis.
ii. Numbers, types and sizes of vessels presently using such areas.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Windfarm Site 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 7: Navigational Features** Non-transit uses of the areas in proximity to the Windfarm Site have been identified, including marine aggregate dredging, pilotage and anchoring. **Section 10: Vessel Traffic Movements** Non-transit users were identified in the vessel traffic survey data and included fishing vessels engaged in fishing activities, marine aggregate dredgers engaged in dredging activities, pilotage activities and anchoring activities.
iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓	**Section 11: Base Case Vessel Routeing** Main commercial routes have been identified using the principles set out in MGN 654 in proximity to the Windfarm Site.
v. Alignment and proximity of the site relative to adjacent shipping lanes.	✓	**Section 7: Navigational Features** There are no IMO routeing measures in proximity as per Section 7.3.

Issue	Compliance	Comments
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓	**Section 7: Navigational Features** There are no IMO routeing measures in proximity as per Section 7.3.
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** Anchorages are considered in Section 7.5. **Section 11.2: Adverse Weather Routeing** Discussed in Section 11.2.
viii. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	**Section 7: Navigational Features** Section 7.4 identifies the locations of ports in proximity to the Project.
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	**Section 10: Vessel Traffic Movements** Fishing vessel movements are considered within the study area in Section 10.1.2.1. This includes assessment of multiple data sources including AIS, radar and VMS data. Detailed analysis of dedicated fishing vessel activities is undertaken in **Chapter 15 Commercial Fisheries.**
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	**Section 7: Navigational Features** There are no military practise areas in proximity as per Section 7.8.
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** Charted wrecks are shown in Section 7.9, and oil and gas infrastructure in Section 7.2. There are no marine aggregate dredging features in proximity.
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** Section 7.1 Identifies other offshore wind farm developments in proximity to the Project. **Section 13: Cumulative and Transboundary Overview** Considers other OREI sites in proximity to the Project cumulatively.
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground.	✓	**Section 7: Navigational Features** See Section 7.10.
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** AtoNs are considered in Section 7.6, and VTS in Section 7.4.

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 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including pinch (or choke) points in proximity to the Windfarm Site.
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 9: Emergency Response and Incident Overview** Historical vessel incident data published by DfT (Section 9.1), RNLI (Section 9.2) and MAIB (Section 9.5) in proximity to the Project has been considered alongside historical offshore wind farm incident data throughout the UK (Section 9.6).
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area.	✓	**Section 10: Vessel Traffic Movements** Non-transit users were identified in the vessel traffic survey data and included recreational activities.
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 14: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes a minimum distance of 1 nm 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.	✓	**Section 14: Future Case Vessel Traffic** Section 14.6 assesses cumulative routeing.
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 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project. **Section 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of users such as commercial vessels, commercial fishing vessels in transit, recreational vessels, anchored vessels and emergency responders – Sections 17 to 19.
b. Clearances of fixed or floating WTG blades above the sea surface are not less than 22 m (above MHWS for fixed).	✓	**Section 6: Project Description Relevant to Shipping and Navigation** Section 6 outlines the shipping and navigation MDS for WTGs including the minimum air gap.

Issue	Compliance	Comments
Floating turbines allow for degrees of motion.		
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** Section 6.3 outlines the shipping and navigation MDS for sub-sea cables including the cable burial specifications.
d. Whether structures block or hinder the view of other vessels or other navigational features.	✓	**Section 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of the potential for vessels navigating in proximity to structures to be visually obscured – Sections 17 to 19.
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 8: Meteorological Ocean Data** Provides meteorological data in proximity to the Project relating to various states of the tide. **Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed including vessel draught (Section 10.1.4.2). **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including accounting for tidal conditions.
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** Provides meteorological data in proximity to the Project relating to various states of the tide. **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including accounting for tidal conditions.
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.	✓	
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 8: Meteorological Ocean Data** Provides meteorological data in proximity to the Project relating to various states of the tide. **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including accounting for tidal conditions and assessment of whether machinery failure could cause vessels to be set into danger.

Issue	Compliance	Comments
f. The structures themselves could cause changes in the set and rate of the tidal stream.	✓	**Section 8: Meteorological Ocean Data** Provides meteorological data in proximity to the Project relating to various states of the tide and notes that no effects are anticipated.
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 8: Meteorological Ocean Data** Provides meteorological data in proximity to the Project relating to various states of the tide. **Section 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of the potential for reduction in under keel clearance – Sections 17 to 19.
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 8: Meteorological Ocean Data** Provides meteorological data in proximity to the Project relating to weather and visibility. **Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed including recreational vessels. **Section 11.2: Adverse Weather Routeing** Discussions around adverse weather conditions. **Section 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of adverse weather routeing – Sections 17 to 19.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	**Section 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of internal allision risk for vessels under sail – Sections 17 to 19.
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 8: Meteorological Ocean Data** Provides meteorological data in proximity to the Project relating to wind direction and various states of the tide. **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including accounting for weather conditions and assessment of whether machinery failure could cause vessels to be set into danger. **Section 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of drifting allision risk – Sections 17 to 19.
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:		

Issue	Compliance	Comments
i. For all vessels. ii. For specified vessel types, operations and/or sizes. iii. In all directions or areas. iv. In specified directions or areas. v. In specified tidal, weather or other conditions.	✓	**Section 4: Consultation** Section 4.2.3 outlines Regular Operator consultation undertaken following the vessel traffic surveys, and Section 4.2.5 summarises an outreach to recreational stakeholders. **Section 11.2: Adverse Weather Routeing** Considers adverse weather routeing. **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including accounting for weather and tidal conditions. **Section 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of internal allision risk – Sections 17 to 19.
b. Navigation in and/or near the site should be prohibited or restricted:		
i. For specified vessel types, operations and/or sizes.	✓	**Section 12: Navigation, Communication and Position Fixing Equipment** Assesses potential hazards on navigation of the different communications and position fixing devices used in and around offshore wind farms. **Section 14: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes a minimum distance of 1 nm from offshore installations and existing offshore wind farm boundaries, i.e., it is assumed that commercial vessels will avoid the Windfarm Site. **Section 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of vessel displacement and emergency response capability – Sections 17 to 19.
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 16: Introduction to Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of vessel displacement, adverse weather and emergency response capability – Sections 17 to 19.

<table>
<tr><th>Issue</th><th>Compliance</th><th>Comments</th></tr>
<tr><td>d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered.</td><td></td><td>Section 14: Future Case Vessel Traffic
A methodology for post wind farm routeing is outlined and includes consideration of the Shipping Route Template.</td></tr>
<tr><td colspan="3">SAR, maritime assistance service, counter pollution and salvage incident response.</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td>a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.</td><td>✓</td><td>Section 21: Risk Control Log
Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including compliance with MGN 654 which includes the provision of an ERCoP.</td></tr>
<tr><td>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.</td><td>✓</td><td>Section 2: Guidance and Legislation
Outlines the guidance and legislation used within the NRA including Annex 5 of MGN 654.

Section 21: Risk Control Log
Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including compliance with MGN 654 and its annexes.</td></tr>
<tr><td>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).</td><td>✓</td><td>Section 21: Risk Control Log
Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including compliance with MGN 654 which includes the completion of the SAR checklist.</td></tr>
<tr><td colspan="3">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:</td></tr>
<tr><td>i. Pre construction: The proposed generating assets area and proposed cable route.</td><td>✓</td><td rowspan="4">Section 22: Through life safety management
Confirms that hydrographic surveys will be undertaken in agreement with the MCA.</td></tr>
<tr><td>ii. On a pre-established periodicity during the life of the development.</td><td>✓</td></tr>
<tr><td>iii. Post construction: Cable route(s).</td><td>✓</td></tr>
<tr><td>iv. Post decommissioning of all or part of the development: the installed generating assets area and cable route.</td><td>✓</td></tr>
</table>

<table>
<tr><th>Issue</th><th>Compliance</th><th>Comments</th></tr>
<tr><td colspan="3">Communications, Radar and positioning systems. To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:</td></tr>
<tr><td colspan="3">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:</td></tr>
<tr><td>i. Vessels operating at a safe navigational distance.</td><td>✓</td><td rowspan="3">Section 12: Navigation, Communication and Position Fixing Equipment
Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to radio interference.</td></tr>
<tr><td>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.</td><td>✓</td></tr>
<tr><td>iii. Vessels by the nature of their work necessarily operating within the OREI.</td><td>✓</td></tr>
<tr><td colspan="3">b. The structures could produce Radar reflections, blind spots, shadow areas or other adverse effects:</td></tr>
<tr><td>i. Vessel to vessel.</td><td>✓</td><td rowspan="4">Section 12: Navigation, Communication and Position Fixing Equipment
Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to marine Radar.</td></tr>
<tr><td>ii. Vessel to shore.</td><td>✓</td></tr>
<tr><td>iii. VTS Radar to vessel.</td><td>✓</td></tr>
<tr><td>iv. Racon to/from vessel.</td><td>✓</td></tr>
<tr><td>c. The structures and generators might produce SONAR interference affecting fishing, industrial or military systems used in the area.</td><td>✓</td><td>Section 12: Navigation, Communication and Position Fixing Equipment
Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to SONAR.</td></tr>
<tr><td>d. The site might produce acoustic noise which could mask prescribed sound signals.</td><td>✓</td><td>Section 12: Navigation, Communication and Position Fixing Equipment
Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to noise.</td></tr>
<tr><td>e. Generators and the seabed cabling within the site and onshore might produce EMFs affecting compasses and other navigation systems.</td><td>✓</td><td>Section 12: Navigation, Communication and Position Fixing Equipment
Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to electromagnetic interference.</td></tr>
<tr><td colspan="3">Risk mitigation measures recommended for OREI during construction, operation and decommissioning.</td></tr>
<tr><td colspan="3">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:</td></tr>
</table>

Issue	Compliance	Comments
i. Promulgation of information and warnings through notices to mariners and other appropriate MSI dissemination methods.	✓	**Section 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including promulgation of information.
ii. Continuous watch by multi-channel VHF, including DSC.	✓	**Section 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including marine coordination, a Vessel Management Plan, and a Navigational Safety Plan.
iii. Safety zones of appropriate configuration, extent and application to specified vessels[4].	✓	**Section 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including the application for Safety Zones.
iv. Designation of the site as an Area to be Avoided (ATBA).	✓	Any need to designate the Windfarm Site as an ATBA would be discussed with the MCA if requested.
v. Provision of aids to navigation as determined by the GLA.	✓	**Section 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including lighting and marking in accordance with NLB and MCA requirements.
vi. Implementation of routeing measures within or near to the development.	✓	There are no plans to implement any new routeing measures in proximity to the Project
vii. Monitoring by Radar, AIS, Closed Circuit Television (CCTV) or other agreed means.	✓	**Section 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards. This includes MGN 654 compliance including agreement of a SAR checklist.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of Safety Zones.	✓	**Section 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including the application for Safety Zones and use of guard vessels, which will be considered in further detail 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 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including compliance with MGN 654 which includes the provision of an ERCoP.

[4] As per SI 2007 No 1948 "The Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007.

Issue	Compliance	Comments
x. Use of guard vessels, where appropriate.	✓	**Section 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including the use of guard vessels.
xi. Update NRAs every two years, e.g. at testing sites.	✓	Not applicable.
xii. Device-specific or array-specific NRAs.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** All offshore elements including floating elements of the Project have been considered in this NRA including all infrastructure (surface and sub-sea) within the Windfarm Site and Offshore Export Cable Corridor.
xiii. Design of OREI structures to minimise risk to contacting vessels or craft.	✓	**Section 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including minimum blade clearance and lighting and marking in agreement with NLB.
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	**Section 21: Risk Control Log** Section 21.1 outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards. **Section 22: Through life safety management** Outlines how HSEQ documentation will be maintained and reviewed.

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 16: Introduction to Risk Assessment** Risk assessment for a range of hazards based on a number of inputs including (but not limited to) baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments – Sections 17 to 19. **Section 23: Summary** Section 23.5 provides a concluding risk statement.

Item	Compliance	Comments
Description of the marine environment.	✓	**Section 7: Navigational Features** Relevant navigational features in proximity to the Project have been described. **Section 13: Cumulative and Transboundary Overview** Potential future developments have been screened in to the cumulative risk assessment where a cumulative or in combination activity has been identified based upon the location and distance from the Project, including consideration of other offshore wind farms, oil and gas infrastructure and marine aggregate dredging areas.
SAR overview and assessment.	✓	**Section 9: Emergency Response and Incident Overview** Existing SAR resources in proximity to the Project are summarised including the UK SAR operations contract, RNLI stations and assets and HMCG stations. **Section 16: Introduction to Risk Assessment** The risk assessment includes an assessment of how activities associated with the Project may restrict emergency response capability of existing resources – Sections 17 to 19..
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 Project for which any shipping and navigation hazards are assessed is provided. **Section 14: Future Case Vessel Traffic** Worst case alternative routeing for commercial traffic has been considered.
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 Project has been analysed and includes vessel density and breakdowns of vessel type. **Section 14: Future Case Vessel Traffic** Future vessel traffic levels have been considered, broken down as increases in commercial vessel activity, commercial fishing vessel and recreational vessel activity, and increases in traffic associated with project operations. Additionally, worst case alternative routeing for commercial traffic has been considered.

Item	Compliance	Comments
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. **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.
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 IMO's FSA guidelines are the primary guidance documents used for the assessment alongside MGN 372. **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the with the results outlined numerically and graphically, where appropriate.
Risk control log	✓	**Section 21: Risk Control Log** Provides the risk control log which summarises the assessment of shipping and navigation hazards scoped into the risk assessment. This includes the proposed embedded mitigation measures, frequency of occurrence, severity of consequence and significance of risk, per hazard.

Appendix B Hazard Log

As per Section 4.2.4, a Hazard Workshop was held for the Project on the 30th May 2022. Following the workshop, a Hazard Log was drafted and distributed to attendees for agreement.

The Hazard Log was based on the discussions held and captured the following:

- Relevant impacts;
- Embedded mitigations;
- Possible causes;
- Frequency and consequence;
- Risk; and
- Any relevant additional mitigations discussed at the workshop.

The Hazard Log is shown in **Table B.1.**

Table B.1: Hazard Log

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences					Risk		Frequency	Consequences					Risk		
							People	Environmen	Property	Business	Average				People	Environmen	Property	Business	Average			
Commercial Vessels																						
Displacement resulting in increased collision risk	Increased collision risk involving commercial vessels due to temporary displacement from historical routes and reduction in available sea room	C/D	- Marking on charts - Promulgation of information - Lighting and marking - COLREGs / SOLAS	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do impact on compliance with COLREGS and result in increased collisions	1	4	4	4	4	4.0	Broadly Acceptable		General consensus was that commercial vessels would avoid the site. Concerns were raised by Scotline representation over potential impacts on their vessels. Further investigation indicated the significant majority of east / west traffic including Scotline vessels currently passes south of the project, and as such would be unaffected. There was limited concern for O&G vessels based on typical transit frequencies.
Collision with project vessels	Increased collision risk between a commercial vessel and a project vessel (construction/decommissioning)	C/D	- Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Marine coordination - Lighting and marking - COLREGs / SOLAS - Guard vessel (via risk assessment)	Presence of project vessels associated with construction/decommissioning Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	1	3	4	4	4	3.8	Broadly Acceptable		Assumes project vessel levels are within typical industry standards.
Allision	New allision risk for commercial vessels due to presence of pre commissioned floating / fixed structures	C/D	- MGN 654 compliance - Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Lighting and marking - Guard vessel (via risk assessment)	Presence of pre commissioned floating / fixed structures Human error or navigational error Mechanical or technical failure (vessel) Adverse weather Unfamiliarity with project Failure of Aid to Navigation	Vessel passes floating / fixed structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with floating / fixed structure resulting in damage to vessel, injury and potentially pollution	2	5	4	5	4	4.5	Tolerable		Assumes layout will be MGN 654 compliant. Noted that an assessment layout for NRA purposes was not shown at the workshop as it was not yet defined.
Restricted access to ports/harbours	Temporary restrictions on a commercial vessel's access route to a port/harbour	C/D	- Marking on charts - Promulgation of information - Marine coordination - Lighting and marking - COLREGs / SOLAS	Project vessel presence Cable installation	Increased journey time but no impact on schedules	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time, potential impacts on schedules	2	2	1	1	2	1.5	Broadly Acceptable		
Anchor interaction	Increased anchor snagging risk for commercial vessels due to subsea cables, cable protection and mooring lines / anchors	C/D	- MGN 654 compliance - Marking on charts - Promulgation of information - Cable burial risk assessment - Guard vessel (via risk assessment)	Presence of subsea cables or cable protection Presence of mooring lines/ anchors Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection/mooring line/anchor but no snagging occurs.	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection/mooring line/anchor resulting in damage to the cable/protection and/or vessel anchor	2	3	1	3	2	2.3	Broadly Acceptable		
Displacement resulting in increased collision risk	Increased collision risk involving commercial vessels due to displacement from historical routes and reduction in available sea room	O	- Marking on charts - Promulgation of information - Lighting and marking - COLREGs / SOLAS	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do not impact on compliance with COLREGS	1	4	4	4	4	4.0	Broadly Acceptable		General consensus was that commercial vessels would avoid the site. Concerns were raised by Scotline representation over potential impacts on their vessels. Further investigation indicated the significant majority of east / west traffic including Scotline vessels currently passes south of the project, and as such would be unaffected. There was limited concern for O&G vessels based on typical transit frequencies.

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences					Risk		Frequency	Consequences					Risk		
							People	Environmen	Property	Business	Average				People	Environmen	Property	Business	Average			
Collision With project vessels	Increased collision risk between a commercial vessel and a project vessel due to the presence of project vessels associated with operation and maintenance	O	- Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Marine coordination - Lighting and marking - COLREGs / SOLAS - Guard vessel (via risk assessment)	Presence of project vessels (O&M) Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	1	3	4	4	4	3.8	Broadly Acceptable		Assumes project vessel levels are within typical industry standards.
Allision	New allision risk for commercial vessels due to presence of floating / fixed structures	O	- MGN 654 compliance - Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Lighting and marking - Guard vessel (via risk assessment)	Presence of floating / fixed structures Human error or navigational error Mechanical or technical failure resulting in a vessel drifting Adverse weather	Vessel passes floating / fixed structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with floating / fixed structure resulting in damage to vessel, injury and potentially pollution	2	5	4	5	4	4.5	Tolerable		Assumes layout will be MGN 654 compliant. Noted that an assessment layout for NRA purposes was not shown at the workshop as it was not yet defined.
Restricted access to ports/harbours	Restrictions on a commercial vessel's access route to a port/harbour	O	- Marking on charts - Promulgation of information - Marine coordination - Lighting and marking - COLREGs / SOLAS	Project vessels Cable maintenance	Increased journey time/distance but does not impact on schedules	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time, impacts on schedules	1	2	1	1	2	1.5	Broadly Acceptable		
Anchor interaction	Increased anchor snagging risk for commercial vessels due to subsea cables, cable protection and mooring lines	O	- MGN 654 compliance - Marking on charts - Promulgation of information - Cable burial risk assessment - Guard vessel (via risk assessment)	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor	1	3	1	2	2	2.0	Broadly Acceptable		
Commercial Fishing Vessels (in Transit)																						
Displacement resulting in increased collision risk	Increased collision risk involving fishing vessels due to temporary displacement from historical routes and reduction in available sea room	C/D	- Marking on charts - Promulgation of information - Lighting and marking - COLREGs / SOLAS	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do impact on compliance with COLREGS and result in increased collisions	2	3	2	3	3	2.8	Broadly Acceptable		Noted that this impact considers fishing vessels in transit. Active fishing is considered in Chapter 13 Commercial Fisheries.
Collision with project vessels	Increased collision risk between a commercial fishing vessel and a project vessel (construction/decommissioning)	C/D	- Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Marine coordination - Lighting and marking - COLREGs / SOLAS - Guard vessel (via risk assessment)	Presence of project vessels associated with construction/decommissioning Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	2	3	4	4	4	3.8	Broadly Acceptable		Assumes project vessel levels are within typical industry standards.
Allision	New allision risk for commercial fishing vessels due to presence of pre commissioned floating / fixed structures	C/D	- MGN 654 compliance - Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Lighting and marking - Guard vessel (via risk assessment)	Presence of pre commissioned floating / fixed structures Human error or navigational error Mechanical or technical failure (vessel) Adverse weather Failure of Aid to Navigation Failure to take note of advisory safe passing distance	Vessel passes floating / fixed structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with floating / fixed structure resulting in damage to vessel, injury and potentially pollution	3	4	4	4	4	4.0	Tolerable		Assumes layout will be MGN 654 compliant. Noted that an assessment layout for NRA purposes was not shown at the workshop as it was not yet defined.

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environmen	Property	Business	Average	Risk		Frequency	People	Environmen	Property	Business	Average	Risk		
Anchor interaction	Increased anchor snagging risk for commercial fishing vessels due to subsea cables, cable protection and mooring lines * Gear snagging is considered in Chapter 13 Commercial Fisheries.	C/D	- MGN 654 compliance - Marking on charts - Promulgation of information - Cable burial risk assessment - Guard vessel (via risk assessment)	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor Risks to vessel stability	2	3	1	3	2	2.3	Broadly Acceptable		Promulgation of information was considered key mitigation.
Displacement resulting in increased collision risk	Increased collision risk involving commercial fishing vessels due to displacement from historical transits to fishing grounds and reduction in available sea room	O	- Marking on charts - Promulgation of information - Lighting and marking - COLREGs / SOLAS	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do impact on compliance with COLREGS and result in increased collisions	1	2	2	2	2	2.0	Broadly Acceptable		Noted that this impact considers fishing vessels in transit. Active fishing is considered in Chapter 13 Commercial Fisheries.
Collision With project vessels	Increased collision risk between a commercial fishing vessel and a project vessel (O&M)	O	- Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Marine coordination - Lighting and marking - COLREGs / SOLAS - Guard vessel (via risk assessment)	Presence of project vessels associated with operation and maintenance Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	2	3	4	4	4	3.8	Broadly Acceptable		Assumes project vessel levels are within typical industry standards.
Allision	New allision risk for commercial fishing vessels due to presence of floating / fixed structures	O	- MGN 654 compliance - Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Lighting and marking - Guard vessel (via risk assessment)	Presence of floating / fixed structures Human error or navigational error Mechanical or technical failure resulting in a vessel drifting Adverse weather	Vessel passes floating / fixed structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with floating / fixed structure resulting in damage to vessel, injury and potentially pollution	3	4	4	4	4	4.0	Tolerable		Assumes layout will be MGN 654 compliant. Noted that an assessment layout for NRA purposes was not shown at the workshop as it was not yet defined.
Anchor interaction	Increased anchor snagging risk for commercial fishing vessels due to subsea cables, cable protection and mooring lines. * Gear snagging is considered in Chapter 13 Commercial Fisheries.	O	- MGN 654 compliance - Marking on charts - Promulgation of information - Cable burial risk assessment - Guard vessel (via risk assessment)	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor Risks to vessel stability	1	3	1	3	2	2.3	Broadly Acceptable		Promulgation of information was considered key mitigation.
Recreational Vessels (2.5 to 24 metres)																						
Displacement resulting in increased collision risk	Increased collision risk involving recreational vessels due to temporary displacement from historical cruising routes and reduction in available sea room	C/D	- Marking on charts - Promulgation of information - Lighting and marking - COLREGs / SOLAS	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters between third party vessels that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels that do impact on compliance with COLREGS and result in increased collisions	1	3	2	2	2	2.3	Broadly Acceptable		General consensus was that recreational vessels may transit through, however this would be on a case by case basis and not during adverse weather.
Collision with project vessels	Increased collision risk between a recreational vessel and a project vessel (construction/decommissioning)	C/D	- Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Marine coordination - Lighting and marking - COLREGs / SOLAS - Guard vessel (via risk assessment)	Presence of project vessels associated with construction/decommissioning Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	2	3	4	4	4	3.8	Broadly Acceptable		Assumes project vessel levels are within typical industry standards.

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average	Risk		
Allision	New allision risk for recreational vessels due to presence of floating / fixed structures	C/D	- MGN 654 compliance - Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Lighting and marking - Minimum 22m blade clearance - Guard vessel (via risk assessment)	Presence of pre commissioned floating / fixed structures Human error or navigational error Mechanical or technical failure (vessel) Adverse weather Failure of Aid to Navigation Failure to take note of advisory safe passing distance	Vessel passes floating / fixed structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with floating / fixed structure resulting in damage to vessel, injury and potentially pollution	2	4	4	4	3	3.8	Broadly Acceptable		Assumes layout will be MGN 654 compliant, and that requirements around degrees of motion (pitch, roll, yaw, heave, surge and sway) will be adhered to in relation to floating structures. Noted that an assessment layout for NRA purposes was not shown at the workshop as it was not yet defined. It was noted that vessels under sail may pass in or in proximity to the site based on wind direction.
Anchor interaction	Increased anchor snagging risk for recreational vessels due to subsea cables, cable protection and mooring lines	C/D	- MGN 654 compliance - Marking on charts - Promulgation of information - Cable burial risk assessment - Guard vessel (via risk assessment)	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs	2	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor Risks to vessel stability	1	2	1	2	2	1.8	Broadly Acceptable		There was limited concern with this impact given vessels will account for the charted cable locations.
Displacement resulting in increased collision risk	Increased collision risk involving recreational vessels due to displacement from historical cruising routes and reduction in available sea room	O	- Marking on charts - Promulgation of information - Lighting and marking - COLREGs / SOLAS	Human error or navigational error Mechanical or technical failure (vessel) Adverse weather	Increased encounters that do not impact on compliance with COLREGS	3	1	1	1	1	1.0	Broadly Acceptable	Increased encounters that do impact on compliance with COLREGS and result in increased collisions	1	2	2	2	2	2.0	Broadly Acceptable		General consensus was that recreational vessels may transit through, however this would be on a case by case basis and not during adverse weather.
Collision with project vessels	Increased collision risk between a recreational vessel and a project vessel (O&M)	O	- Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Marine coordination - Lighting and marking - COLREGs / SOLAS - Guard vessel (via risk assessment)	Presence of project vessels associated with operation and maintenance Third party users not aware project vessels are engaged in operations	Increased encounters between third party vessels and project vessels that do not impact on compliance with COLREGS	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters between third party vessels and project vessels that do impact on compliance with COLREGS and result in increased collisions	2	4	3	4	4	3.8	Broadly Acceptable		Assumes project vessel levels are within typical industry standards.
Allision	New allision risk for recreational vessels due to presence of floating / fixed structures	O	- MGN 654 compliance - Marking on charts - Promulgation of information - Buoyed construction area - Safety zones - Lighting and marking - Minimum 22m blade clearance - Guard vessel (via risk assessment)	Presence of floating / fixed structures Human error or navigational error Mechanical or technical failure resulting in a vessel drifting Adverse weather	Vessel passes floating / fixed structure at an unsafe distance and has to make last minute adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Vessel allides with floating / fixed structure resulting in damage to vessel, injury and potentially pollution	2	4	3	4	3	3.5	Broadly Acceptable		Assumes layout will be MGN 654 compliant, and that requirements around degrees of motion (pitch, roll, yaw, heave, surge and sway) will be adhered to in relation to floating structures. Noted that an assessment layout for NRA purposes was not shown at the workshop as it was not yet defined. It was noted that vessels under sail may pass in or in proximity to the site based on wind direction.
Anchor interaction	Increased anchor snagging risk for recreational vessels due to subsea cables, cable protection and mooring lines	O	- MGN 654 compliance - Marking on charts - Promulgation of information - Cable burial risk assessment - Guard vessel (via risk assessment)	Presence of subsea cables or cable protection Human error or navigational error Mechanical or technical failure Adverse weather	Vessel anchors on or drags anchor over an installed cable/protection but no interaction occurs	2	1	1	1	1	1.0	Broadly Acceptable	Vessel anchors on or drags anchor over an installed cable/protection resulting in damage to the cable/protection and/or anchor Risks to vessel stability	1	2	1	2	2	1.8	Broadly Acceptable		There was limited concern with this impact given vessels will account for the charted cable locations.
All Vessels																						
Interference with marine navigation, communications and position fixing equipment	Presence of floating / fixed structures, export and inter array cables may interfere with equipment used on board all vessels.	O	- MGN 654 compliance - Marking on charts - Promulgation of information - Lighting and marking - COLREGs / SOLAS	Human error relating to adjustment of Radar controls Presence of floating / fixed structures Insufficient cable burial / design to mitigate EMF impacts	Infrastructure has minor but manageable effect upon the Radar, communications and navigation equipment on a vessel	5	1	1	1	1	1.0	Tolerable	Interference with marine equipment affecting efficiency of navigation and/or collision avoidance	3	1	1	1	1	1.0	Broadly Acceptable		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average	Risk		Frequency	People	Environment	Property	Business	Average	Risk		
Loss of station	Floating structure breaks free of mooring creating collision risk to passing traffic	O	- MGN 654 compliance - Promulgation of information - Lighting and marking - COLREGs / SOLAS - Minimum 22m blade clearance - Guard vessel (via risk assessment)	Damage to or failure of mooring line(s)	Failure of a single mooring line leads to temporary increase in the maximum excursion of the floating structure but not full loss of station	3	2	2	2	2	2.0	Broadly Acceptable	Total failure of mooring system leads to drifting of floating structure with risk of collision with vessels	1	4	4	4	4	4.0	Broadly Acceptable		It was noted that even though commercial vessels would likely avoid the site regardless of the floating aspect, the potential for loss of station means floating projects are still viewed as higher risk.
Interaction with mooring lines	Vessels passing in proximity to floating structures interacting with mooring lines.	O	- MGN 654 compliance - Marking on charts - Promulgation of information - Lighting and marking	Presence of mooring lines Mooring line design Human error or navigational error Mechanical or technical failure resulting in a vessel drifting Adverse weather	Vessel passes in proximity to floating structure but no interaction with mooring lines occurs	4	1	1	1	1	1.0	Broadly Acceptable	Vessel passes in proximity to floating structure and makes contact with mooring line	2	3	2	3	3	2.8	Broadly Acceptable		Noted that level of impact will depend on mooring line design. There may also be underkeel interaction impacts associated with the subsea sections of the floating substructures, again dependent on design. This will require further assessment once designs are progressed.
Emergency response																						
Emergency response	Presence of floating / fixed structures may restrict access/response for existing emergency responders	C/O/D	- MGN 654 compliance - Marine coordination - Lighting and marking - COLREGs / SOLAS - Marine Pollution Contingency Plan - Guard vessel (via risk assessment)	Wind farm array not designed to facilitate responder access Adverse weather	Delay to response request	2	1	1	1	2	1.3	Broadly Acceptable	Delay to response request leading to loss of life	1	5	4	5	5	4.8	Broadly Acceptable		Assumes layout will be MGN 654 compliant. Noted that an assessment layout for NRA purposes was not shown at the workshop as it was not yet defined.

Appendix C Consequences

C.1 Introduction

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 Project.

The significance of the risk due to the presence of the Project is also assessed based on risk evaluation criteria and comparison with historical incident data in UK waters[5].

C.2 Risk Evaluation Criteria

C.2.1 Risk to People

Regarding the assessment of risk to people two measures are considered, namely:

- Individual risk; and
- Societal risk.

C.2.1.1 Individual Risk

Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of the Project. Individual risk considers not only the frequency of the incident 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.

The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the Project 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 Project relative to the UK background individual risk levels.

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 Maritime Safety Committee 72/16 (IMO, 2001). The annual individual risk level to crew falls within the ALARP region for each of the vessel types presented.

[5] For the purposes of this assessment, UK waters is defined as the UK Exclusive Economic Zone (EEZ) and UK territorial waters refers to the 12 nm limit from the British Isles, excluding the Republic of Ireland.

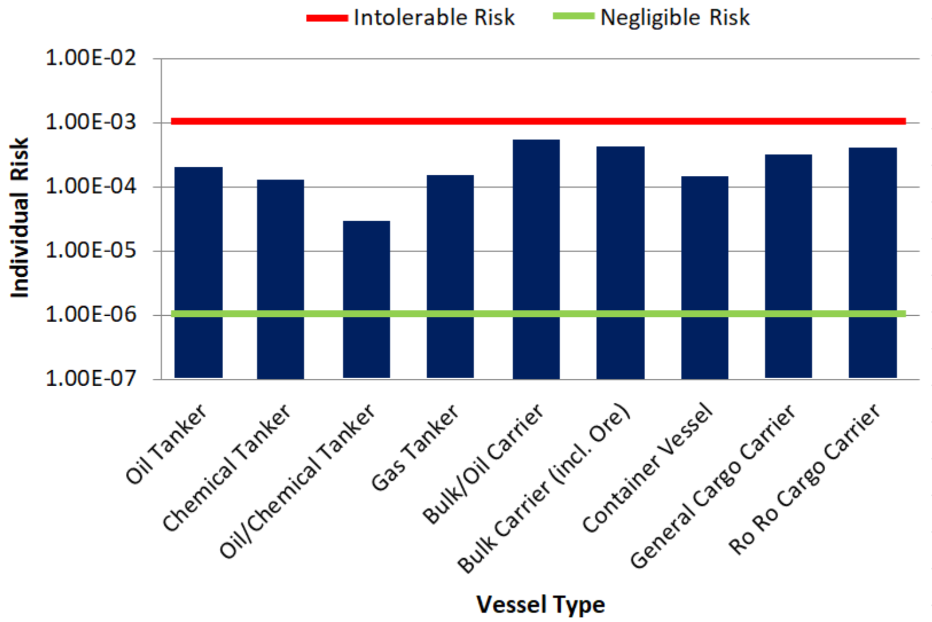

Figure C.1 Individual Risk Levels and Acceptance Criteria per Vessel Type

The typical bounds defining the ALARP regions for decision making within shipping are presented in **Table C.1**. For a new vessel, the target upper bound for ALARP is set lower since new vessels are expected to benefit (in terms of design) from changes in legislation and improved maritime safety.

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

On a UK basis, the MCA have presented individual risks for various UK industries based on HSE data from 1987 to 1991. The risks for different industries are presented in Figure C.2.

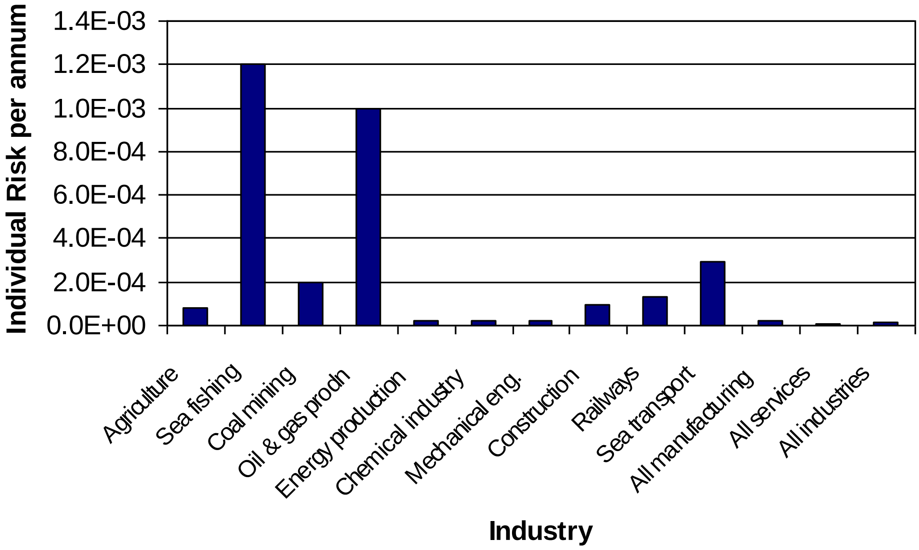

Figure C.2 Individual Risk per Year for Various UK Industries

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.2.1.2 Societal Risk

Societal risk is used to estimate risks of incidents 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.

Within this assessment, societal (navigation based) risk can be assessed for the Project, giving account to the change in risk associated with each incident scenario cause by the introduction of the structures within the Windfarm Site. 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.

When assessing societal risk this study focuses on PLL, which accounts for 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 UK background risk levels.

C.2.1.3 Risk to the Environment

For risk to the environment the key criteria considered in terms of the risk due to the Project is the potential quantity of oil spilled from a vessel involved in an incident.

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 Project compared to UK background pollution risk levels.

C.3 Marine Accident Investigation Branch Incident Data

C.3.1 All Incidents in UK Waters

All British flagged commercial vessels are required to report incidents to the MAIB. Non-British flagged vessels do not have to report an incident to the MAIB unless located at a UK port or within 12 nm territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report incidents to the MAIB; however, a significant proportion of such incidents are reported to and investigated by the MAIB.

The MCA, harbour authorities and inland waterway authorities also have a duty to report incidents to the MAIB. Therefore, whilst there may be a degree of underreporting of incidents with minor consequences, those resulting in more serious consequences, such as fatalities, are likely to be reported.

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 incident occurring offshore, which is the location of most relevance to the Project.

Accounting for these criteria, a total of 12,093 accidents, injuries and hazardous incidents were reported to the MAIB in the 20-year period between 2000 and 2019 involving 13,965 vessels (some incidents, such as collisions, involved more than one vessel).

The location of all incidents in proximity to the UK are presented in Figure C.3, colour-coded by incident type[6]. The majority of incidents occur in coastal waters. Following this, the distribution of incidents by year in UK waters is presented in Figure C.4.

[6] The MAIB aim for 97% accuracy in reporting the location of incidents.

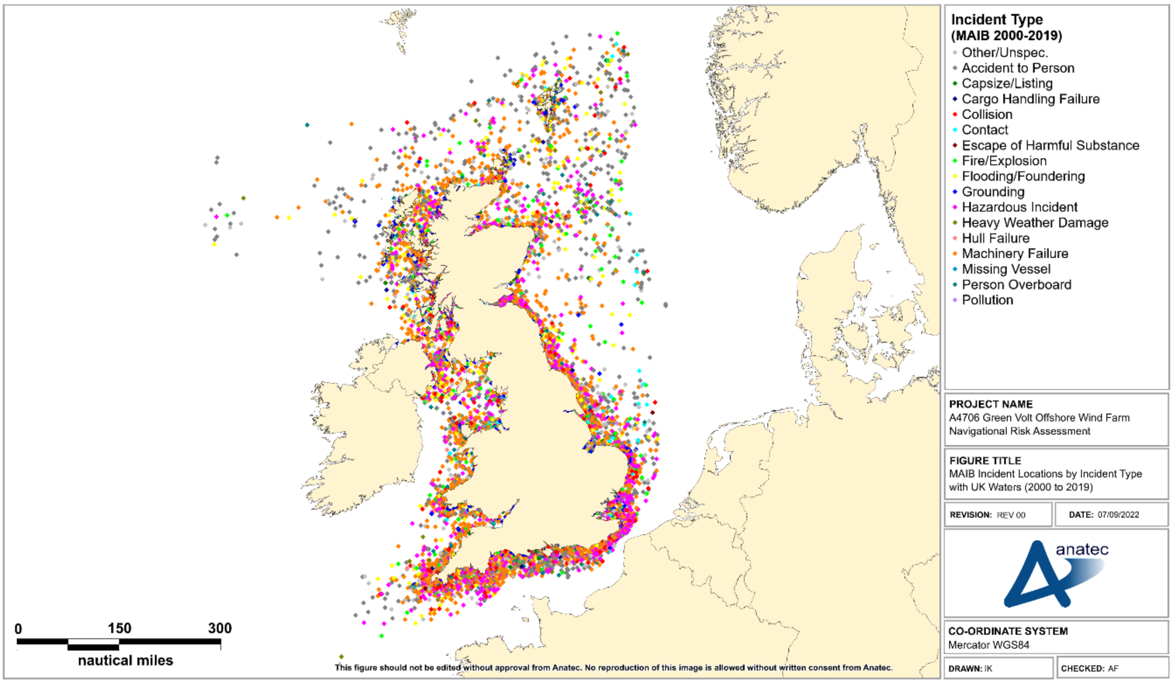

Figure C.3 MAIB Incident Locations by Incident Type within UK Waters (2000 to 2019)

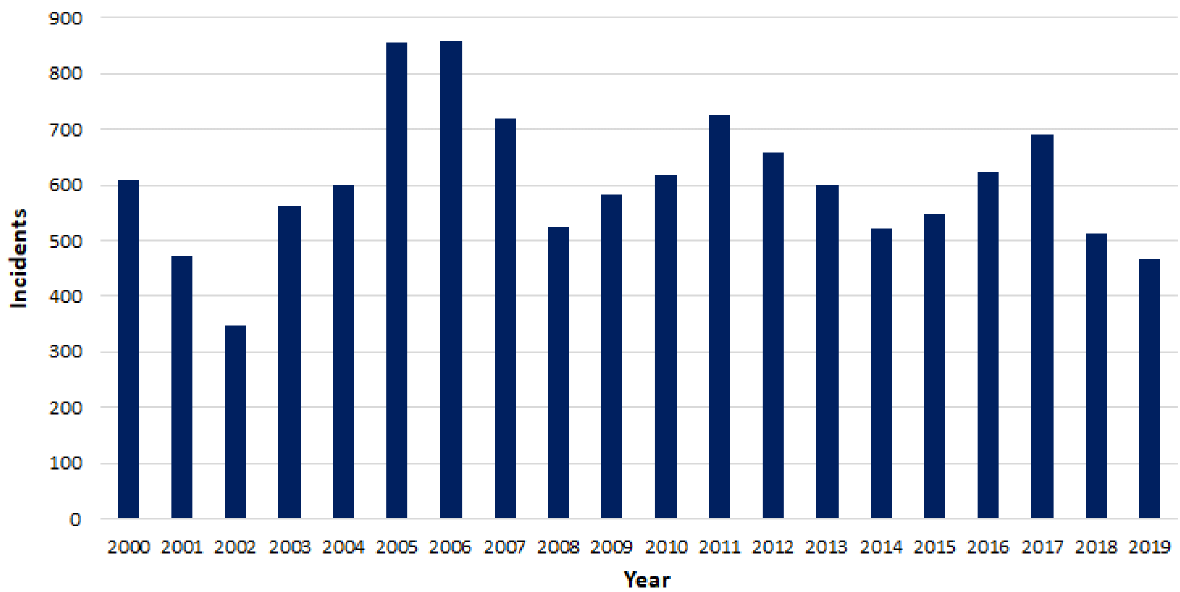

Figure C.4 MAIB Unique Incidents per Year within UK Waters (2000 to 2019)

The average number of unique incidents per year was 605. There has generally been a fluctuating trend in incidents over the 20-year period.

The distribution of incidents in UK waters by incident type is presented in Figure C.5.

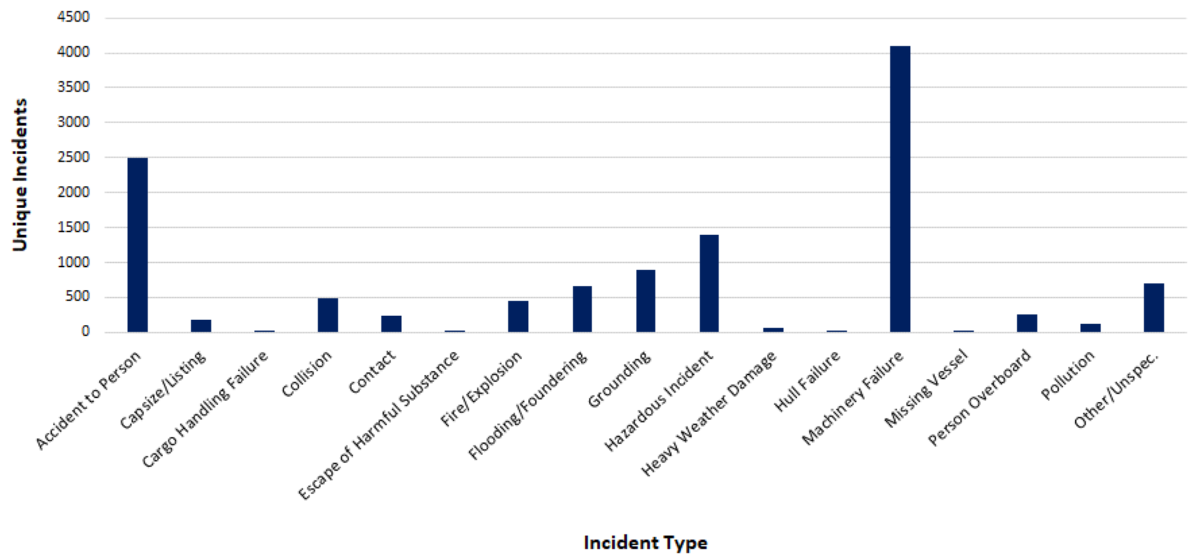

Figure C.5 MAIB Incident Types Breakdown within UK Waters (2000 to 2019)

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.

The distribution of incidents in UK waters by vessel type is presented in **Figure C.6**.

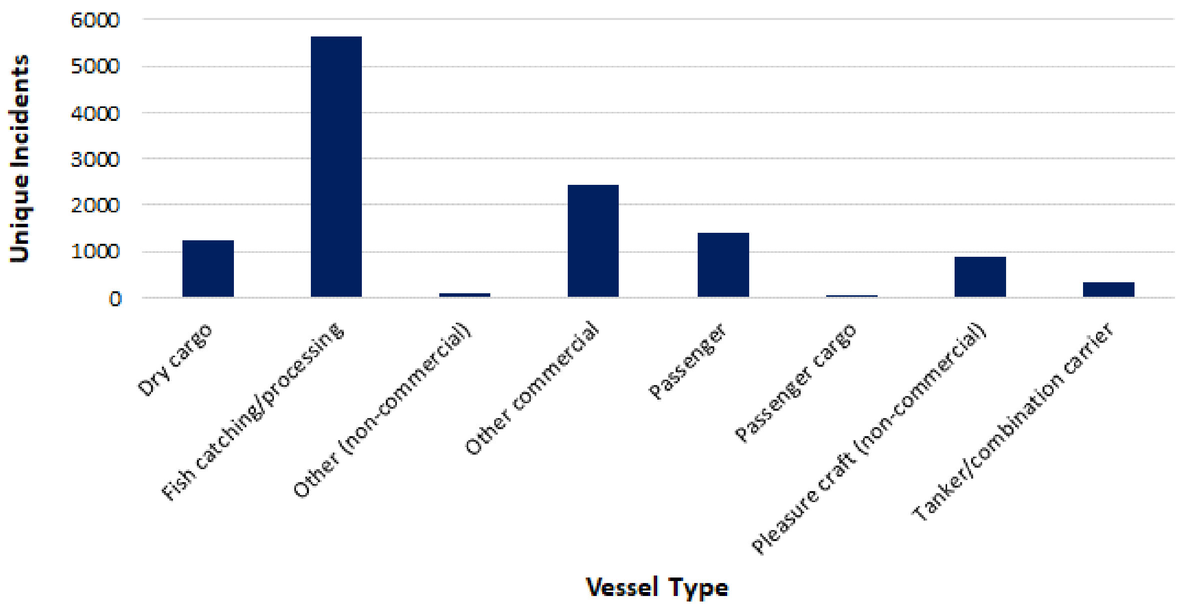

Figure C.6 MAIB Incident Types Breakdown within UK Waters (2000 to 2019)

The most frequent vessel types 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%).

A total of 373 fatalities were reported in the MAIB incident data within UK waters between 2000 and 2019, corresponding to an average of 19 fatalities per year.

The distribution of fatalities in UK waters by vessel type and person category (crew, passenger and other) is presented in Figure C.7.

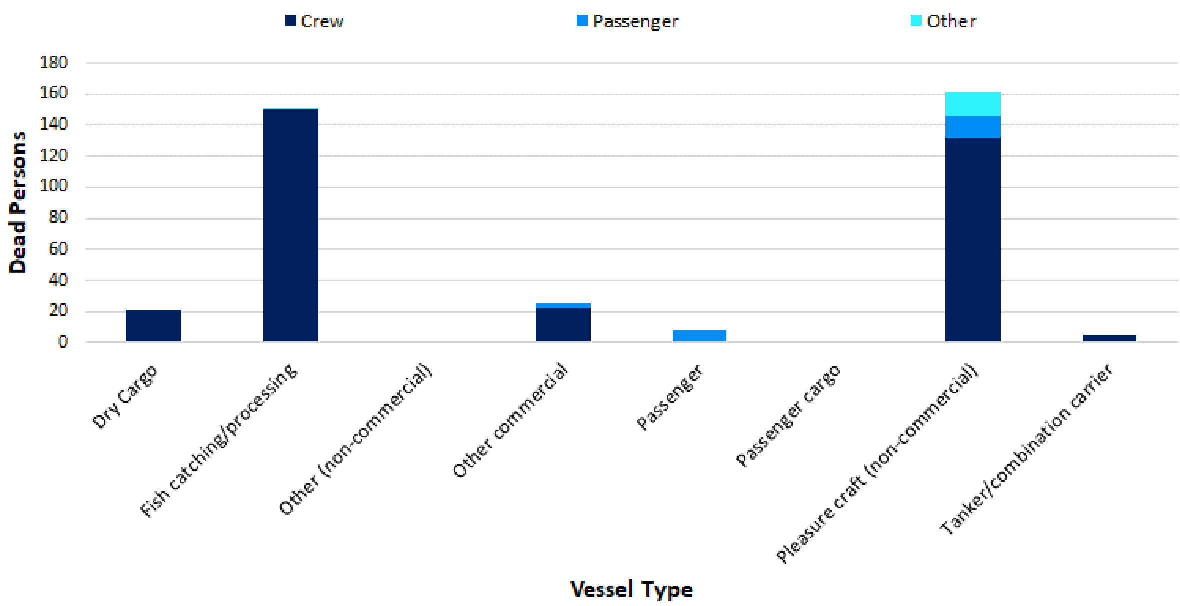

Figure C.7 MAIB Fatalities by Vessel Type within UK Waters (2000 to 2019)

The majority of fatalities occurred to pleasure craft (43%) and fishing vessels (40%), with crew members the main people involved (89%).

C.3.2 Collision Incidents

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).

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).

The locations of collision incidents reported in proximity to the UK are presented in Figure C.8. Following this, the distribution of collision incidents per year is presented in Figure C.9.

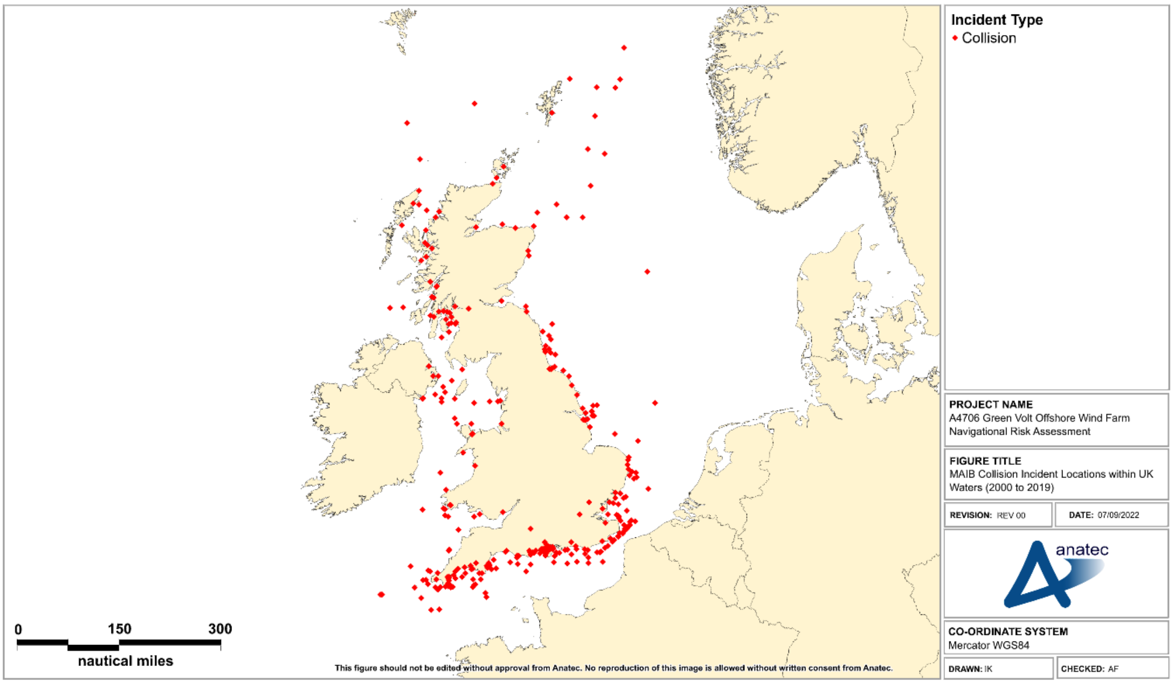

Figure C.8 MAIB Collision Incident Locations within UK Waters (2000 to 2019)

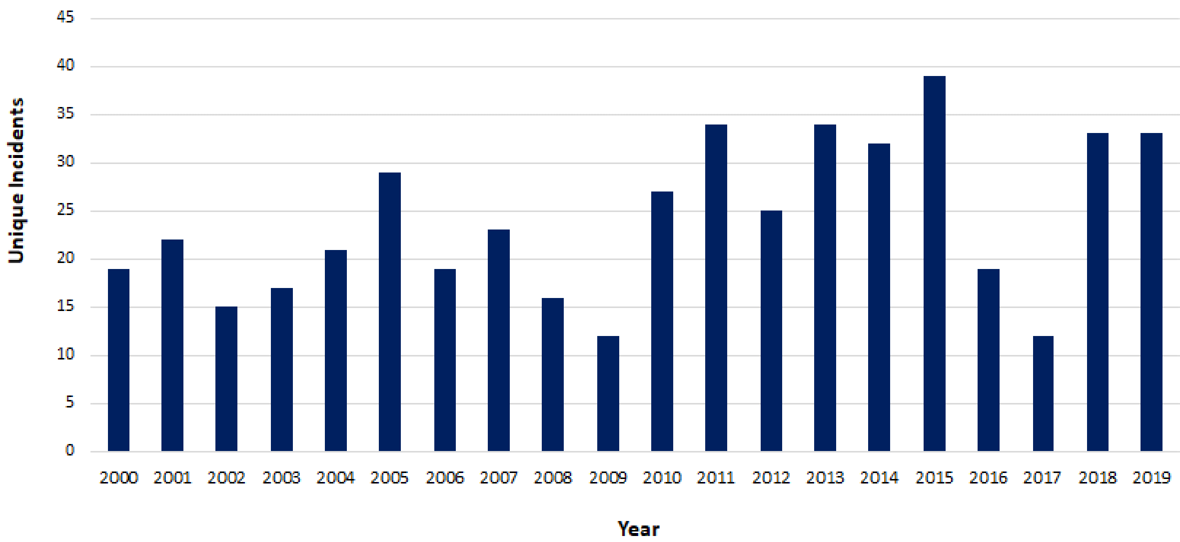

Figure C.9 MAIB Annual Collision Incidents within UK Water (2000 to 2019)

The average number of collision incidents per year was 14. There has been an overall increasing trend (albeit slight) in collision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

The most frequent vessel types involved in collision incidents were other commercial vessels (29%), fishing vessels (24%), non-commercial pleasure craft (23%) and dry cargo vessels (12%).

A 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.3.3 Contact Incidents

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).

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).

The locations of contact incidents reported in proximity to the UK are presented in Figure C.10. Following this, the distribution of contact incidents per year is presented in Figure C.11.

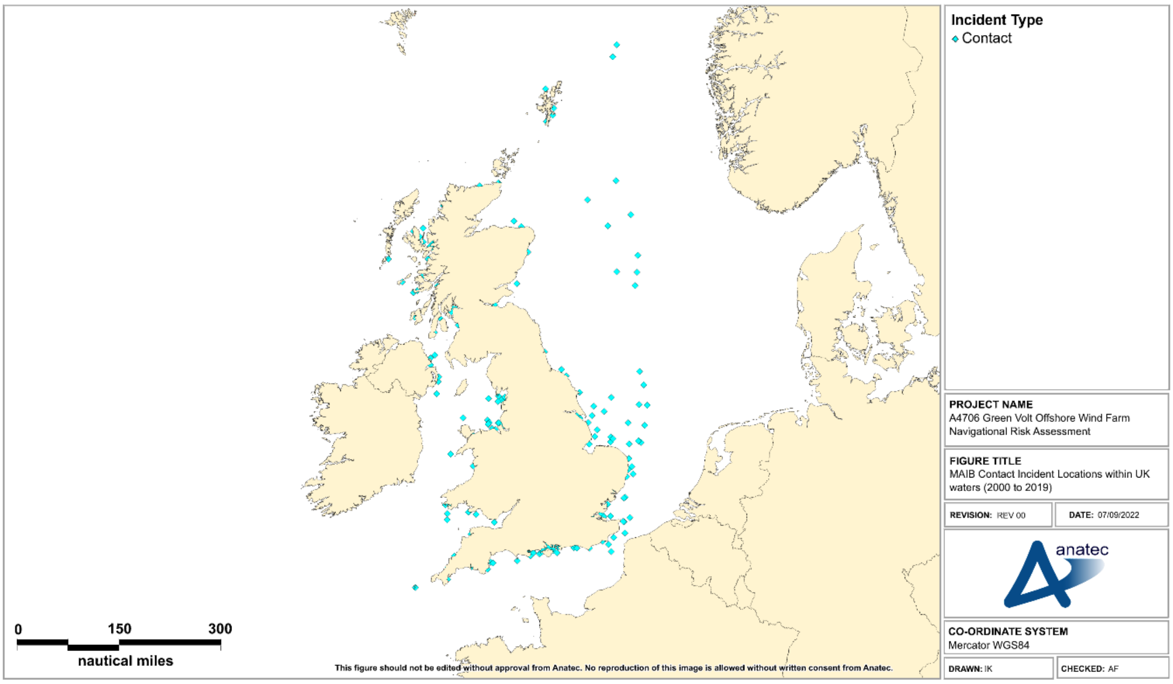

Figure C.10 MAIB Contact Incident Locations within UK waters (2000 to 2019)

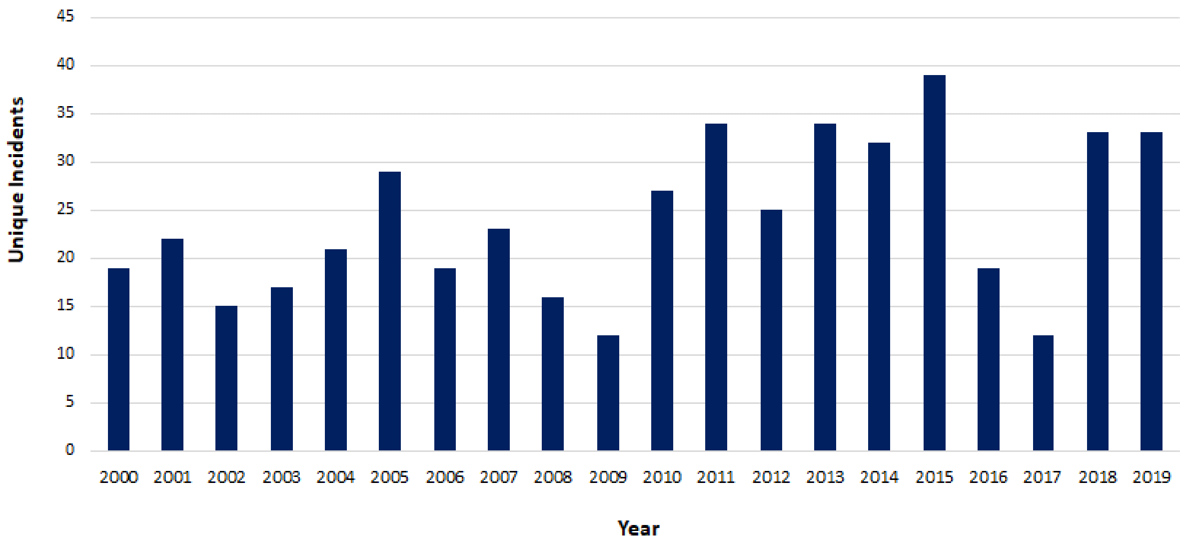

Figure C.11 MAIB Contact Incidents per Year within UK Waters (2000 to 2019)

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.

The distribution of vessel types involved in contact incidents is presented in Figure C.12.

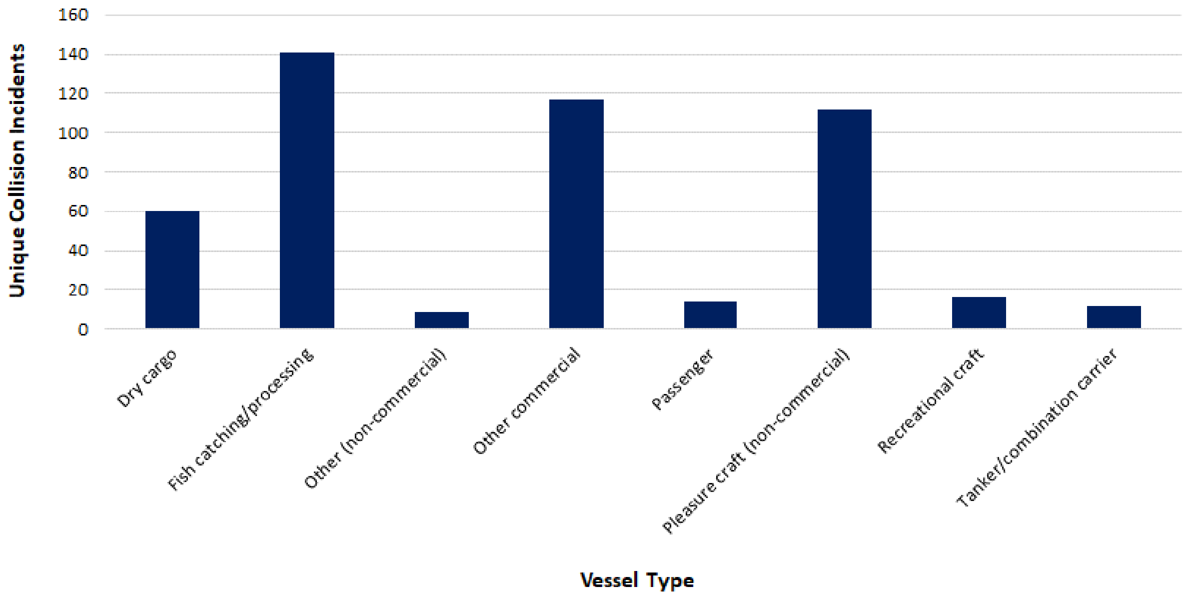

Figure C.12 MAIB Contact Incidents by Vessel Type within UK Waters (2000 to 2019)

The most frequent vessel types involved in contact incidents were other commercial vessels (43%), fishing vessels (15%) and non-commercial pleasure craft (13%).

A total of 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.4 Fatality Risk

C.4.1 Incident Data

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 maritime incident associated with the Project.

The Project is 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.

Of these incident types, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in Section C.3.2 is considered directly applicable to these types of incidents.

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 WTG or OSP. From Section C.3.3 , 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.

As the mechanics involved in a vessel contacting a WTG may differ in severity from striking, 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.4.2 Fatality Probability

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.

To assess the fatality risk for personnel onboard a vessel (crew, passenger or other) the number of persons involved in the incidents needs to be estimated. **Table C.4** presents the average number of personnel on board (POB) estimated for each category of vessel navigating in proximity to the Project. For passenger vessels this is based upon information available for the specific vessels recorded in the vessel traffic survey data (noting that passenger vessel traffic was limited in the vicinity of the Windfarm Site). For other vessel categories, this is based upon information available from 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	RoRo passenger, cruise liner, etc.	Vessel traffic survey data / online information	1,070
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

It is recognised that these average POB 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, particularly when noting that the average POB for the dominant vessel category (passenger) is based upon the vessel traffic survey data where possible.

Using the average POB, along with the vessel type information involved in collision incidents reported by the MAIB (see Section C.3.2), there was an estimated 17,848 POB the vessels involved in the collision incidents.

Based upon six fatalities, the overall fatality probability in a collision for any individual onboard is approximately 3.4×10^{-4} per collision.

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 three 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}

The risk is higher by two orders of magnitude for POB small craft compared to larger commercial vessels.

C.4.3 Fatality Risk due to the Project

The base case and future case annual collision frequency levels pre and post wind farm for the Project are summarised in **Table 15.1**.

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 Project for the base case and future cases are presented in **Figure C.13**.

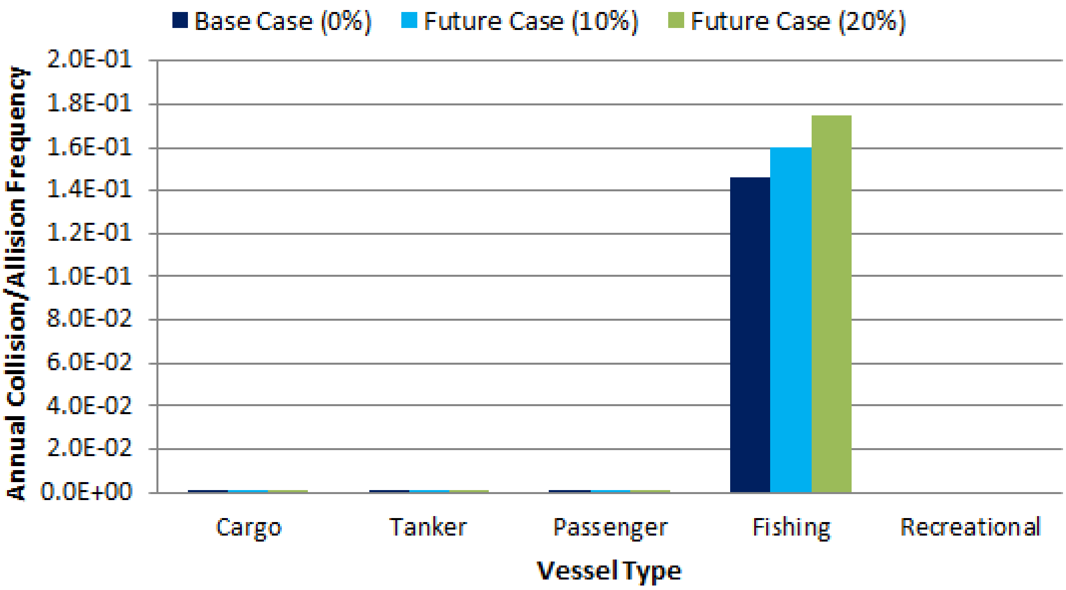

Figure C.13 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

As shown, the significant majority of the change in collision and allision frequency is associated with fishing vessels due to their prevalence within the Windfarm Site in comparison to other vessel types. It is important to note that as per Section 15.4.4, the allision modelling assumes no change in baseline fishing activity which is considered a very conservative assumption.

Combining the annual collision and allision frequency, estimated number of POB for each vessel type and the estimated fatality probability for each vessel type category, the annual increase in PLL due to the Project for the base case is estimated to be 9.79×10^{-4}, equating to one additional fatality every 1,021 years.

The estimated incremental increases in PLL due to the Project, distributed by vessel type and for the base case and future cases, are presented in **Figure C.14**.

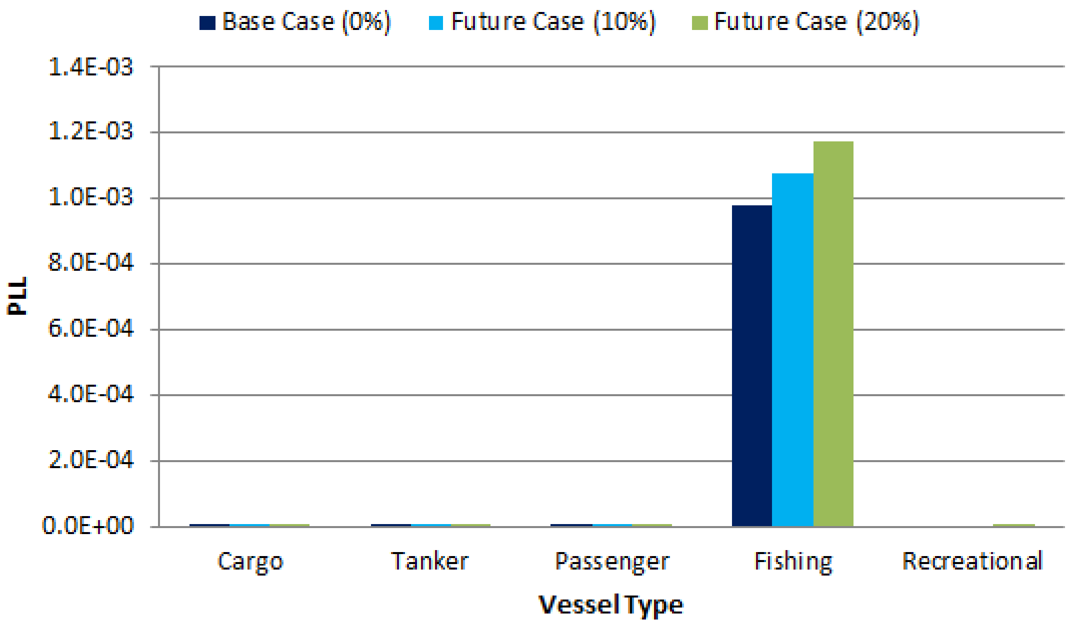

Figure C.14 Estimated Change in Annual PLL by Vessel Type

As with the change in collision and allision frequency, the significant majority of the change in annual PLL is associated with fishing vessels, which historically have a higher fatality probability than commercial vessels. The conservatism of the assumption that baseline fishing activity will remain unchanged is again noted (see Section 15.4.4).

Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in **Figure C.15**.

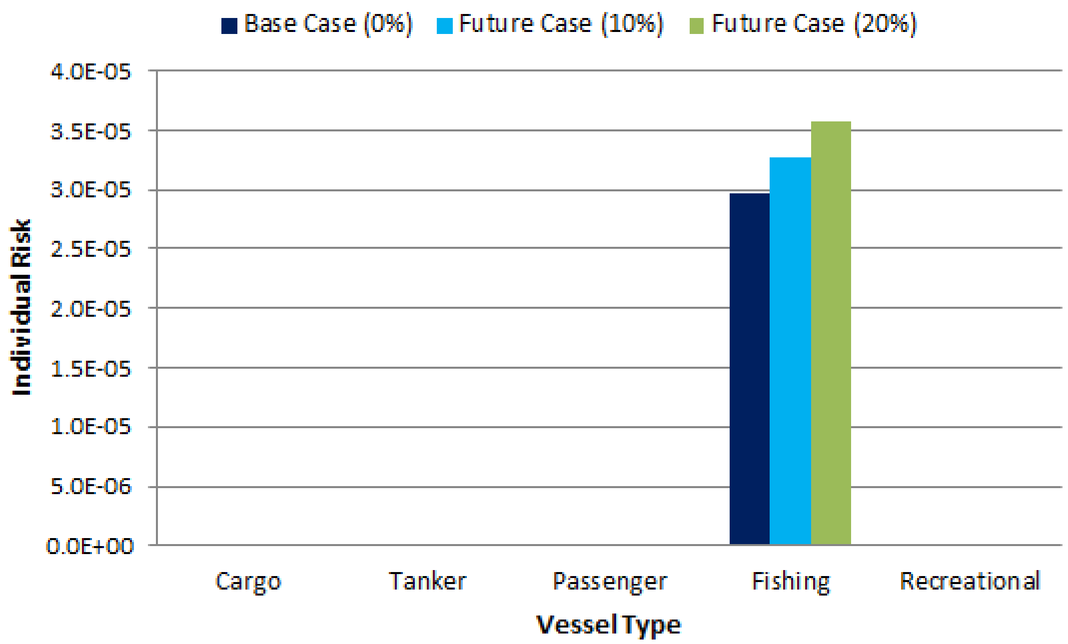

Figure C.15 Estimated Change in Individual Risk by Vessel Type

It can be seen that the individual risk to people is dominated by fishing vessels, reflecting the higher probability of a fatality occurring in the event of an incident involving a fishing vessel in comparison to other vessel types. The conservatism of the assumption that baseline fishing activity will remain unchanged is again noted (see Section 15.4.4).

C.4.4 Significance of Increase in Fatality Risk

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 1,021 years represents a negligible change.

In terms of individual risk to people, the change for commercial vessels attributed to the Project (approximately 1.59×10^{-9} for the base case) is negligible compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

For fishing vessels, the change in individual risk attributed to the Project (approximately 2.98×10^{-5} for the base case) is low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

C.5 Pollution Risk

C.5.1 Historical Analysis

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).

Two types of oil spill are considered in this assessment:

- Fuel oil spills from bunkers (all vessel types); and
- Cargo oil spills (laden tankers).

The research undertaken as part of the DfT's Marine Environmental High Risk Areas (MEHRAs) 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 per incident was calculated based upon historical incident data for each incident type as presented in **Figure C.16**.

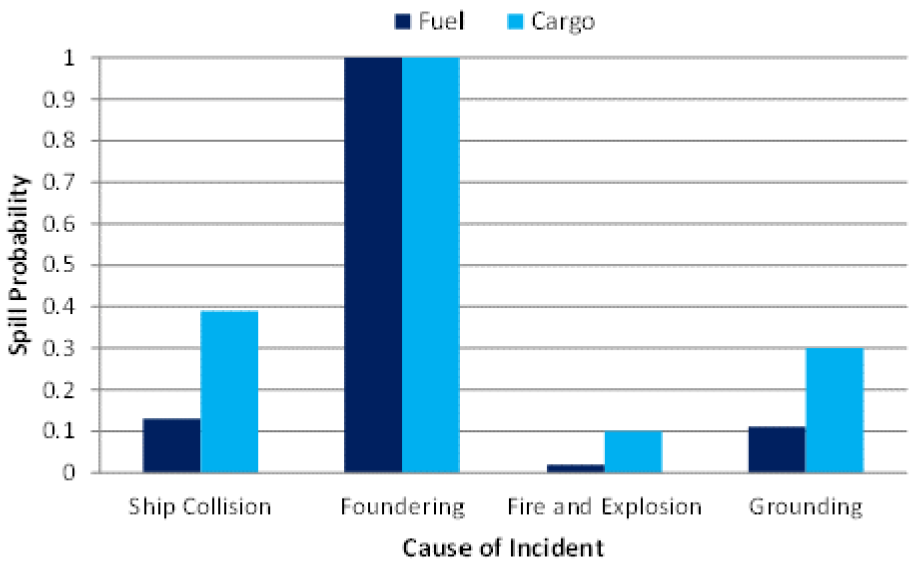

Figure C.16 Probability of an Oil Spill Resulting from an Accident

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.

In the event of a bunker spill, the potential outflow of oil depends upon the bunker capacity of the vessel. Historical bunker spills from vessel have generally been limited to a size below 50% of bunker capacity, and in most incidents much lower.

For the types and sizes of vessels exposed to the Project, an average spill size of 100 tonnes of fuel oil is considered a conservative assumption.

For cargo spills from laden tankers, the spill size can vary significantly. The 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.

Based upon this data and the tankers transiting in proximity to the Project, an average spill size of 400 tonnes is considered a conservative assumption.

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, due to a lack of data 50% of collisions are conservatively assumed to lead to a spill with an average size of one tonne.

C.5.2 Pollution Risk due to the Project

Applying the above probabilities to the annual collision and allision frequency by vessel type and the average spill size per vessel, the amount of oil spilled per year due to the impact of the Project is estimated to be 0.37 tonnes per year for the base case.

The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future cases are presented in **Figure C.17**.

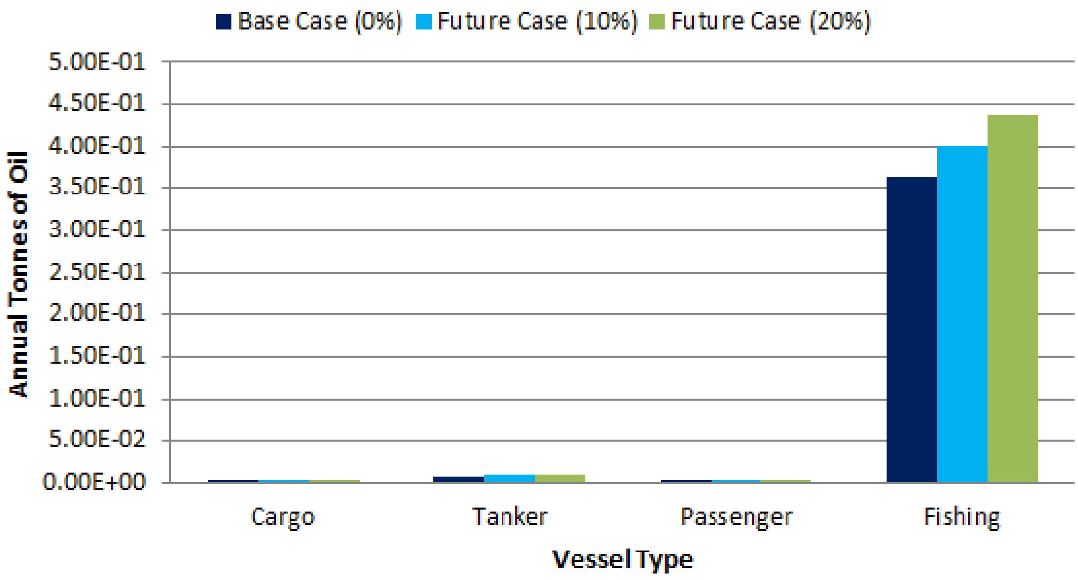

Figure C.17 Estimated Change in Pollution by Vessel Type

The significant majority of annual oil spill results are associated with fishing vessels due to their high associated allision frequency (noting the conservative modelling assumptions as per Section 15.4.4).

C.5.3 Significance of Increase in Pollution Risk

To assess the significance of the increased pollution risk from vessels caused by the Project, historical oil spill data for the UK has been used as a benchmark.

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. 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 resulting from operational errors or equipment failure). Commercial vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

The overall increase in pollution estimated due to the Project of 0.37 tonnes for the base case represents a 0.002% increase compared to the historical average pollution quantities from maritime incidents in UK waters.

C.6 Conclusion

This appendix has quantitively assessed the fatality and pollution risk associated with the Project in the event of a collision or allision incident occurring. The assessment indicates that the fatality and pollution risk associated with fishing vessels is the largest for the Project.

Overall, the impact of the Project on people and the environment is relatively low compared to the existing background risk levels in UK waters. However, this is the localised impact of a single offshore wind farm development and there will be additional maritime risks associated with other offshore wind farm developments in the UK as a whole.

Discussion of relevant mitigation measures and monitoring is provided in Section 21 of the NRA.

Appendix D Regular Operators Letter

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Date: 06/04/2022
Ref: A4706-FE-RO-1

Stakeholder Consultation on Impacts Relating to Shipping and Navigation for the Proposed Green Volt Offshore Windfarm

Dear Stakeholder,

Green Volt Offshore Wind Limited is the developer of the proposed Green Volt Offshore Windfarm ('the Project'), which is to be located in the North Sea approximately 38 nautical miles (nm) off the northeast coast of Aberdeenshire. The Project comprises floating turbines that will facilitate decarbonisation of the oil and gas industry via electrification of the nearby Buzzard oil and gas field, noting there will also be full UK grid connection. Further information relating to the Project is available here.

Following a Scoping Report for the Project submitted to Marine Scotland in November 2021 (see here), Green Volt Offshore Wind Limited are proceeding to create the associated Navigational Risk Assessment (NRA) which will inform the shipping and navigation assessment undertaken for the application.

As part of the NRA process, the Project would like to ensure that comprehensive consultation is undertaken and to identify any potential impacts that the Project may have upon shipping and navigation. To analyse shipping movements within and in the vicinity of the site, Automatic Identification System (AIS), Radar data, and visual observations obtained from traffic surveys undertaken during 2021 and 2022 have been collected and assessed and will feed into the NRA as required by the Maritime and Coastguard Agency (MCA).

According to the assessment of the available datasets, your company's vessel(s) have been recorded navigating within and/or in the vicinity of the site. Consequently, your company has been identified as a potential marine stakeholder for the Project. We therefore invite your feedback on the potential development including any impact it may have upon the navigation of vessels.

An overview of the site for the Project is provided in Figure 1. The Buzzard platform and nearby Golden Eagle platform have been included for reference.

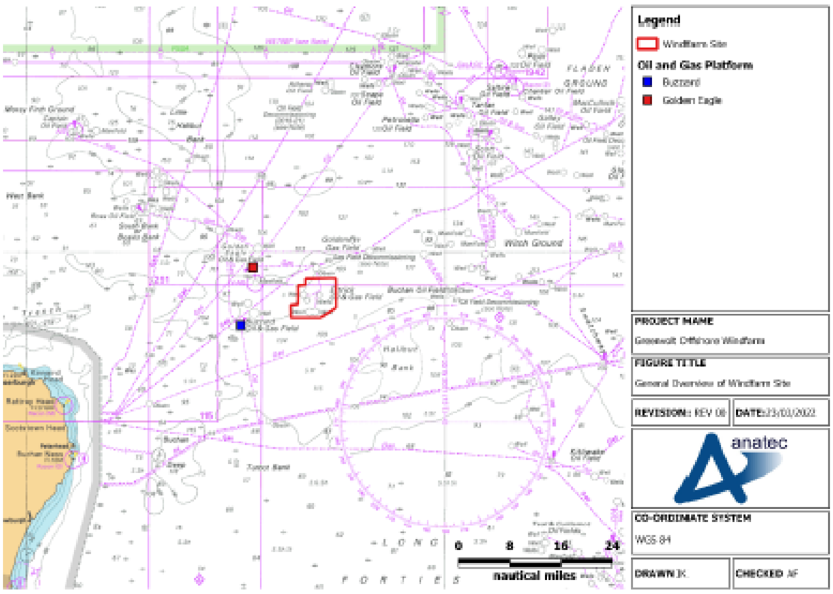

Figure 1: General Overview of Windfarm Site

We would be grateful if you could provide us with any comments or feedback that you may have by the 20th April 2022. This will allow us to assess your feedback as part of the NRA which is currently being undertaken. 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 the Project is likely to impact the routeing of any specific vessels, including the nature of any change in regular passage;
2. Whether any aspect of the Project poses any safety concerns to your vessels, including any adverse weather routeing;
3. Whether you would choose to make passage internally through the array of floating structures;
4. Whether you would view floating turbines any differently from fixed turbines from a passing vessel perspective;
5. Whether you wish to be retained on our list of marine stakeholders and consulted throughout the NRA process; and
6. Whether you wish to attend a Hazard Workshop in late April / early May 2022, where impacts relating to shipping and navigation will be discussed.

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.

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GREEN VOLT

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