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Volume 7B Proposed Development (Offshore)

Appendix 9-1 Navigational Risk Assessment

Caledonia Offshore Wind Farm Ltd

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Volume 7B Appendix 9-1 Navigational Risk Assessment

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This document contains the following report: 'Caledonia Offshore Wind Farm Navigational Risk Assessment' as prepared by Anatec Limited in October 2024. For the purpose of Consent Application, the document has been retitled to: 'Volume 7B, Appendix 9-1: Navigational Risk Assessment', alongside the addition of a new front cover.

Caledonia Offshore Wind Farm Navigational Risk Assessment

Prepared by	Anatec Limited
Presented to	Caledonia Offshore Wind Farm Ltd
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00	31 May 2024	Initial Draft
01	1 July 2024	Incorporation of Arup / GoBe comments
02	2 August 2024	Incorporation of Arup / GoBe comments
03	2 September 2024	Further Review Cycle
04	17 October 2024	Post close out session

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Abbreviations Table

Abbreviation	Definition
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ALB	All-weather Lifeboat
ARPA	Automatic Radar Plotting Aid
ATBA	Area to be Avoided
AtoN	Aid to Navigation
BBC	British Broadcasting Corporation
BWEA	British Wind Energy Association
CA	Cruising Association
CAA	Civil Aviation Authority
CaP	Cable Plan
CBA	Cost Benefit Analysis
CfD	Contract for Difference
CHIRP	Confidential Human Factors Incident Reporting Programme
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
CCTV	Closed Circuit Television
CTV	Crew Transfer Vessel
DC	Direct Current
DE	Design Envelope
DGC	Defence Geographic Centre
DF	Direction Finding
DfT	Department for Transport
DSC	Digital Selective Calling
DSLP	Development Specification and Layout Plan
DWT	Deadweight Tonnage
EEA	European Economic Area
EEZ	Exclusive Economic Zone

Abbreviation	Definition
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
ERCoP	Emergency Response Cooperation Plan
EU	European Union
ESRI	Environmental Systems Research Institute
ETRS89	European Terrestrial Reference System 1989
FLO	Fisheries Liaison Officer
FMMS	Fisheries Management and Mitigation Strategy
FRB	Fast Rescue Boat
FSA	Formal Safety Assessment
GIS	Geographical Information System
GLA	General Lighthouse Authority
GMDSS	Global Maritime Distress and Safety System
GPS	Global Position System
GRP	Glass Reinforced Plastic
GW	Gigawatt
HAT	Highest Astronomical Tide
HDD	Horizontal Directional Drilling
HLV	Heavy Lift Vessels
HF	High Frequency
HMCG	His Majesty's Coast Guard
HSE	Health and Safety Executive
HVAC	High Voltage Alternative Current
HVDC	High Voltage Direct Current
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHO	International Hydrographic Organisation
ILB	Inshore Lifeboat
IMCA	International Marine Contractors Association

Abbreviation	Definition
IMO	International Maritime Organization
IPS	Intermediate Peripheral Structure
JRCC	Joint Rescue Coordination Centre
JUV	Jack Up Vessel
kHz	Kilohertz
kt	Knots
LMP	Lighting and Marking Plan
LOA	Length Overall
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MD-LOT	Marine Directorate – Licensing Operations Team
MEPC	Marine Environment Protection Committee
MF	Medium Frequency
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MOD	Ministry of Defence
MPCP	Marine Pollution Contingency Plan
MRCC	Maritime Rescue Coordination Centres
MSC	Maritime Safety Committee
MSI	Maritime Safety Information
MSL	Mean Sea Level
NATEX	Navigational Telex
NLB	Northern Lighthouse Board
nm	Nautical mile
nm^2	Square nautical mile
NRA	Navigational Risk Assessment
NSP	Navigational Safety Plan
NUC	Not Under Command
O&M	Operation and Maintenance

Abbreviation	Definition
OECC	Offshore Export Cable Corridor
OREI	Offshore Renewable Energy Installation
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PEMP	Project Environmental Monitoring Plan
PLA	Port of London Authority
PLL	Potential Loss of Life
PNT	Positioning, Navigation and Timing
POB	People on Board
QHSE	Quality, Health, Safety and Environment
Racon	Radar Beacons
Radar	Radio Detection and Ranging
RAM	Restricted in Ability to Manoeuvre
REZ	Renewable Energy Zone
RIB	Rigid-hulled Inflatable Boat
RNLI	Royal National Lifeboat Institution
RoPax	Roll-on/Roll-off Passenger
RoRo	Roll-on/Roll-off Cargo
RYA	Royal Yachting Association
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea
SONAR	Sound Navigation Ranging
SOV	Service Operation Vessel
SPS	Significant Peripheral Structure
TCE	The Crown Estate
TPV	Third-Party Verification
TSS	Traffic Separation System
UK	United Kingdom

Abbreviation	Definition
UKCoS	United Kingdom Chamber of Shipping
UKHO	United Kingdom Hydrographic Office
USA	United States of America
UXO	Unexploded Ordnance
VHF	Very High Frequency
VMP	Vessel Management Plan
VMS	Vessel Monitoring System
VTS	Vessel Traffic System
WCS	Worst Case Scenario
WETREP	Western European Tanker Reporting System
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator

1 Introduction

1.1 Background

Anatec was commissioned by Ocean Winds on behalf of Caledonia Offshore Wind Farm Ltd (hereafter 'the Applicant') to undertake a Navigational Risk Assessment (NRA) for the Caledonia Offshore Wind Farm (OWF) which comprises; Caledonia North and Caledonia South, collectively referred to as the 'Proposed Development (Offshore)'.

This NRA presents information on the Proposed Development (Offshore) relative to the existing and estimated future navigational activity and forms a supporting study to the Environmental Impact Assessment Report (EIAR):

- Volume 2 Proposed Development (Offshore), Chapter 9: Shipping and Navigation;
- Volume 3 Caledonia North, Chapter 9: Shipping and Navigation; and
- Volume 4 Caledonia South, Chapter 9: Shipping and Navigation.

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 OWF developments;
- Summary of Design Envelope (DE) 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 Proposed Development (Offshore) including collision and allision risk modelling;
- Hazard identification for further assessment in Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR;
- Identification of embedded mitigation measures; and
- Completion of the MGN 654 Checklist (see Appendix A).

Potential hazards have been considered for each phase of the Proposed Development (Offshore) as follows:

- Construction (including pre-construction);
- Operation and maintenance (O&M); and
- Decommissioning.

The assessment of the Proposed Development (Offshore) is based on a DE (i.e., a range of design parameters within which Caledonia could be constructed), an approach which is standard practice for OWF developments given the potential for findings from further site investigations (to be undertaken post consent) and advancements in technology. The DE includes conservative assumptions to form a Worst Case Scenario (WCS) which is considered and assessed for all hazards on the basis that any deviation from the WCS (but still within the parameters of the DE) will result in the risk of any relevant hazards being no greater than that assessed using the WCS. Further details on the DE are provided in Section 6. The assessment registers an increased risk (1 in 2.9-3.5 years) with regards to fishing vessel to structure allision.

2 Guidance and Legislation

2.1 Legislation

An EIAR is required to support the applications for the Section 36 consent for the Proposed Development (Offshore). 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 Formal Safety Assessment (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 Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR 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 Amendment 1 (Merchant and Fishing) Offshore Renewable Energy Installations (OREI): Guidance to Mariners Operating in the Vicinity of UK OREIs* (MCA, 2022);
- *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures* (IALA, 2021 (a));
- *IALA Guidance G1162 The Marking of Offshore Man-Made Structures* (IALA, 2021 (b)); and
- *The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy* (RYA, 2019 (b)).

2.4 Lessons Learnt

There is considerable benefit for the Proposed Development (Offshore) in the sharing of lessons learnt within the offshore industry. The NRA, and in particular the risk assessment undertaken in Section 18 and Volumes 2, 3, and 4 Chapter 9: Shipping and Navigation of the EIAR, includes general consideration for lessons learnt and expert opinion from previous OWF developments and other sea users, capitalising upon the UK's position as a leading generator of offshore wind power. It is noted that Ocean Winds also developed Moray East and Moray West OWFs, the NRAs of which are included below.

Data sources for lessons learnt include the following:

- *Sharing the Wind – Recreational Boating in the Offshore Wind Strategic Areas* (RYA and Cruising Association (CA), 2004);
- *Results of the Electromagnetic Investigations* (MCA and QinetiQ, 2004);
- *Offshore Wind Farm Helicopter Search and Rescue Trials Undertaken at the North Hoyle Wind Farm* (MCA, 2005);
- *Interference to Radar Imagery from Offshore Wind Farms* (Port of London Authority (PLA) ,2005);
- *Strategic Assessment of Impacts on Navigation of Shipping and Related Effects on Other Marine Activities Arising from the Development of Offshore Wind Farms in the UK Renewable Energy Zone* (Anatec and The Crown Estate (TCE), 2012);
- *Offshore Wind and Marine Energy Health and Safety Guidelines* (RenewableUK, 2014);
- *Influence of UK Offshore Wind Farm Installation on Commercial Vessel Navigation: A Review of Evidence* (Anatec, 2016);
- *G+ Global Offshore Wind Health & Safety Organisation 2020 Incident Data Report* (G+, 2021);
- *Moray East Offshore Wind Farm Navigational Risk Assessment* (Anatec, 2012);
- *Moray West Offshore Wind Farm Navigational Risk Assessment* (Anatec, 2018); and
- Navigational Planning and Risk Assessment (ORE Catapult, 2023).

3 Navigational 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 herein 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 considers hazards to commercial fishing vessels in transit. A separate methodology and assessment have been applied in Volume 2 Proposed Development (Offshore), Chapter 8: Commercial Fisheries 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 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 Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR and Section 18 of the 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 the FSA Methodology (IMO, 2018)

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 has been defined within the hazard log, respectively.

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(ies)	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	Less 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).

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 Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR and Section 18 the NRA.

Table 3.3 Tolerability Matrix and Risk Rankings

Severity of Consequence						
	5					
	4					
	3					
	2					
	1					
		1	2	3	4	5
		Frequency of occurrence				

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

3.3 Methodology for Cumulative Risk Assessment

The hazards identified in the FSA are also assessed for cumulative risks with other projects and proposed developments within the cumulative risk assessment. Given the varying type, status and location of developments, different scenarios have been considered in the cumulative risk assessment, which allocates developments into the scenarios depending upon the following criterion:

- Development status;
- Distance from the Proposed Development (Offshore);
- Level of interaction with baseline traffic relevant to the Proposed Development (Offshore);
- Level of concern raised during consultation; and
- Data confidence.

It is noted that given the unique nature of shipping and navigation, the tiering system applied in the NRA differs from that assumed in the overarching EIAR (see Volume 1, Chapter 7: EIA Methodology).

The scenarios and associated level of assessment undertaken for each tier are summarised in Table 3.4.

The maximum distance within which developments are considered for the cumulative risk assessment is 50 nautical miles (nm) from Caledonia OWF on the basis that there is not considered to be a direct pathway between the Proposed Development (Offshore) and any development beyond 50nm from Caledonia OWF. This distance is standard within NRAs and provides a good overview of cumulative traffic patterns.

An aggregate of the criterion can determine the relevant scenario(s) for each development. For example, if a development is located within 50nm of Caledonia OWF but does not impact a main commercial route passing within 1nm of Caledonia OWF and has low data confidence it may still be screened out of the cumulative risk assessment.

For the purpose of the cumulative assessment, the development status in the context of shipping and navigation has been defined as the following;

- 'Consented' indicates that a development has been consented but has not yet begun construction.
- 'Under determination' refers to a project submitted but not yet consented.
- 'Under construction' indicates that offshore construction was ongoing at the time of the baseline being established and a buoyed construction area is present.

Projects meeting the assessment criteria are detailed in Section 14.

Table 3.4 Cumulative Development Screening Summary

Tier	Minimum Development Status	Criterion	Data Confidence Level	Level of Cumulative Risk Assessment
1	Under construction, consented or under determination	▪ **May** impact a main commercial route passing within 1nm of Caledonia OWF. *OWFs:* ▪ Up to 50nm from Caledonia OWF; or ▪ Up to 2nm from the Caledonia OECC. *Sub-sea cables:* ▪ Up to 2nm from Caledonia OWF; or ▪ Up to 2nm from the Caledonia OECC. *Other* ▪ Oil and gas platform within 10nm.	High or medium	Quantitative cumulative re-routeing of main commercial routes
2	Under construction, consented or under determination	▪ **Does not** impact a main commercial route passing within 1nm of Caledonia OWF. *OWFs:* ▪ Up to 50nm from Caledonia OWF; or ▪ Between 2nm and 5nm from the Caledonia OECC. *Sub-sea cables:* ▪ Between 2nm and 5nm from Caledonia OWF; or ▪ Between 2nm and 5nm from the Caledonia OECC. *Other* ▪ Oil and gas platform within 10nm.	High or medium	Qualitative cumulative re-routeing of main commercial routes

Tier	Minimum Development Status	Criterion	Data Confidence Level	Level of Cumulative Risk Assessment
3	Scoped or under examination	▪ **Does not** impact a main commercial route passing within 1nm of Caledonia OWF. *OWFs:* ▪ Up to 50nm from Caledonia OWF; or ▪ Further than 5nm from the Caledonia OECC. *Sub-sea cables:* ▪ Further than 5nm from Caledonia OWF; or ▪ Further than 5nm from the Caledonia OECC.	Low	Qualitative assumptions of routeing only

3.4 Study Area

A 10nm buffer has been applied around Caledonia OWF (hereafter the ‘study area’) as shown in Figure 3.2. This study area has been defined to provide local context to the analysis of risks by obtaining the vessel traffic movements within, and in proximity to, Caledonia OWF. A 10nm study area has been used within the majority of UK OWF NRAs and is suitable for collection of Radio Detection and Ranging (Radar) data.

A 2nm buffer has been applied around the Caledonia OECC (hereafter the ‘OECC study area’) as shown in Figure 3.2. As with the study area, this OECC study area has been defined to capture relevant users and their movements within and near the Caledonia OECC.

The study area and OECC study area capture all offshore elements of the Caledonia OWF, the Caledonia South OWF, and the Caledonia North OWF. The study area and OECC study area have been presented to stakeholders including in the Scoping Report and at the hazard workshop.

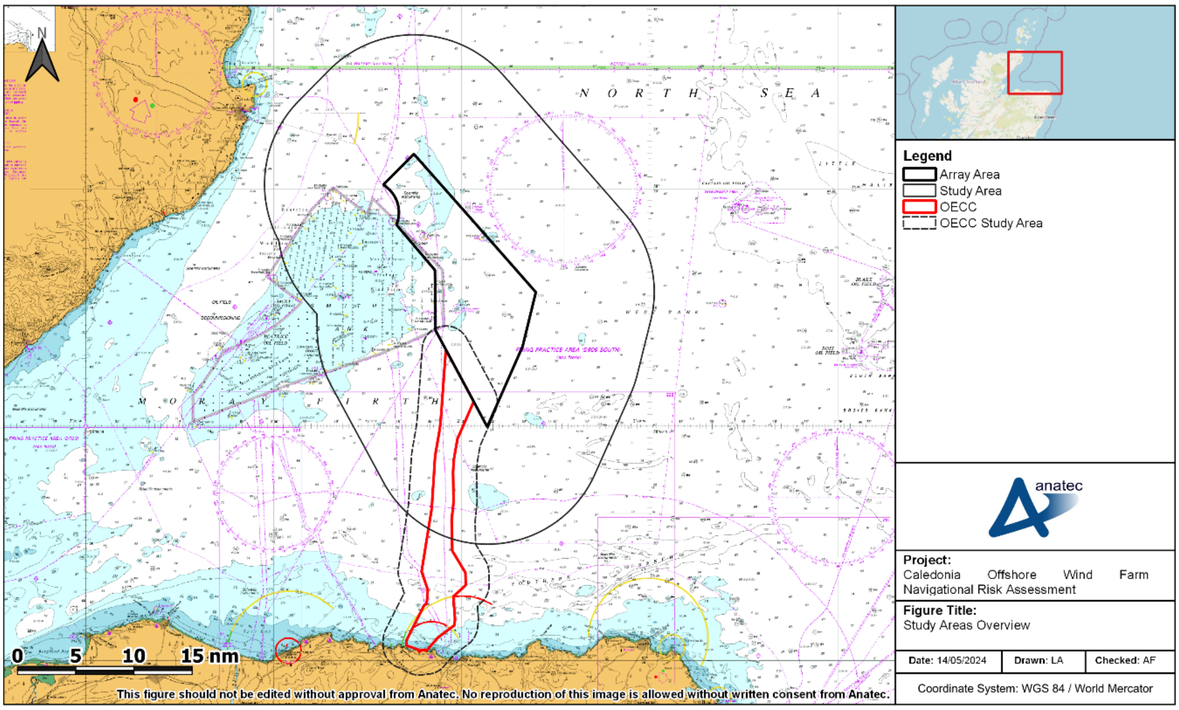

Figure 3.2 Study Area Overview

4 Consultation

4.1 Stakeholders Consulted in the Navigational Risk Assessment Process

Key shipping and navigation stakeholders have been consulted in the NRA process. The following stakeholders have been consulted including via the Hazard Workshop:

- MCA;
- Northern Lighthouse Board (NLB);
- UK Chamber of Shipping (UKCoS);
- Nigg Energy Park;
- RYA Scotland;
- CA;
- Scottish White Fish Producers Association;
- Scottish Fishermen's Federation;
- Green Marine;
- Smyril Line; and
- Serco NorthLink.

Meetings have included the Hazard Workshop (see Section 4.3) and standalone consultation meetings held both prior to, and following, the Scoping stage.

As well as consulting with the organisations outlined in Section 4.1, 26 Regular Operators identified from the vessel traffic surveys and long-term vessel traffic data were provided with an overview of the Proposed Development (Offshore) and offered the opportunity to provide feedback. Specific questions were included to aid Regular Operators wishing to make a response, including in relation to changes in routeing or adverse weather routeing. The Regular Operator letter is presented in full in Appendix D.

The full list of Regular Operators identified and subsequently contacted is provided below:

- Tidal transit;
- Smyril Line;
- NorthLink Ferries;
- Wilson Ship;
- Seacat Services;
- VOS;
- Scotline;
- Maersk;
- Thun Tankers;
- Aurora Offshore;
- Solstad Offshore;
- Jan De Nul;
- Esvagt;
- Farra Marine;
- Njord Offshore;

- Longship;
- Eimskip;
- Cadeler;
- Samskip;
- Seajacks;
- Subsea7;
- Bontrup;
- Green Marine;
- Arklow Shipping;
- Fednav; and
- MSC Cruises.

Smyril Line, Thun Tankers, Tidal Transit, and Serco NorthLink provided feedback directly, as summarised in the relevant entries in Table 4.1.

4.2 Consultation Responses

Various responses have been received from stakeholders during consultation undertaken in the NRA process including during the Hazard Workshop, other consultation meetings, via email correspondence, and through the Scoping Opinion. The key points and where they have been addressed in the NRA or Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR are summarised in Table 4.1.

Table 4.1 Consultation Summary

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
Marine Directorate-Licensing Operations Team (MD-LOT)	13/01/2023	Scoping Opinion	The Scottish Ministers are content with the study area identified in section 13.2 of the Scoping Report. With regards to baseline data listed in table 13.1 of the Scoping Report, the Scottish Ministers direct the Developer to the representation to the UKCoS. The Scottish Ministers advise that the Marine Accident Investigation Branch (MAIB) spatial accident data included within the EIA Report must be increased from 10 years to 20 years to fully assess trends and historic incidents.	The NRA has assessed 20 years of MAIB data (see Section 9.5).
MD-LOT	13/01/2023	Scoping Opinion	In line with the representation from the MCA, the Scottish Ministers are content that the two separate 14-day periods of Automatic Identification System (AIS) data set out in the Scoping Report meets the standard MGN 654, however highlight the advice from the UKCoS that an additional full 12 months of AIS data should be included in the EIA Report. The Scottish Ministers advise that the Developer must engage further with the MCA and UKCoS to reach a suitable agreement on the provision of AIS data and document the rationale for the final approach within the EIA Report. Only AIS data from either 2019 or 2021 must be utilised within the EIA Report due to the impact of the Covid 19 pandemic on shipping, and in particular on cruise and passenger traffic during 2020.	The NRA has assessed 12 months of AIS data from 2022 to 2023 (see Appendix E). The vessel traffic datasets and study areas used have been shared with the MCA and UKCoS.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
MD-LOT	13/01/2023	Scoping Opinion	Table 13.2 of the Scoping Report summarises the potential impacts to shipping and navigation for each phase of the Proposed Development which the Developer proposes to scope into and out of the EIA Report. The Scottish Ministers broadly agreed with the impacts scoped in and out however, advise that cumulative and transboundary effects must also be scoped into the EIA Report. This is in line with the UKCoS, MCA and RYA representations.	As per Section 14, cumulative and transboundary impacts have been assessed within the NRA.
MD-LOT	13/01/2023	Scoping Opinion	With regards to cabling routes and cable burial, the Scottish Ministers advise that a Burial Protection Index 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 on a maximum 5% reduction in surrounding depth referenced to Chart Datum if cable protection measures are required and in particular where depths are decreasing towards shore.	As per Section 17, there will be full MGN 654 (MCA, 2021) compliance including in relation to anchor studies and water depth reductions. A CBRA will be undertaken post consent.
MD-LOT	13/01/2023	Scoping Opinion	The Scottish Ministers advise the Developer must give consideration within the EIA Report for the potential effect of electromagnetic deviation on ships' compasses should High-Voltage Direct Current (HVDC) transmission infrastructure be installed. For completeness, the Scottish Minsters highlight the	HVDC is not being considered within the DE.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
			advice from the MCA regarding the maximum deviation from the cable route.	
MD-LOT	13/01/2023	Scoping Opinion	The Scottish Ministers also highlight the MCA representation regarding Search and Rescue (SAR), Emergency Response Co-operation Plans, levels of radar surveillance, AIS and shore-based Very High Frequency (VHF) radio coverage. The Scottish Ministers advise that the MCA representation must be fully addressed in the EIA Report and that a SAR checklist must be completed by the Developer in consultation with the MCA. In relation to the proposed embedded mitigation measures, the Scottish Ministers highlight the representations from the MCA, UKCoS and NLB which must be fully addressed by the Developer	As per Section 17, there will be full compliance with MGN 654 (MCA, 2021) including the completion of a SAR Checklist.
MD-LOT	13/01/2023	Scoping Opinion	For completeness, the Developer should note, if floating foundations are selected the MCA confirmed that compliance with regulatory expectations for floating infrastructure is required and Third-Party Verification of the mooring arrangements will be required. The MCA highlighted that the IALA recommendations 0-139 Marking of Man-Made Offshore Structures has been replaced by G1162 ED1.0.	As per Section 2, the most up-to-date guidance has been considered, including in relation to floating infrastructure.
MD-LOT	13/01/2023	Scoping Opinion	The Scottish Ministers also agree with The Highland Council that, should the Developer plan to use any ports within the	Not specifically assessed within the NRA. Addressed elsewhere within the EIA

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
			Highland Council area for construction or supply chain components, this must be assessed within the EIA Report.	(Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation)
MD-LOT	13/01/2023	Scoping Opinion	The Developer identifies the Proposed Development (Offshore) will be located within Danger Area D809 South in Section 15.2.3.1 of the Scoping Report. In line with the Ministry of Defence (MOD) representation, The Developer must ensure that no infrastructure related to the Proposed Development (Offshore) is installed within the boundary identified in the MOD representation. Military training activities are conducted in this Danger Area and the EIA Report should consider the effects of vessels, barges, platforms and associated traffic present during the construction of the Proposed Development (Offshore) to ensure it does not interfere with these activities.	Not specifically addressed within the NRA. Addressed elsewhere within the EIA (e.g. Volume 2, Chapter 11: Military and Civil Aviation).
MCA	26/10/2022	Scoping Opinion	The EIA should supply detail on the possible 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 site and information to mariners	The listed hazards have been assessed in the NRA and in Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
			▪ 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.	
MCA	26/10/2022	Scoping Opinion	The development area carries a significant amount of through traffic to major ports, with a number of important shipping routes in close proximity, and attention needs to be paid to routeing, particularly in heavy weather ensuring shipping can continue to make safe passage without large-scale deviations. The likely cumulative and in combination effects on shipping routes should also be considered, the impact on navigable sea room and include an appropriate assessment of the distances between wind farm boundaries and shipping routes as per MGN 654.	As per Section 18, displacement, deviation, adverse weather routeing, and collision risk have been assessed within the NRA, as well as within Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR.
MCA	26/10/2022	Scoping Opinion	An NRA will need to be submitted in accordance with MGN 654 and the MCA Methodology for Assessing the Marine Navigation Safety & Emergency Response Risks of OREIs. This NRA should be accompanied by a detailed MGN 654 Checklist.	The relevant MCA guidance has been considered (see Section 2). A completed MGN 654 checklist is provided in Appendix A.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
MCA	26/10/2022	Scoping Opinion	Noted in paragraph 13.8.1.1 of the Scoping Report that vessel traffic surveys will be undertaken to the standard of MGN 654 i.e. at least 28 days which is to include seasonal data (two 14-day surveys) collected from a vessel-based survey using AIS, Radar, and visual observations to capture all vessels navigating in the study area, and we note this survey will be conducted within 2-years of application submission.	Vessel traffic methodology is agreed and in line with MGN requirements (see Section 5.2).
MCA	26/10/2022	Scoping Opinion	The turbine layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and SAR aircraft operating within the site. Any additional navigation safety and/or SAR requirements, as per MGN 654 Annex 5, will be agreed at the approval stage.	As per Section 17, there will be full compliance with MGN 654 (MCA, 2021) including the approval of a layout with the MCA.
MCA	26/10/2022	Scoping Opinion	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. 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 17 there will be full MGN 654 (MCA, 2021) compliance including in relation to anchor studies and water depth reductions. A CBRA will be undertaken post consent.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
MCA	26/10/2022	Scoping Opinion	Under Section 13.4.1.2 - M-31 regulatory mooring expectations is identified as a potential mitigation for floating infrastructure, and I can confirm this guidance should be followed and that a Third-Party Verification of mooring arrangements will be required. Also identified in 13.4.1.2 M-30 is the IALA recommendations O-139 Marking of Man-Made Offshore Structures, however this was replaced by G1162 ED1.0 The Marking of Man-Made Offshore Structures.	As per Section 2, the NRA considers the most up-to-date guidance including in relation to floating infrastructure.
MCA	26/10/2022	Scoping Opinion	Particular consideration will need to be given to the implications of the 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 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 wind farm sites and their surrounding areas. A SAR Checklist will also need to be completed in consultation with MCA.	As per Section 17, there will be full MGN 654 (MCA, 2021) compliance including in relation to MCA SAR requirements.
MCA	26/10/2022	Scoping Opinion	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	As per Section 17 there will be full MGN 654 (MCA, 2021) compliance including in relation to hydrographic surveys.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
			conduct it to Order 1a might invalidate the NRA if it was deemed not fit for purpose.	
MCA	26/10/2022	Scoping Opinion	It is noted that High Voltage Alternative Current (HVAC) transmission infrastructure maybe installed. If HVDC is being considered, consideration must be given to electromagnetic deviation on ships' compasses. 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 would however expect a deviation survey post the cable being laid; this will confirm conformity with the consent condition. The developer should then provide this data to UK Hydrographic Office (UKHO) via a hydrographic note (H102), as they may want a precautionary notation on the appropriate Admiralty Charts.	See Section 6, HVDC is no longer under consideration for the current application.
MCA	26/10/2022	Scoping Opinion	*Do you agree with the data sources, including project specific surveys, to be used to characterise the Shipping and Navigation baseline within the NRA and the Offshore EIA?* Yes	Data sources are as per the Scoping Report (see Section 5).
MCA	26/10/2022	Scoping Opinion	*Do you agree that all potential impacts (hazards and associated risks) have been identified for Shipping and Navigation?*	Risk assessment including consideration of risk control options is provided in Section 18.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
			The full list of risk controls will be identified during the NRA process of consultation with navigation stakeholders and hazard analysis.	
MCA	26/10/2022	Scoping Opinion	*Do you agree with the project impacts (hazards and associated risks) which have been scoped out of the EIA for Shipping and Navigation?* As per above.	Risk assessment including consideration of risk control options is provided in Section 18
MCA	26/10/2022	Scoping Opinion	*Do you agree that cumulative impacts and transboundary impacts (hazards and associated risks) for Shipping and Navigation may be scoped out of the Offshore EIA?* We believe the cumulative and transboundary impacts (specific to shipping and navigation) should be a part of the EIA process and should be addressed in the NRA and offshore EIA.	The NRA has assessed cumulative and transboundary impacts (see Section 18).
MCA	26/10/2022	Scoping Opinion	*Do you agree with the proposed approach to assessment?* Yes.	Methodology is as per the Scoping Report (see Section 3).
MCA	26/10/2022	Scoping Opinion	*Do you agree on the suitability of proposed embedded mitigation of relevance to Shipping and Navigation that have been identified for the Proposed Development?* The full list of risk controls and associated mitigation measures will be identified during the NRA process of consultation with navigation stakeholders and hazard analysis.	Risk assessment including consideration of risk control options is provided in Section 18.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
MCA	26/10/2022	Scoping Opinion	On the understanding that the Shipping and Navigation aspects are undertaken in accordance with MGN 654, its annexes and the above comments, MCA is likely to be content with the approach.	A completed MGN 654 checklist is provided in Appendix A.
Ministry of Defence (MOD)	18/11/2022	Scoping Opinion	The principal development zone for the offshore windfarm outlined in the submission will be located within MOD Danger Area D809 South. The extent of MOD Practise and Exercise Areas in the locality have been accurately identified in the Scoping Report (ref. Section 15.2.3.1) and the need to take account of defence activities has also been recognised. However, it will be necessary for defence maritime navigational interests to be specifically taken into account in the preparation of any application for this development proposal. The eastern extent of the development zone, in which offshore turbine structures are to be located, extends over an area containing a highly surveyed route that is retained to maintain national defence requirements. To prevent this route from being obstructed it will be necessary to ensure that any wind turbines or other offshore structures (including associated offshore safety zones) deployed within the project boundary defined are not located eastward of a line connecting the points 580 22.171N 0020 38.83W and 580 07.171N 0020 19.00W.	Not specifically addressed within the NRA. Addressed elsewhere within the EIA (e.g. Volume 2, Chapter 11: Military and Civil Aviation).

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
NLB	11/10/2022	Scoping Opinion	NLB have no objection to the content of the Scoping Report, and are satisfied with the elements to be included within the Shipping and Navigation section of the EIA.	Methodology is as per that set out in the Scoping Report (Section 3).
NLB	11/10/2022	Scoping Opinion	It should be noted that within Section 13.4.1.2 – M-30, the latest IALA guidelines for the lighting and marking of offshore structures is no longer contained within IALA document O-139. This guidance is now found within IALA document G-1162.	As per Section 2 the most up-to-date guidance has been used to inform the NRA.
RYA	24/10/2022	Scoping Opinion	*Do you agree with the data sources, including project specific surveys, to be used to characterise the Shipping and Navigation baseline within the NRA and the Offshore EIA?* The coverage of the UK Coastal Atlas of Recreational Boating is incomplete in the area of the proposed wind farm and it is quite possible that the two 14-day survey periods may not capture any recreational vessels as I expect most recreational traffic to take place near the beginning and end of the sailing season. I estimate that about a quarter of recreational vessels in these waters transmit an AIS signal. Nevertheless I do not feel that additional data need to be collected beyond that planned. I expect that some vessels pass through the wind farm site en route from Rattray Head to Wick or the Northern Isles and vice versa. It is not yet clear what the impact of the Beatrice and Moray East wind farms has been on the routeing of recreational craft on passage.	Data sources are as per the Scoping Report (see Section 5). RYA Scotland have also been consulted directly.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
RYA	24/10/2022	Scoping Opinion	*Do you agree that all potential impacts (hazards and associated risks) have been identified for Shipping and Navigation?* Yes.	Risk assessment including consideration of risk control options is provided in Section 18.
RYA	24/10/2022	Scoping Opinion	*Do you agree with the project impacts (hazards and associated risks) which have been scoped out of the EIA for Shipping and Navigation?* None appear to have been scoped out.	Risk assessment including consideration of risk control options is provided in Section 18.
RYA	24/10/2022	Scoping Opinion	*Do you agree that cumulative impacts and transboundary impacts (hazards and associated risks) for Shipping and Navigation may be scoped out of the Offshore EIA?* The cumulative impacts with other OWF, particularly Beatrice and Moray East must be scoped in. Transboundary impacts for recreational boating can be scoped out. Recreational vessels from continental Europe may pass through the wind farm site but there are unlikely to be any additional impacts.	As per Section 14, cumulative and transboundary impacts have been assessed within the NRA.
RYA	24/10/2022	Scoping Opinion	*Do you agree with the proposed approach to assessment?* Yes.	Methodology is as per that set out in the Scoping Report (Section 3).
RYA	24/10/2022	Scoping Opinion	*Do you agree on the suitability of proposed embedded mitigation of relevance to Shipping and Navigation that have been identified for the Proposed Development?* Yes.	Risk assessment including consideration of risk control

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
				options is provided in Section 18.
UKCoS	17/10/2022	Scoping Opinion	Under section 3.1.3 the approach to consider development under a wide design envelope is understood and understandable given the early stage of planning. It is however difficult for stakeholders, particularly in shipping and navigation to provide substantive feedback and input when the design envelope is so wide and so the Chamber recommends that it be narrowed and areas confirmed as early as possible so substantive feedback can be offered.	Relevant design details pertinent to the NRA are provided in Section 6.
UKCoS	17/10/2022	Scoping Opinion	The Chamber is aware that the MAIB have spatial accident data extending back to 1992 and is of the view that for long term projects such as OWFs, examining 10 years of accident data is not truly representative of trends and historic incidents. As such the Chamber recommends that 20 years of MAIB spatial accident data be included in the EIA baseline. This request the Chamber is making to all prospective developments and is being met with general agreement.	As per Section 9.5, a total of 20 years of MAIB spatial accident data has been assessed.
UKCoS	17/10/2022	Scoping Opinion	Given the large area of the proposed development the Chamber would strongly recommend at full 12 months AIS data be acquired in addition to the two – 14 days periods as required. This will fully factor in seasonal variation and occasional traffic.	The NRA has assessed 12 months of AIS data from 2022 to 2023, as per Appendix E.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
			The Chamber would recommend either 2019 or 2021 as preferable years for this data, in recognition of the impact of Covid-19 on shipping, in particular cruise and passenger traffic.	
UKCoS	17/10/2022	Scoping Opinion	Whilst only at the Scoping stage, the Chamber has some elevated concerns about the potential unique risk profile from a development with a mixture of fixed and floating turbines, in particular the importance of clear charting and marking and looks forward to engagement in these areas via the NRA process. The Chamber also notes with greater concern the southern extent and in particular isolated structures that may be proposed as the planning process proceeds.	Risk assessment including consideration of risk control options is provided in Section 18. This includes consideration of the use of floating infrastructure and the southern extent of the Caledonia South Site.
UKCoS	17/10/2022	Scoping Opinion	The Chamber does not agree that cumulative impacts and transboundary impacts (hazards and associated risks) for Shipping and Navigation may be scoped out of the Offshore EIA and from what it has read of the Scoping Report, does not understand the rationale for its potential scoping out. Clarification accordingly would be welcomed.	As per Section 14, cumulative and transboundary impacts have been assessed within the NRA.
UKCoS	17/10/2022	Scoping Opinion	The Chamber otherwise finds the Scoping Report to contain what it would hope for and expect in terms of the data and methodology employed. The Chamber looks forward to early engagement with the development as the planning and consenting process continues.	The UKCoS were invited to and attended the hazard workshop.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
MCA and NLB	02/11/2023	Consultation Meeting	The MCA and NLB confirmed content with the approach being taken for the NRA.	Approach undertaken is as per that agreed.
Smyril Line	19/02/2024	Consultation email	No concerns over the Proposed Development (Offshore)	Noted.
Serco NorthLink Ferries	07/03/2024	Consultation Meeting	Noted concern over additional journey length of roughly 40nm if adverse weather required vessels to route inshore of the Moray Firth OWFs, and stated that adverse weather transits are key concern.	Baseline adverse weather routeing is considered in Section 12, with further assessment of the impact from the Proposed Development (Offshore) provided in Sections 15.6 and 18. This includes the implementation of a Structure Exclusion Zone (SEZ) to increase the available sea room for NorthLink ferries in adverse weather.
Tidal Transit	13/03/2024	Regular Operator email correspondence	No concern regarding the Proposed Development (Offshore)	Noted.
Thun Tankers	14/03/2024	Regular Operator email correspondence	No concerns regarding the Proposed Development (Offshore) as long as construction activities are appropriately and accurately announced, as well as updating the relevant nautical charts in a timely manner.	Promulgation of information and updating nautical charts are considered embedded mitigation in Section 17.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
Thun Tankers	14/03/2024	Regular Operator email correspondence	Indicated that it would be unlikely for a vessel to transit through Caledonia OWF.	The NRA considers post-wind farm routeing in Section 15 and assumes vessels will not transit through the Array.
Serco NorthLink Ferries	22/04/2024	Consultation Meeting	Expressed that deviated inshore routes occur roughly once or twice a year and depends on weather conditions as well as passage planning for daylight. Not a big concern if it occurs infrequently for passenger vessels.	Baseline adverse weather routeing is considered in Section 12, with further assessment of the impact from the Proposed Development (Offshore) provided in Sections 15.6 and 18. This includes the implementation of a SEZ to increase the available sea room for NorthLink ferries in adverse weather.
Serco NorthLink Ferries	22/04/2024	Consultation Meeting	Concerned over the large route increases especially for freight vessels which could mean large delays, particularly in winter. There may be a knock-on effect if sailings have to be delayed.	
Serco NorthLink Ferries	22/04/2024	Consultation Meeting	The biggest concern is potential for cancelled sailings with a number of adverse weather sailings failing to go ahead.	
RYA Scotland	13/05/2024	Consultation Meeting	Noted the importance of publicising location of the Proposed Development (Offshore) well in advance and to provide suggestions of alternative routeing options for vessels heading north-south through the Moray Firth.	Promulgation of information assumed as embedded mitigation (Section 17).

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
			Indicated that vessels may not choose to pass offshore of the Proposed Development (Offshore) as it would be an uncomfortable journey, thus transits may be made through the Array Area. Though this would depend on a variety of conditions alongside the individuals choice. Also noted that vessels which currently transit offshore of Moray East would not require a large deviation due to the Proposed Development (Offshore) and will likely transit further offshore.	Risk assessment including in terms of recreational vessels is provided in Section 18.
NLB	07/05/2024	Hazard Workshop	Queried potential for Caledonia South to be built first with a gap before Caledonia North.	The NRA considers each build-out scenario separately.
Scottish White Fish Producers	07/05/2024	Hazard Workshop	Noted the importance of a Vessel Management Plan (VMP)	Adherence to a VMP is included as an embedded mitigation measure as per Section 17.
UKCoS	07/05/2024	Hazard Workshop	Noted the potential for loss of station during construction/decommissioning, and would be interesting to know how wet storage is taken into account.	Loss of station is considered in the risk assessment in Section 18. Wet storage site selection process will be undertaken.

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
Serco NorthLink Ferries	07/05/2024	Hazard Workshop	Noted that adverse weather routeing is not frequent but sometimes required to facilitate the journey. Stated that there is an ongoing dialogue with the project. Noted a possible alternative of routeing inshore of Moray West OWF but this would increase the distance.	Adverse weather routeing is considered in Section 12.
UKCoS	07/05/2024	Hazard Workshop	Noted the importance of lifeline routes to coastal communities and Scotland's Marine Plan.	Engagement has been ongoing with Serco NorthLink Ferries, as per Sections 4 and 12.
Scottish White Fish Producers	07/05/2024	Hazard Workshop	Fishing vessels would perhaps deviate around the floating structures but may undertake fishing amongst the fixed structures.	Fishing vessel internal allision risk is considered in Sections 16 and 18.
NLB	07/05/2024	Hazard Workshop	UKHO will need to consider how large-scale floating developments are charted.	Charting of offshore structures is considered embedded mitigation within Section 17.
NLB	07/05/2024	Hazard Workshop	Important to consider lighting and marking in the scenario where a floating wind turbine generator (WTG) with a marine aid to navigation (AtoN) is towed from site.	This will be agreed within the LMP process as part of embedded mitigation measures (see Section 17).

Stakeholder	Date	Form of Correspondence	Remarks	Response and Where Addressed in the NRA
Serco NorthLink Ferries	12/08/2024	Consultation Meeting	Discussions around adverse weather routeing of NorthLink ferries. In particular, the Applicant provided a proposal for the implementation of an SEZ to increase the available sea room for adverse weather routeing. Serco NorthLink confirmed the SEZ was viewed as a positive for both adverse weather routeing and shipping and navigation in general.	Baseline adverse weather routeing is considered in Section 12, with further assessment of the impact from the Proposed Development (Offshore) provided in Sections 15.6 and 18. This includes the implementation of the SEZ to increase the available sea room for NorthLink ferries in adverse weather.

4.3 Hazard Workshop

A key element of the consultation undertaken 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 to be used as input into the risk assessment undertaken in Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR and Section 18 of the NRA. This ensured that expert opinion and local knowledge was incorporated into the hazard identification process and that the hazard log was site-specific.

4.3.1 Hazard Workshop Attendance

The Hazard Workshop was held on 7th May 2024 and was attended, either in-person or virtually, by the organisations listed in Section 4.1, with the exception of RYA Scotland and the CA who were followed up with separately.

4.3.2 Hazard Workshop Process and Hazard Log

During the Hazard Workshop, key maritime hazards associated with the construction, O&M and decommissioning of the Proposed Development (Offshore) were identified and discussed. Where appropriate, hazards were considered by vessel type to ensure risk control options could be identified on a type-specific basis.

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. Where appropriate, mitigation measures were identified, including any additional measures required to reduce the risks to ALARP. The hazard log was then provided to the Hazard Workshop attendees for comment.

The hazard log has been used to inform the risk assessment undertaken in Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR and Section 18 of the NRA , and is presented in full in Appendix B.

5 Data Sources

This section summarises the main data sources used to characterise the shipping and navigation baseline relative to the Proposed Development (Offshore).

5.1 Summary of Data Sources

The main data sources used in assessing the shipping and navigation baseline relative to the Proposed Development (Offshore) are outlined in Table 5.1.

Table 5.1 Data Sources Used to Inform Shipping and Navigation Baseline

Data	Source(s)	Purpose
Vessel traffic	AIS, Radar, and visual observation winter survey data for the study area (14 days January to February 2023).	Characterising vessel traffic movements within and in proximity to Caledonia OWF
	AIS, Radar, and visual observation summer survey data for the study area (14 days July to August 2023).	
	AIS winter data for the OECC study area (14 days January to February 2023)	Characterising vessel traffic movements within and in proximity to the Caledonia OECC.
	AIS summer data for the OECC study area (14 days July to August 2023)	
	AIS data for the study area (12 months, 2022/2023)	Validation of survey data for the study areas.
	AIS data for the Banff/Macduff designated anchorage area (three years January 2020 to December 2022).	
	Long term AIS data for Serco NorthLink ferries within the study area (2019 to 2023).	
	Anatec's ShipRoutes database (2024)	
	UK Coastal Atlas of Recreational Boating (RYA, 2019 (a)).	Characterising recreational activity in proximity to the Proposed Development (Offshore).
Maritime Incidents	MAIB marine accidents database (2003 to 2022)	Review of historical maritime incidents within an in

Data	Source(s)	Purpose
	Royal National Lifeboat Institution (RNLI) incident data (2010 to 2022)[1]	proximity to the Proposed Development (Offshore).
	Department for Transport (DfT) UK Civilian SAR helicopter taskings (April 2015 to March 2023)	
Other navigational features	UKHO Admiralty chart 115 (UKHO, 2024)	Characterising other navigational features within and in proximity to the Proposed Development (Offshore)
	Admiralty Sailing Directions North Coast of Scotland Pilot NP52 (UKHO, 2022)	
Weather	Wind direction data provided by the Long-Term corrected series.	Characterising weather conditions in proximity to the Proposed Development (Offshore) for use as input to the collision and allision risk modelling.
	Significant wave height data provided by the ABPmer Report for Moray East OWF.	
	Tidal data from Admiralty Chart 115 (UKHO, 2024).	
	Visibility data from *Admiralty Sailing Directions North Coast of Scotland Pilot NP52* (UKHO, 2022).	

5.2 Vessel Traffic Surveys

The vessel traffic surveys were undertaken using methodology agreed with the MCA and NLB. Two 14-day AIS, Radar, and visual observation surveys undertaken in winter 2023 (25 January to 9 February) and summer 2023 (22 July to 5 August) have been considered within the baseline for a total of 28 full days, with a long-term dataset from November 2022 to October 2023 used as validation (see Section 5.3 and Appendix E). It is noted that due to severe weather, the survey vessel left the study area for approximately 17.5 hours between the 31 January and the 1 February, with this period of time appended to the end of the survey period to allow for the full 28 days of data to be collected.

A number of vessel tracks recorded during the survey periods were classified as temporary (non-routine), such as the tracks of the survey vessel and other non-routeing survey vessels. These have therefore been excluded from the analysis.

[1] Longer than 10 years has been studied given that no RNLI responses were recorded in the dataset within the study area post 2019.

The dataset is assessed in full in Section 10.

5.3 Long-Term Vessel Traffic Data

Long-term vessel traffic data consisting of AIS covering 12 months between November 2022 and October 2023 was collected from coastal receivers. Taking into account the distance offshore of Caledonia OWF, the long-term vessel traffic data is considered to be comprehensive for the study area. The assessment of this dataset allowed seasonal variations to be captured.

The dataset is assessed in full in Appendix E.

5.4 Data Limitations

5.4.1 Automatic Identification System Data

For the purposes of the NRA, it has been assumed that vessels under an obligation to broadcast information via AIS have done so, both in the vessel traffic surveys and long-term vessel traffic data. It has also been assumed that the details broadcast via AIS (such as vessel type and dimensions) are accurate unless clear evidence to the contrary was identified during Anatec's thorough quality assurance of the data.

5.4.2 Vessel Traffic Data for Offshore Export Cable Corridor

The methodology for vessel traffic data collection within the OECC study area was shared with stakeholders at the hazard workshop. This method used only the AIS dataset to characterise vessel movements within the OECC study area. Consequently, this dataset has limitations associated with non-AIS targets.

5.4.3 Historical Incident Data

Although all UK commercial vessels are required to report accidents to the MAIB, this is not mandatory for non-UK vessels unless they are in a UK port, within 12nm of 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 an 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. For AtoNs, only those charted and considered key to establishing the shipping and navigation baseline are shown.

During consultation, input has been sought from relevant stakeholders regarding the navigational features baseline. Navigational features are based upon the most recently available UKHO Admiralty Charts and Sailing Directions at the time of writing.

6 Design Envelope Relevant to Shipping and Navigation

The NRA reflects the DE, which is outlined in full in Volume 1, Chapter 3: Proposed Development Description (Offshore).

To support with delivery, the Applicant has elected to deliver the Caledonia OWF in phases. Two sets of consent applications (Section 36 and Marine Licences) will be submitted for these phases to facilitate the development and delivery of the Caledonia OWF.

The two distinct application areas encompassed within Caledonia OWF of the Proposed Development (Offshore) are the Caledonia North Site and the Caledonia South Site. Flexibility is being sought to build out the applications subsequently (in no particular order) with a gap of up to five years between the construction of each application. The Applicant has advised that, whilst simultaneous build out of the applications is unlikely, any unforeseeable project delays may require the concurrent construction of both phases.

Therefore, three distinct possible scenarios exist within the limits of the Proposed Development (Offshore) – the Caledonia North Site alone, the Caledonia South Site alone, and full build out of both (Caledonia OWF). The following subsections outline the maximum extents of these scenarios for which any shipping and navigation hazards are assessed, hereafter referred to as the WCS.

6.1 Proposed Development (Offshore) Boundaries

6.1.1 Caledonia OWF

Caledonia OWF is located within the Moray Firth approximately 13.2nm southeast of Wick and 20nm north of Banff. It covers an area of approximately 123 square nautical miles (nm^2), and shares approximately 10nm of its western boundary with Moray East OWF. Charted water depths in this area range from 39 metres (m) to 82m.

All surface piercing structures (WTGs and Offshore Substation Platforms (OSP)) will be located entirely within Caledonia OWF, inclusive of blade overfly. The coordinates defining the boundary of Caledonia OWF are illustrated in Figure 6.1 and provided in Table 6.1. It is not intended that Caledonia OWF be designated as an Area to be Avoided (ATBA), with navigation only restricted where Safety Zones are active (see Section 17).

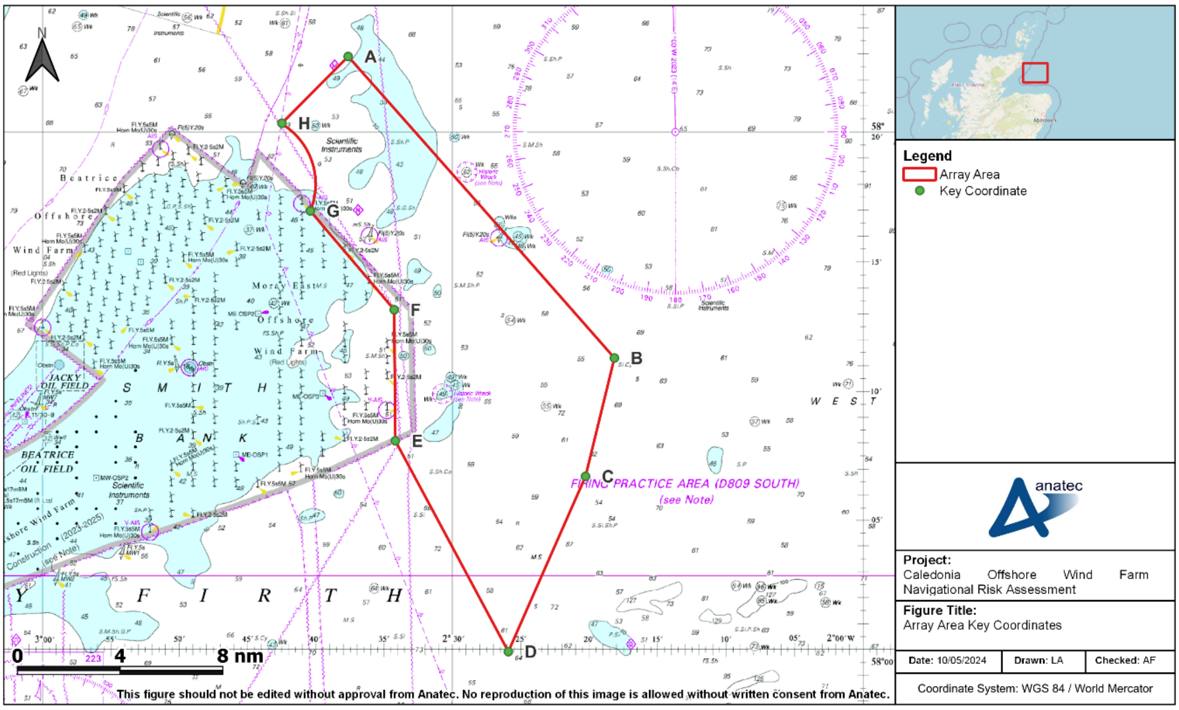

Figure 6.1 Caledonia OWF Key Coordinates

Table 6.1 Caledonia OWF Key Coordinates

Point	Latitude (World Geodetic System 1984 (WGS84))	Longitude (WGS84)
A	58° 22′ 54.61″ N	002° 37′ 37.91″ W
B	58° 11′ 17.07″ N	002° 18′ 09.49″ W
C	58° 06′ 42.19″ N	002° 20′ 16.23″ W
D	57° 59′ 54.04″ N	002° 25′ 55.08″ W
E	58° 08′ 04.75″ N	002° 34′ 11.04″ W
F	58° 13′ 08.80″ N	002° 34′ 15.91″ W
G	58° 16′ 57.88″ N	002° 40′ 24.38″ W
H	58° 20′ 20.49″ N	002° 42′ 28.85″ W

6.1.2 Caledonia North Site

The Caledonia North Site is located approximately 13.2nm southeast of Wick, and shares 10nm of its western boundary with the northern boundary of Moray East OWF. The total area covered by the Caledonia North Site is approximately 64nm^2, with charted water depths ranging between 39m and 60m.

As noted for Caledonia OWF, all surface piercing structures (WTGs and OSPs) will be located entirely within the Caledonia North Site, inclusive of blade overfly. The coordinates defining the boundary of the Caledonia North Site are illustrated in Figure 6.2 and provided in Table 6.2. It is not intended that the Caledonia North Site be designated as an ATBA, with navigation only restricted where Safety Zones are active (see Section 17).

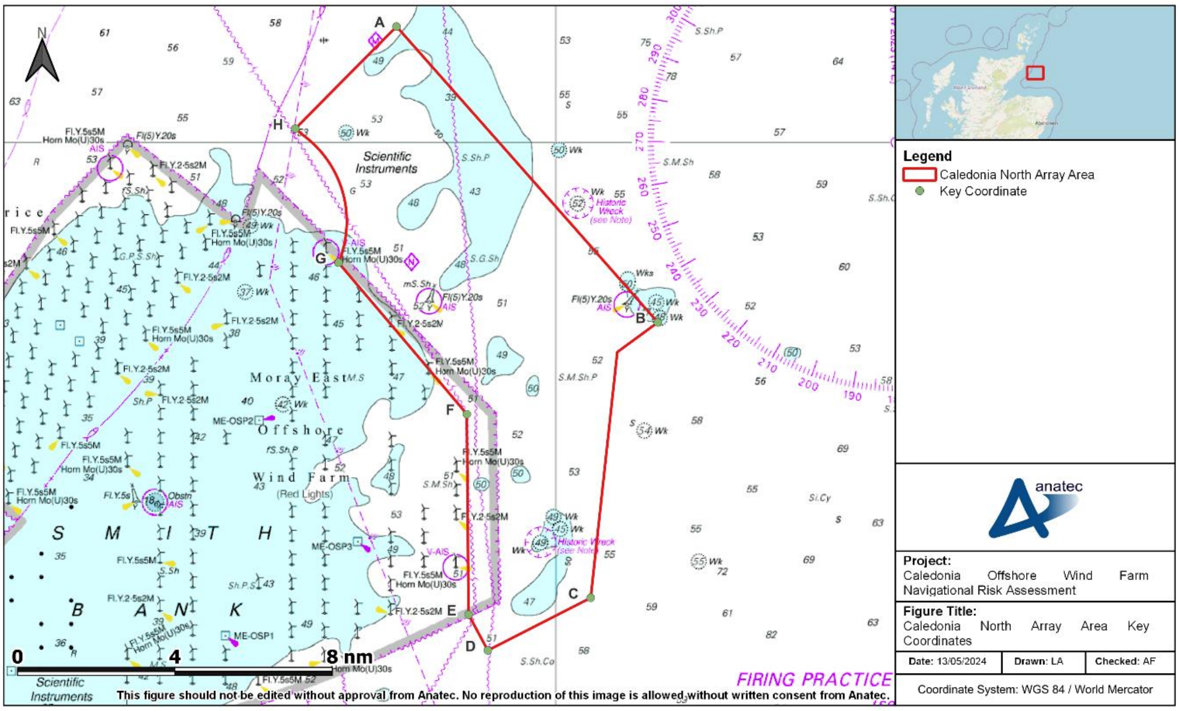

Figure 6.2 The Caledonia North Site Array Area Key Coordinates

Table 6.2 The Caledonia North Site Key Coordinates

Point	Latitude (WGS84)	Longitude (WGS84)
A	58° 22′ 54.61″ N	002° 37′ 37.91″ W
B	58° 15′ 27.68″ N	002° 25′ 07.24″ W
C	58° 08′ 30.15″ N	002° 28′ 20.08″ W
D	58° 07′ 10.26″ N	002° 33′ 15.74″ W
E	58° 08′ 04.75″ N	002° 34′ 11.04″ W
F	58° 13′ 08.80″ N	002° 34′ 15.91″ W
G	58° 16′ 57.88″ N	002° 40′ 24.38″ W
H	58° 20′ 20.49″ N	002° 42′ 28.85″ W

6.1.3 Caledonia South Site

The Caledonia South Site is located approximately 23nm southeast of Wick, and approximately 20nm north of Banff and Macduff. The total area covered by the Caledonia South Site is approximately $60nm^2$, with charted water depths ranging between 52m and 88m.

As noted for Caledonia OWF and the Caledonia North Site, all surface piercing structures (WTGs and OSP) will be located entirely within the Caledonia South Site, inclusive of blade overfly. The coordinates defining the boundary of the Caledonia South Site are illustrated in Figure 6.3 and provided in Table 6.3. It is not intended that the Caledonia South Site be designated as an ATBA, with navigation only restricted where Safety Zones are active (see Section 17).

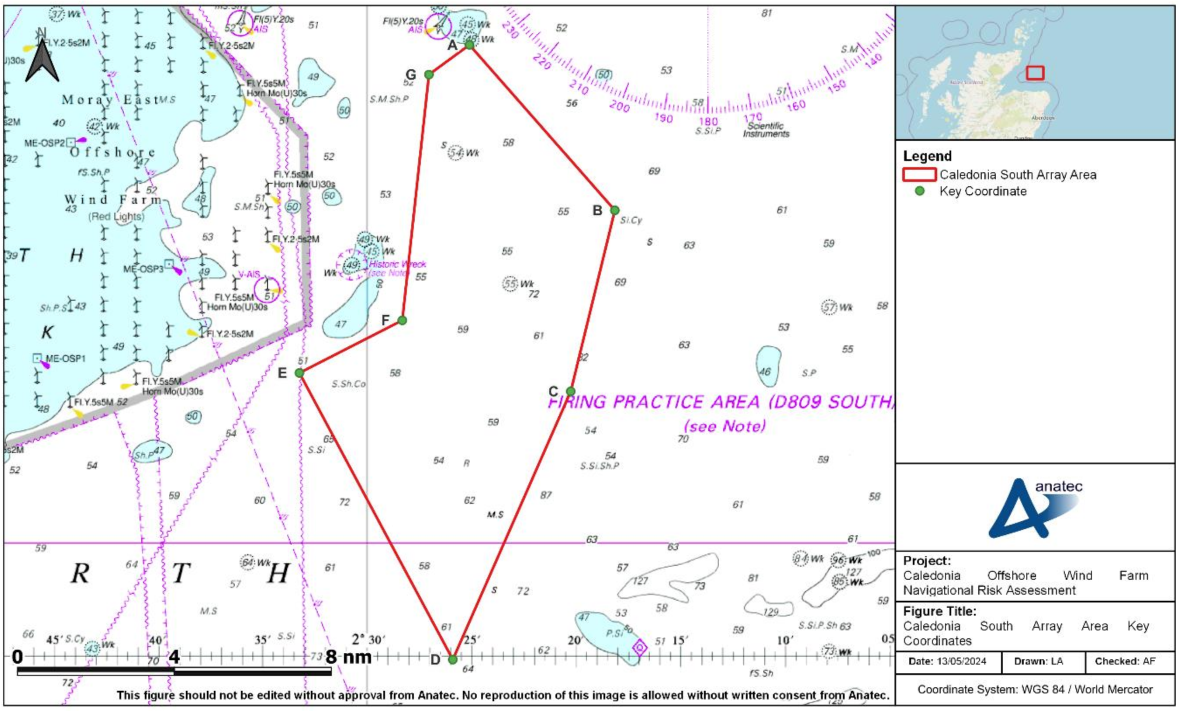

Figure 6.3 The Caledonia South Site Array Area Key Coordinates

Table 6.3 The Caledonia South Site Key Coordinates

Point	Latitude (WGS84)	Longitude (WGS84)
A	58° 15’ 27.68” N	002° 25’ 07.24” W
B	58° 11’ 17.07” N	002° 18’ 09.49” W
C	58° 06’ 42.19” N	002° 20’ 16.23” W
D	57° 59’ 54.04” N	002° 25’ 55.08” W
E	58° 07’ 10.26” N	002° 33’ 15.74” W

Point	Latitude (WGS84)	Longitude (WGS84)
F	58° 08’ 30.15” N	002° 28’ 20.08” W
G	58° 14’ 42.72” N	002° 27’ 03.66” W

6.1.4 Offshore Export Cable Corridor

The Caledonia OECC runs between the southwestern boundary of Caledonia OWF and the landfall point at Stake Ness, and is presented in Figure 6.4. The total area is approximately 55nm^2 (127km^2) with charted water depths within the Caledonia OECC ranging between shoreline and 80m. The offshore export cables will be located fully within the Caledonia OECC.

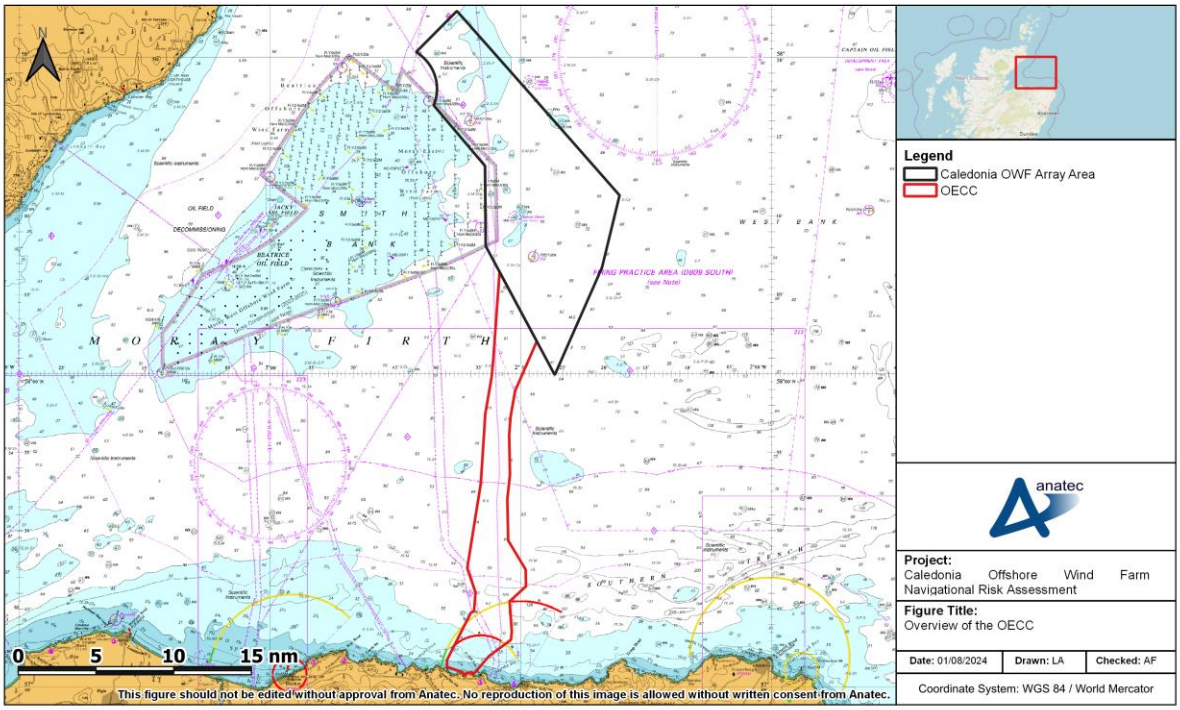

Figure 6.4 Overview of the Caledonia OECC

The Caledonia North OECC runs between the southeastern boundary of the Caledonia North Site and the landfall point at Stake Ness, and includes the Caledonia South Site. This is presented in Figure 6.5. The total area is approximately 114nm^2 (391km^2) with charted water depths within the Caledonia North OECC ranging between shoreline and 88m. The offshore export cables will be located fully within the Caledonia North OECC.

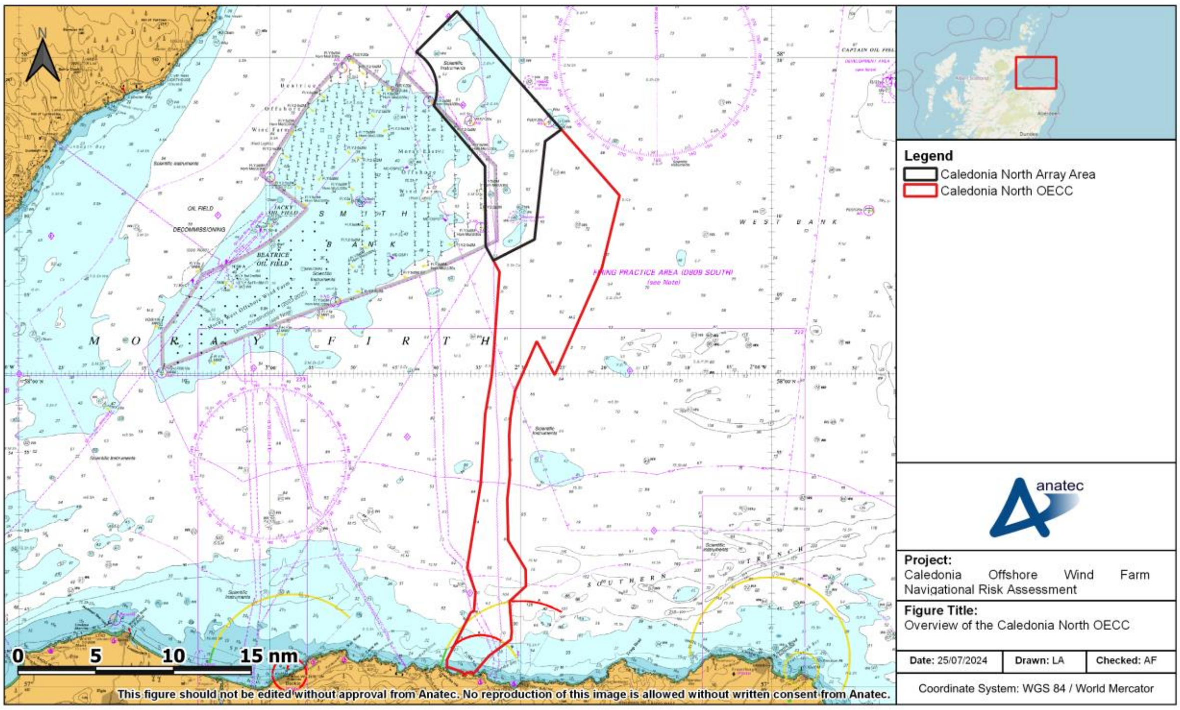

Figure 6.5 Overview of Caledonia North OECC

The Caledonia South OECC runs between the southwestern boundary of Caledonia OWF (and the Caledonia South Site) and the landfall point at Stake Ness, and is presented in Figure 6.6. The total area is approximately 55nm^2 (127km^2) with charted water depths within the Caledonia South OECC ranging between shoreline and 80m. The offshore export cables will be located fully within the Caledonia South OECC.

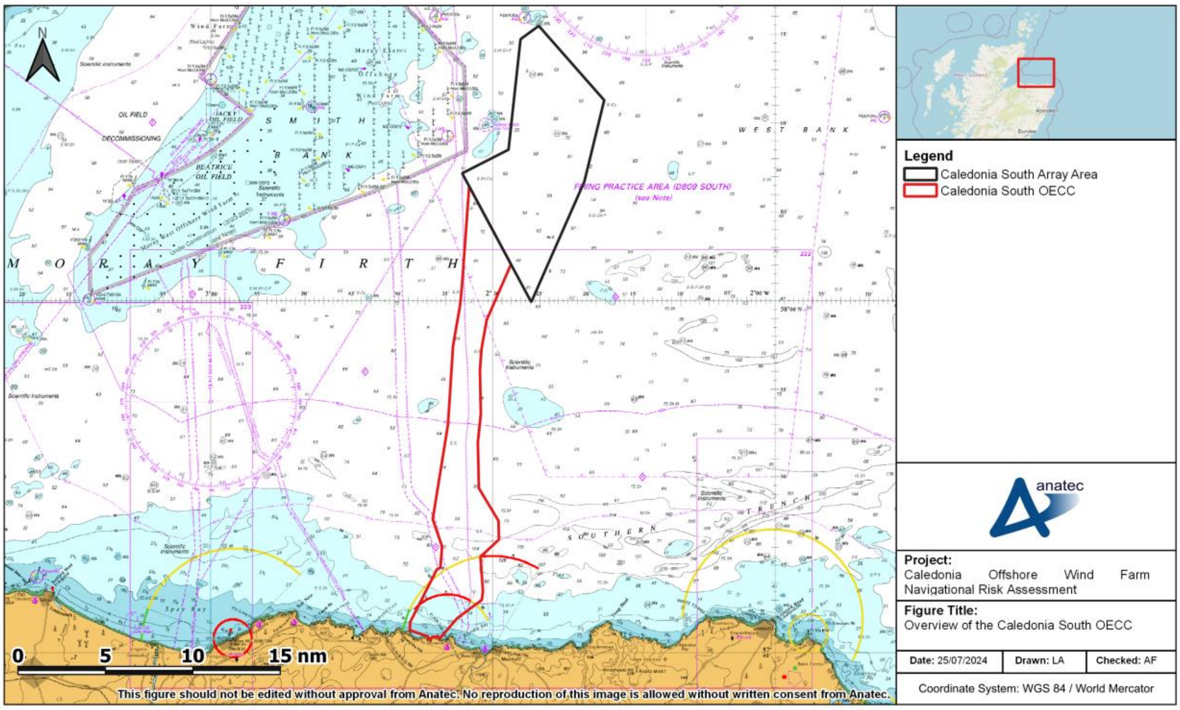

Figure 6.6 Overview of Caledonia South OECC

6.2 Surface Infrastructure

6.2.1 Indicative Array Layout

Although the final locations of infrastructure have not yet been defined, indicative array layout options have been considered in this NRA which represents the maximum spatial area and maximum number of WTGs for each scenario. These layouts are generally considered in the risk assessment in Section 18; however it is noted that where a minimum spacing or non grid layout has been considered as the worst case (as opposed to maximum spatial area) this has been flagged. The minimum centre-to-centre spacing between WTGs within the offshore DE is 944m.

The indicative WCS array layouts consist of a full build out of Caledonia OWF (and each other scenario) periphery to maximise the spatial extent of vessel deviations and the maximum possible number of surface structures to maximise exposure for passing (or adrift) vessels.

It is noted that temporary equipment (e.g., mooring buoys, in field FLIDAR measurement systems) will also be used during the construction phase of each scenario. Such equipment will be within Caledonia OWF and therefore by extension the buoyed construction area.

6.2.1.1 Caledonia OWF

Within Caledonia OWF up to 144 surface structures will be installed, consisting of up to 140 WTGs and 4 OSPs. The layout is presented in Figure 6.7.

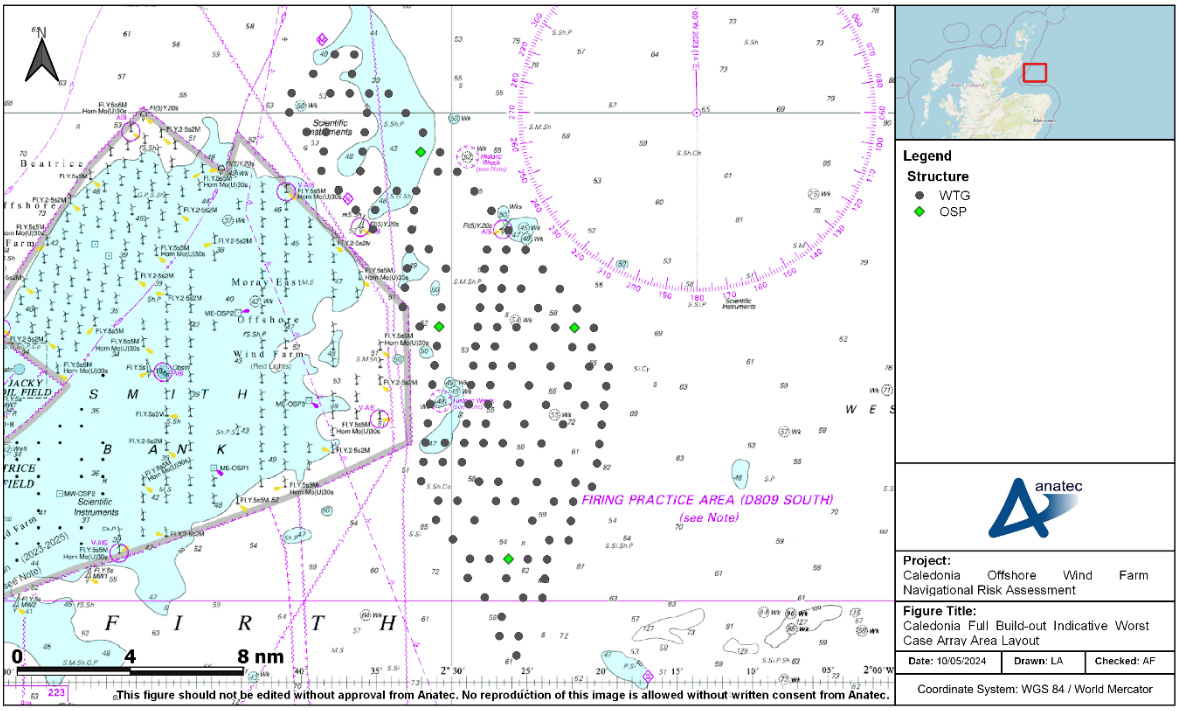

Figure 6.7 Caledonia OWF Indicative WCS Array Area Layout

6.2.1.2 Caledonia North Site

Up to 79 surface infrastructures will be installed within the Caledonia North Site, consisting of up to 77 WTGs and up to two OSPs. The layout is presented in Figure 6.8.

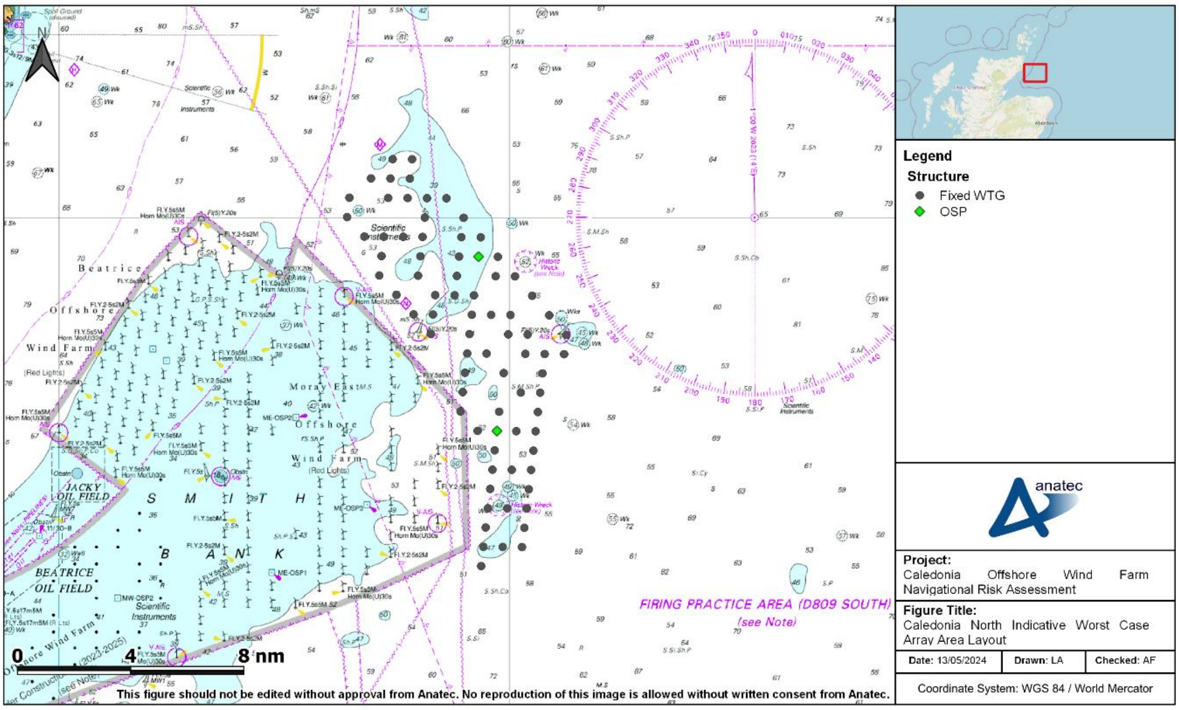

Figure 6.8 Caledonia North Site Indicative WCS Array Area Layout

6.2.1.3 Caledonia South Site

Up to 80 surface infrastructures will be installed within the Caledonia South Site, consisting of up to 39 floating WTGs, 39 fixed WTGs, and up to two OSPs. The layout is presented in Figure 6.9.

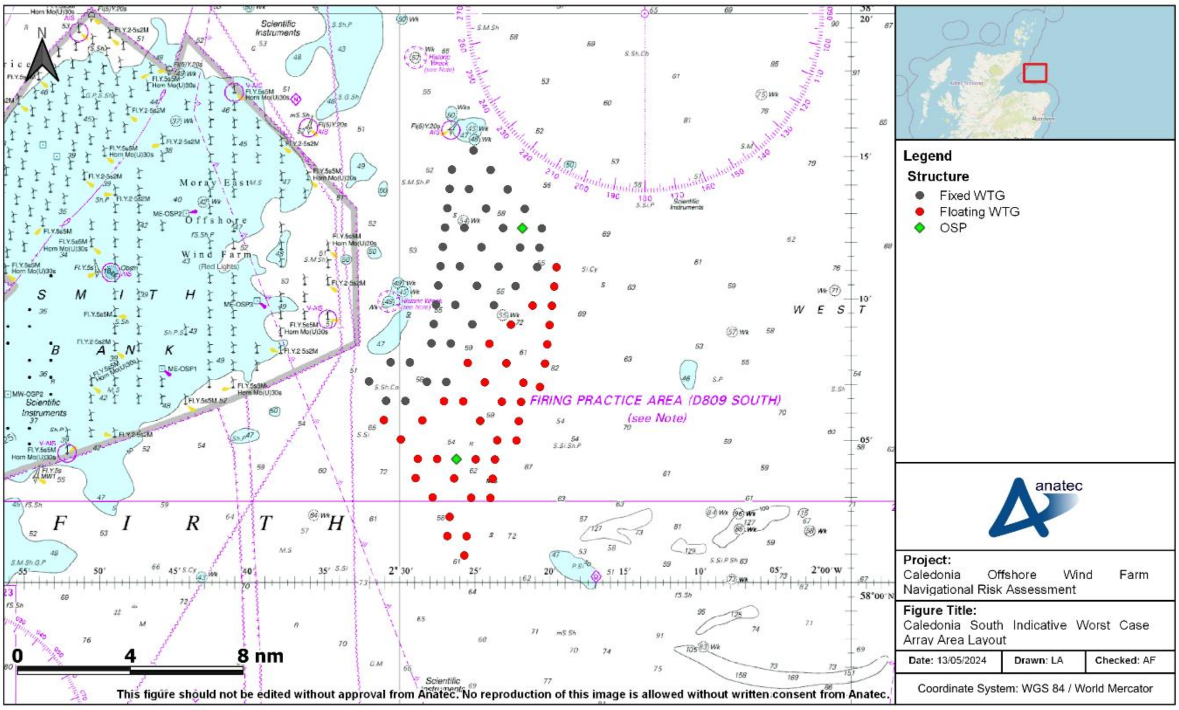

Figure 6.9 Caledonia South Site Indicative WCS Array Area Layout

6.2.2 Wind Turbine Generators

The WCS for the WTGs within each indicative array layout is for a maximum rotor diameter of 236m and maximum blade tip height (above Mean Sea Level (MSL)) of up to 297m. It is noted that these values reflect the WCS for shipping and navigation that considers the most number of structures that could be used (i.e. the smallest size of WTG).

Jackets with suction caisson foundations for fixed structures and semi-submersible foundations for floating structures have been considered as the WCS for shipping and navigation as these foundation types provide the maximum structure dimension at the sea surface, and therefore maximise exposure for passing (or adrift) vessels. The WCS for the WTGs, which assume use of a jacket with suction caissons or semi-submersible foundation design, are provided in Table 6.4, Table 6.5, and Table 6.6.

Table 6.4 Caledonia OWF WTG WCS for Shipping and Navigation

Parameter	Floating	Fixed
Number	39	101
Foundation type	Floating Semi-submersible	Jacket with suction caissons
Dimensions at sea surface	102m x 96.7m	24 × 24m
Blade clearance above MSL	35m	35m

Parameter	Floating	Fixed
Blade tip height above MSL	297m	297m
Rotor diameter	236m	236m

Table 6.5 Caledonia North Site WTG WCS for Shipping and Navigation

Parameter	WCS for shipping and navigation
Number	77
Foundation type	Jacket with suction caissons
Dimensions at sea surface	24 × 24m
Blade clearance above MSL	35m
Blade tip height above MSL	297m
Rotor diameter	236m

Table 6.6 Caledonia South Site WTG WCS for Shipping and Navigation

Parameter	Floating	Fixed
Number (up to 78 WTG in total)	39	39
Foundation type	Floating semi-submersible	Jacket with suction caissons
Dimensions at sea surface	102 x 96.7m	24 × 24m
Blade clearance above MSL	35m	35m
Blade tip height above MSL	297m	297m
Rotor diameter	236m	236m

6.2.3 Offshore Substation Platform

Up to four OSPs may be installed within Caledonia OWF, with two in each of the Caledonia North Site and the Caledonia South Site. There are a number of foundation options under consideration for the OSPs, however topside dimensions have been modelled to ensure a WCS. The maximum topside dimensions are 75m x 75m. Positions of substations are not yet known, however they may be installed anywhere within Caledonia OWF.

6.3 Subsea Infrastructure

6.3.1 Inter-array Cables

The inter-array cables will be fully installed within Caledonia OWF to connect individual WTGs to each other and to the OSPs. Up to 354nm of inter-array cables will be required with up to 20 cable crossings required in Caledonia OWF, although the final length and number of crossings will depend upon the final array layout. The maximum height of inter-array cable crossings will be 1.5m.

Table 6.7 Caledonia Inter-array Cables

	Caledonia North Site	Caledonia South Site	Caledonia OWF
Maximum Inter-array cable length (nm)	194	197	354
Maximum Inter-array cable crossings	10	10	20
Maximum height of cable crossings (m)	1.5	1.5	1.5

6.3.2 Interconnector Cables

The interconnector cables will be fully installed within Caledonia OWF to provide an interlink connection between the OSPs. Up to 32nm of interconnector cables will be required (with up to four crossings in Caledonia OWF), although the final length will depend upon the final array layout. The maximum height of interconnector cable crossings will be 1.5m.

Table 6.8 Caledonia Interconnector Cables

	Caledonia North Site	Caledonia South Site	Caledonia OWF
Maximum Interconnector cable length (nm)	16	16	32
Maximum Interconnector cable crossings	2	2	4
Maximum height of cable crossings (m)	1.5	1.5	1.5

6.3.3 Offshore Export Cables

The offshore export cables will be installed within either the Caledonia North OECC or the Caledonia South OECC to carry the electricity generated by the WTGs to the landfall location.

Up to 178nm of offshore export cables will be required with up to 16 crossings, with a maximum of two offshore export cables within each of the Caledonia North OECC and the Caledonia South OECC. The maximum height of offshore export cable crossings will be 1.5m.

6.3.4 Cable Burial and Protection

Where possible, the primary means of cable protection will be by seabed burial. The extent and method by which the subsea cables will be buried will depend on the results of a detailed seabed survey of the final subsea cable routes and associated cable burial risk assessment (CBRA). However, a target burial depth of 1-3m for all subsea cables associated with Caledonia OWF is assumed as part of the WCS.

Where cable burial is not possible, alternative cable protection methods may be deployed which will be determined within the CBRA. These methods may include a combination of concrete mattresses, rock placement, grout bags, cement bags, cast iron shells, and engineered cable protection system. It is assumed as part of the WCS that there will be a maximum cable protection height of 1.5m and width of 20m.

6.4 Construction Phase

The indicative offshore construction phase will last for up to three years, noting schedules will be subject to change (e.g., due to adverse weather, vessel availability). Table 6.9 provides a breakdown of the activities associated with the construction phase. It is noted that this indicative construction programme includes the installation of floating foundations, but if this technology is not deployed, the construction programme may be slightly shorter.

Table 6.9 Indicative Construction Phase Vessel Movements[2]

Activity	Indicative Vessel Movements		
	Caledonia North	Caledonia South	Caledonia OWF
Foundation Piling	154	156	280
Substructure	308	312	560
WTG Installation	219	221	397
WTG Commissioning	437	442	793
Array Area cables installation and hook up	798	807	1450

[2] Indicative vessel movements associated with Caledonia OWF as a whole are not the sum of those of Caledonia North and Caledonia South because the total number of wind farm structures is not the sum of Caledonia North and Caledonia South.

Activity	Indicative Vessel Movements		
	Caledonia North	Caledonia South	Caledonia OWF
OSP installation (foundation, substructure and topside)	219	222	396
Export cables	65	65	116
Total	**2,200**	**2,225**	**3,992**

Indicatively, there may be 3,992 total vessel movements during the construction phase of the Caledonia OWF, where one movement is classed as a transit to, from and within the construction site. It is likely that construction will be seasonal with limited operations over winter months due to weather restrictions.

6.5 Operation and Maintenance Phase

The O&M phase is assumed to last up to 35 years for Caledonia OWF. O&M activities are likely to be completed by Crew Transfer Vessels (CTVs), Service Operation Vessels (SOVs) and, for major repairs or replacements, Jack Up Vessels (JUVs) and / or Heavy Lift Vessels (HLV).

6.6 Decommissioning Phase

The decommissioning phase will generally be the reverse of the construction phase in terms of duration, vessel types and vessel numbers. It is anticipated that all sea surface structures will be completely removed above the seabed. All cable infrastructure may be removed or some sections may be left *in situ*, with any exposed sections cut below mean seabed level and protected.

6.7 Worst Case Scenario

The WCS for each shipping and navigation hazard for Caledonia OWF, the Caledonia North Site, and Caledonia South Site are provided in Table 6.10, Table 6.11, and Table 6.12 respectively, and is based on the parameters described in the previous subsections.

Table 6.10 WCS for Shipping and Navigation by Hazard – Caledonia OWF

Potential Impact	Assessment Parameter	Explanation
Construction		
Impact 1: Vessel displacement	Construction period of up to six years with a potential five year gap between phases (including one year of pre-construction activities; e.g., UXO and Boulder Clearance). **Construction of:** 140 WTGs; - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 101 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Four OSPs with topside dimensions of 55mx45m. 140 inter-array cables of 353.7nm (655km) combined length; Two interconnector cables of 32.4nm (60km) combined length; Four offshore export cables of 178.2km (330km) combined length; 500m safety zones during installation (50m safety zones around partially complete structures or complete structures); and 25 vessels on-site simultaneously and 3,992 vessel movements.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement, including during adverse weather.

Potential Impact	Assessment Parameter	Explanation
Impact 2: Increased third party vessel to vessel collision risk	Construction period of up to six years with a potential five year gap between phases (including one year of pre-construction activities; e.g., Unexploded Ordnance (UXO) and Boulder Clearance). **Construction of:** 140 WTGs; - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 101 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Four OSPs with topside dimensions of 55mx45m; 140 inter-array cables of 353.8nm (655km) combined length; Two interconnector cables of 32.4nm (60km) combined length; Four offshore export cables of 178.2nm (330km) combined length; Buoyed construction area encompassing the maximum extent of the Caledonia OWF; 500m construction safety zones (50m safety zones around partially complete structures or complete structures); Temporary ancillary equipment within buoyed construction area (e.g., mooring buoys); and 25 vessels on-site simultaneously and 3,992 vessel movements.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk.

Potential Impact	Assessment Parameter	Explanation
Impact 3: Increased third party vessel to project vessel collision risk	Refer to Impact 2.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.
Impact 4: Vessel to structure allision risk	Construction period of up to six years with a potential five year gap between phases (including one year of pre-construction activities; e.g., UXO and Boulder Clearance). **Construction of:** 140 WTGs; - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 101 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Four OSPs with topside dimensions of 55mx45m; 500m safety zones during installation (50m safety zones around partially complete structures or complete structures); and 25 vessels on-site simultaneously with up to 3,992 vessel movements.	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk.

Potential Impact	Assessment Parameter	Explanation
Impact 5: Reduced access to local ports	Refer to Impact 2.	Greatest number of vessels on-site simultaneously, greatest extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on reduced access to local ports.
Impact 6: Reduction of under keel clearance	Construction period of six years with a potential five year gap between phases (including one year of pre-construction activities; e.g., UXO and Boulder Clearance). **Construction of:** 140 inter-array cables of 353.7nm (655km) combined length (this includes dynamic sections of inter-array cables for floating structures); Two interconnector cables of 32.4nm (60km) combined length; Four offshore export cables of 178.2nm (330km) combined length; Six mooring lines per floating WTG; 20 crossings for the inter-array cables; Four crossings for the interconnector cables; 16 crossings for the offshore export cables; and Protection for inter-array, interconnector and offshore export cables (including crossings) of 1.5m height.	Largest possible extent of sub-sea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on under keel clearance.

Potential Impact	Assessment Parameter	Explanation
Impact 7: Loss of station	Construction period of up to six years with a potential five year gap between phases. **Construction of:** 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; and Six mooring lines per floating WTG.	Largest possible extent of floating infrastructure and greatest duration resulting in the maximum spatial and temporal effect on loss of station.
Impact 8: Reduction of SAR capabilities	Refer to Impact 1.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability.
Operation		
Impact 9: Vessel displacement	Maximum operational life of 35 years. **Operation of:** 140 WTGs; - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 101 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs;	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement, including during adverse weather.

Potential Impact	Assessment Parameter	Explanation
	Four OSPs with topside dimensions of 55mx45m; 500m safety zones during major maintenance; Three vessels on-site simultaneously during routine operations; 25 vessels on-site simultaneously during major works; and 938 vessel movements annually.	
Impact 10: Increased third party vessel to vessel collision risk	Maximum operational life of 35 years. **Operation of:** 140 WTGs: - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 101 fixed WTGs with sea surface dimensions of 24mx24m; Four OSPs with topside dimensions of 55mx45m. 140 inter-array cables of 353.7nm (655km) combined length; Two interconnector cables of 32.4nm (655km) combined length; Four offshore export cables of 178.2nm (330km) combined length; 500m safety zones during major maintenance; Three vessels on-site simultaneously during routine operations; 25 vessels on-site simultaneously during major works; and 938 vessel movements annually.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk.

Potential Impact	Assessment Parameter	Explanation
Impact 11: Increased third party vessel to project vessel collision risk	Refer to Impact 10.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.
Impact 12: Vessel to structure allision risk	Maximum operational life of 35 years. **Operation of:** 140 WTGs; - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 101 fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Four OSPs with topside dimensions of 55mx45m; 500m safety zones during major maintenance; Three vessels on-site simultaneously during routine operations; 25 vessels on-site simultaneously during major works; and 938 vessel movements annually.	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk.
Impact 13: Reduced access to local ports	Refer to Impact 10.	Greatest number of vessels on-site simultaneously, greatest extent of subsea infrastructure and greatest duration resulting in the maximum spatial and

Potential Impact	Assessment Parameter	Explanation
		temporal effect on reduced access to local ports.
Impact 14: Reduction of under keel clearance	Maximum operational life of 35 years. **Operation of:** 140 inter-array cables of 353.7nm (655km) combined length (this includes dynamic sections of inter-array cables for floating structures); Two interconnector cables of 32.4nm (60km) combined length; Four offshore export cables of 178.2nm (330km) combined length; Six mooring lines per floating WTG; 20 crossings for the inter-array cables; Four crossings for the interconnector cables; 16 crossings for the offshore export cables; and Protection for inter-array, interconnector and offshore export cables (including crossings) of 1.5m height.	Largest possible extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on under keel clearance.
Impact 15: Anchor interaction with sub-sea cables and mooring lines	Maximum operational life of 35 years. **Operation of:** Six mooring lines per floating WTG; 140 inter-array cables of 353.7nm (655km) combined length; Two interconnector cables of 32.4nm (60km) combined length;	Largest possible extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on anchor interaction with subsea cables.

Potential Impact	Assessment Parameter	Explanation
	Four offshore export cables of 178.2nm (330km) combined length; 20 crossings for the inter-array cables; Four crossings for the interconnector cables; 16 crossings for the offshore export cables; and Protection for inter-array, interconnector and offshore export cables (including crossings) of 1.5m height.	
Impact 16: Loss of station	Maximum operational life of 35 years. **Operation of:** 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; and Six mooring lines per floating WTG.	Largest possible extent of floating infrastructure and greatest duration resulting in the maximum spatial and temporal effect on loss of station.
Impact 17: Reduction of SAR capabilities	Refer to Impact 9.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial duration resulting in the maximum spatial and temporal effect on emergency response capability.
Decommissioning		

Potential Impact	Assessment Parameter	Explanation
Impact 18: Vessel displacement	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 1.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement during adverse weather. Decommissioning impact is assumed to be no more than construction.
Impact 19: Increased third party vessel to vessel collision risk	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 2.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk. Decommissioning impact is assumed to be no more than construction.
Impact 20: Increased third party vessel to project vessel collision risk	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 3.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel. Decommissioning impact is assumed to be no more than construction.

Potential Impact	Assessment Parameter	Explanation
Impact 21: Vessel to structure allision risk	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 4.	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk. Decommissioning impact is assumed to be no more than construction.
Impact 22: Reduced access to local ports	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 5.	Greatest number of vessels on-site simultaneously, greatest extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on reduced access to local ports. Decommissioning impact is assumed to be no more than construction.
Impact 23: Loss of station	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 7.	Largest possible extent of floating infrastructure and greatest duration resulting in the maximum spatial and temporal effect on loss of station. Decommissioning impact is assumed to be no more than construction.
Impact 24: Reduction of SAR capabilities	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 8.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest

Potential Impact	Assessment Parameter	Explanation
		duration resulting in the maximum spatial and temporal effect on emergency response capability. Decommissioning impact is assumed to be no more than construction.

Table 6.11 WCS for Shipping and Navigation by Hazard – Caledonia North Site

Potential Impact	Assessment Parameter	Explanation
Construction		
Impact 1: Vessel displacement	Construction period of three years (including one year of pre- construction activities; e.g., UXO and Boulder Clearance). **Construction of:** 77 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Two OSPs with topside dimensions of 55mx45m. 77 inter-array cables of 194.4nm (360km) combined length; One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 97.1nm (180km) combined length; 500m safety zones during (50m safety zones around partially complete structures or complete structures); and 25 vessels on-site simultaneously and 2,200 vessel movements.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement, including during adverse weather.

Potential Impact	Assessment Parameter	Explanation
Impact 2: Increased third party vessel to vessel collision risk	Construction period of three years (including one year of pre-construction activities; e.g., Unexploded Ordnance (UXO) and Boulder Clearance). **Construction of:** 77 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Two OSPs with topside dimensions of 55mx45m.; 77 inter-array cables of 194.4nm (360km) combined length; One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 97.1nm (180km) combined length; Buoyed construction area encompassing the maximum extent of the Caledonia North Site; 500m construction safety zones (50m safety zones around partially complete structures or complete structures); Temporary ancillary equipment within buoyed construction area (e.g., mooring buoys); and 25 vessels on-site simultaneously and 2,200 vessel movements.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk.
Impact 3: Increased third party vessel to project vessel collision risk	Refer to Impact 2.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and

Potential Impact	Assessment Parameter	Explanation
		greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.
Impact 4: Vessel to structure allision risk	Construction period of three years (including one year of pre- construction activities; e.g., UXO and Boulder Clearance).; **Construction of:** 77 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Two OSPs with topside dimensions of 55mx47m; 500m safety zones during installation (50m safety zones around partially complete structures or complete structures); and 25 vessels on-site simultaneously and 2,200 vessel movements.	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk.
Impact 5: Reduced access to local ports	Refer to Impact 2.	Greatest number of vessels on-site simultaneously, greatest extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on reduced access to local ports.

Potential Impact	Assessment Parameter	Explanation
Impact 8: Reduction of SAR capabilities	Refer to Impact 1.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability.
Operation		
Impact 7: Vessel displacement	Maximum operational life of 35 years. **Operation of:** 77 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Two OSPs with topside dimensions of 55mx45m; 500m safety zones during major maintenance; Three vessels on-site simultaneously during routine operations; 25 vessels on-site simultaneously during major works; and 938 vessel movements annually.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement, including during adverse weather.
Impact 8: Increased third party vessel to vessel collision risk	Maximum operational life of 35 years. **Operation of:**	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and

Potential Impact	Assessment Parameter	Explanation
	77 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Two OSPs with topside dimensions of 55mx45m. 77 inter-array cables of 194.4nm (360km) combined length; One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 97.1nm (180km) combined length; 500m safety zones during major maintenance; Three vessels on-site simultaneously during routine operations; 25 vessels on-site simultaneously during major works; and 938 vessel movements annually.	greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk.
Impact 9: Increased third party vessel to project vessel collision risk	Refer to Impact 8.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.
Impact 10: Vessel to structure allision risk	Maximum operational life of 35 years. **Operation of:**	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial

Potential Impact	Assessment Parameter	Explanation
	77 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Two OSPs with topside dimensions of 55mx45m; 500m safety zones during major maintenance; Three vessels on-site simultaneously during routine operations; 25 vessels on-site simultaneously during major works; and 938 vessel movements annually.	and temporal effect on vessel to structure allision risk.
Impact 11: Reduced access to local ports	Refer to Impact 8.	Greatest number of vessels on-site simultaneously, greatest extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on reduced access to local ports.
Impact 12: Reduction of under keel clearance	Maximum operational life of 35 years. **Operation of:** 77 inter-array cables of 194.4nm (360km) combined length; One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 97.1nm (180km) combined length;	Largest possible extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on under keel clearance.

Potential Impact	Assessment Parameter	Explanation
	Ten crossings for the inter-array cables; Two crossings for the interconnector cable; Eight crossings for the offshore export cables; and Protection for inter-array, interconnector and offshore export cables (including crossings) of 1.5m height.	
Impact 13: Anchor interaction with sub-sea cables	Refer to Impact 12.	Largest possible extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on anchor interaction with subsea cables.
Impact 14: Reduction of SAR capabilities	Refer to Impact 7.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability.
Decommissioning		
Impact 15: Vessel displacement	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 1.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement during

Potential Impact	Assessment Parameter	Explanation
		adverse weather. Decommissioning impact is assumed to be no more than construction.
Impact 16: Increased third party vessel to vessel collision risk	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 2.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk. Decommissioning impact is assumed to be no more than construction.
Impact 17: Increased third party vessel to project vessel collision risk	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 3.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel. Decommissioning impact is assumed to be no more than construction.
Impact 18: Vessel to structure allision risk	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 4.	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk. Decommissioning impact is assumed to be no more than construction.

Potential Impact	Assessment Parameter	Explanation
Impact 19: Reduced access to local ports	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 5.	Greatest number of vessels on-site simultaneously, greatest extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on reduced access to local ports. Decommissioning impact is assumed to be no more than construction.
Impact 20: Reduction of SAR capabilities	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 6.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability. Decommissioning impact is assumed to be no more than construction.

Table 6.12 WCS for Shipping and Navigation by Hazard – Caledonia South Site

Potential Impact	Assessment Parameter	Explanation
Construction		
Impact 1: Vessel displacement	Construction period of up to three years (including one year of pre- construction activities; e.g., UXO and Boulder Clearance); **Construction of:** 78 WTGs; - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 39 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Two OSPs with topside dimensions of 55mx45m. 78 inter-array cables of 197nm (365km) combined length; One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 81nm (150km) combined length; 500m safety zones during installation (50m safety zones around partially complete structures or complete structures); and	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement, including during adverse weather.

Potential Impact	Assessment Parameter	Explanation
	25 vessels on-site simultaneously and 2,225 vessel movements.	
Impact 2: Increased third party vessel to vessel collision risk	Construction period three years (including one year of pre-construction activities; e.g., Unexploded Ordnance (UXO) and Boulder Clearance).; **Construction of:** 78 WTGs; - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 39 bottom-fixed WTGs with sea surface dimensions of 24mx24m;140 WTGs; Two OSPs with topside dimensions of 55mx45m; 78 inter-array cables of 197nm (365km) combined length; One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 81nm (150km) combined length; Buoyed construction area encompassing the maximum extent of the Caledonia South Site; 500m safety zones during installation (50m safety zones around partially complete structures or complete structures);	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk.

Potential Impact	Assessment Parameter	Explanation
	Temporary ancillary equipment within buoyed construction area (e.g., mooring buoys); and 25 construction vessels on-site simultaneously and 2,225 vessel movements.	
Impact 3: Increased third party vessel to project vessel collision risk	Refer to Impact 2.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.
Impact 4: Vessel to structure allision risk	Construction period of three years (including one year of pre- construction activities; e.g., UXO and Boulder Clearance); **Construction of:** 78 WTGs; - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 39 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Two OSPs with topside dimensions of 55mx45m;	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk.

Potential Impact	Assessment Parameter	Explanation
	500m safety zones during installation (50m safety zones around partially complete structures or complete structures); and 25 vessels on-site simultaneously and 2,225 vessel movements.	
Impact 5: Reduced access to local ports	Refer to Impact 2.	Greatest number of vessels on-site simultaneously, greatest extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on reduced access to local ports.
Impact 6: Reduction of under keel clearance	Construction period of three years (including one year of pre- construction activities; e.g., UXO and Boulder Clearance); **Construction of:** 78 inter-array cables of 197nm (365km) combined length (this includes dynamic sections of inter-array cables for floating structures); One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 81nm (150km) combined length; Six mooring lines per floating WTG; Ten crossings for the inter-array cables;	Largest possible extent of sub-sea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on under keel clearance.

Potential Impact	Assessment Parameter	Explanation
	Two crossings for the interconnector cable; Eight crossings for the offshore export cables; and Protection for inter-array, interconnector and offshore export cables (including crossings) of 1.5m height.	
Impact 7: Loss of station	Construction period of three years. **Construction of:** 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; and Six mooring lines per floating WTG.	Largest possible extent of floating infrastructure and greatest duration resulting in the maximum spatial and temporal effect on loss of station.
Impact 8: Reduction of SAR capabilities	Refer to Impact 1.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability.
Operation		
Impact 9: Vessel displacement	Maximum operational life of 35 years. **Operation of:** 78 WTGs;	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel

Potential Impact	Assessment Parameter	Explanation
	- 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 39 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Minimum spacing of 944m between WTGs; Two OSPs with topside dimensions of 55mx45m; 500m safety zones during major maintenance; Three vessels on-site simultaneously during routine operations; 25 vessels on-site simultaneously during major works; and 938 vessel movements annually.	displacement, including during adverse weather.
Impact 10: Increased third party vessel to vessel collision risk	Maximum operational life of 35 years. **Operation of:** 78 WTGs: - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 39 bottom-fixed WTGs with sea surface dimensions of 24mx24m; Two OSPs with topside dimensions of 55mx45m; 78 inter-array cables of 197nm (365km) combined length;	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk.

Potential Impact	Assessment Parameter	Explanation
	One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 81nm (150km) combined length; 500m safety zones during major maintenance; Three vessels on-site simultaneously during routine operations; 25 vessels on-site simultaneously during major works; and 938 vessel movements annually.	
Impact 11: Increased third party vessel to project vessel collision risk	Refer to Impact 10.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.
Impact 12: Vessel to structure allision risk	Maximum operational life of 35 years. **Operation of:** 78 WTGs: - 39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; - 39 bottom-fixed WTGs with sea surface dimensions of 24mx24m;	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk.

Potential Impact	Assessment Parameter	Explanation
	Minimum spacing of 944m between WTGs; Two OSPs with topside dimensions of 55mx45m; 500m safety zones during major maintenance; Three vessels on-site simultaneously during routine operations; 25 vessels on-site simultaneously during major works; and 938 vessel movements annually.	
Impact 13: Reduced access to local ports	Refer to Impact 10.	Greatest number of vessels on-site simultaneously, greatest extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on reduced access to local ports.
Impact 14: Reduction of under keel clearance	Maximum operational life of 35 years. **Operation of:** 78 inter-array cables of 197nm (365km) combined length (this includes dynamic sections of inter-array cables for floating structures); One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 81nm (150km) combined length; Six mooring lines per floating WTG;	Largest possible extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on under keel clearance.

Potential Impact	Assessment Parameter	Explanation
	Ten crossings for the inter-array cables; Two crossings for the interconnector cable; Eight crossings for the offshore export cables; and Protection for inter-array, interconnector and offshore export cables (including crossings) of 1.5m height.	
Impact 15: Anchor interaction with sub-sea cables and mooring lines	Maximum operational life of 35 years. **Operation of:** Six mooring lines per floating WTG; 78 inter-array cables of 197nm (365km) combined length; One interconnector cable of 16.2nm (30km) length; Two offshore export cables of 81nm (150km) combined length; Ten crossings for the inter-array cables; Two crossings for the interconnector cable; Eight crossings for the offshore export cables; and Protection for inter-array, interconnector and offshore export cables (including crossings) of 1.5m height.	Largest possible extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on anchor interaction with sub-sea cables.
Impact 16: Loss of station	Maximum operational life of 35 years. **Operation of:**	Largest possible extent of floating infrastructure and greatest duration resulting in the maximum spatial and temporal effect on loss of station.

Potential Impact	Assessment Parameter	Explanation
	39 floating semi-submersible WTGs with sea surface dimensions of 102m×96.7m; and Six mooring lines per floating WTG.	
Impact 17: Reduction of SAR capabilities	Refer to Impact 9.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability.
Decommissioning		
Impact 18: Vessel displacement	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 1.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement during adverse weather. Decommissioning impact is assumed to be no more than construction.
Impact 19: Increased third party vessel to vessel collision risk	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 2.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel

Potential Impact	Assessment Parameter	Explanation
		collision risk. Decommissioning impact is assumed to be no more than construction.
Impact 20: Increased third party vessel to project vessel collision risk	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 2.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel. Decommissioning impact is assumed to be no more than construction.
Impact 21: Vessel to structure allision risk	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 4.	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk. Decommissioning impact is assumed to be no more than construction.
Impact 22: Reduced access to local ports	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 5.	Greatest number of vessels on-site simultaneously, greatest extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on reduced access to local ports. Decommissioning

Potential Impact	Assessment Parameter	Explanation
		impact is assumed to be no more than construction.
Impact 23: Loss of station	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 7.	Largest possible extent of floating infrastructure and greatest duration resulting in the maximum spatial and temporal effect on loss of station. Decommissioning impact is assumed to be no more than construction.
Impact 24: Reduction of SAR capabilities	The worst-case scenario will be equal to (or less than) that of the construction phase. Refer to Impact 7.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability. Decommissioning impact is assumed to be no more than construction.

7 Navigational Features

The navigational features within, and in proximity to, Caledonia OWF and the Caledonia OECC are presented in Figure 7.1. It is noted that planned developments (e.g. Broadshore OWF and Stromar OWF) are not considered baseline but have been considered on a cumulative basis in Section 14.

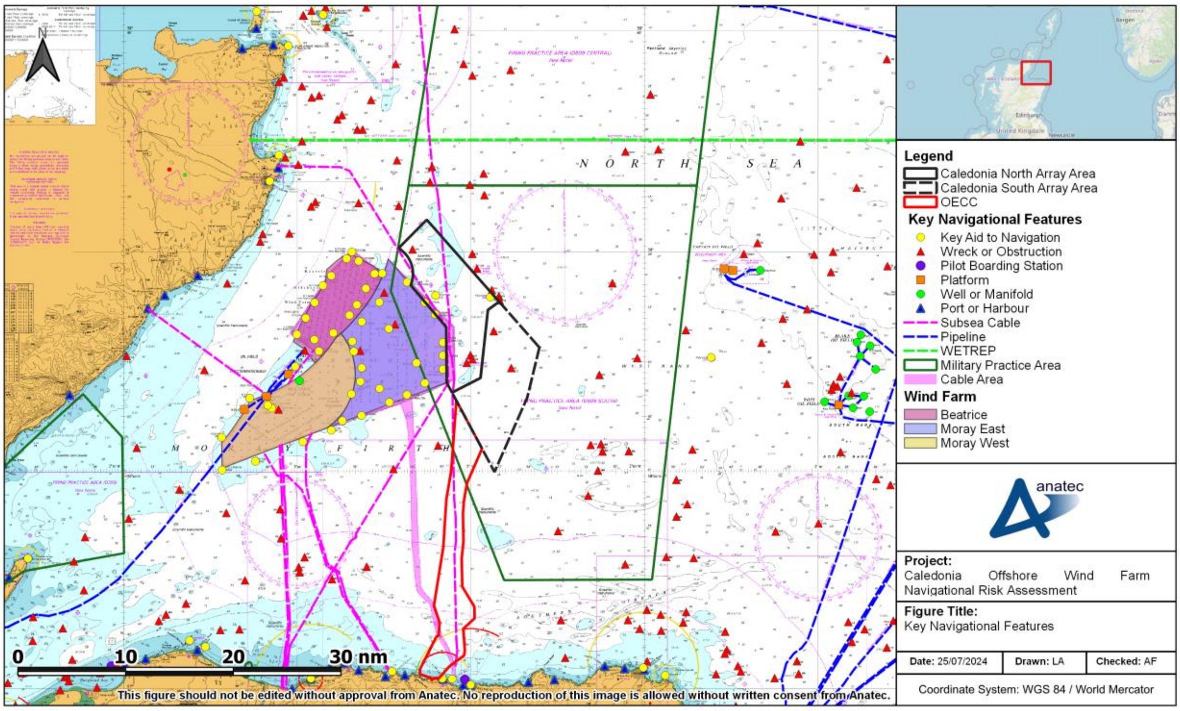

Figure 7.1 Navigational Features in Proximity to the Proposed Development (Offshore)

7.1 Ports and Related Services

The closest port or harbour to the Caledonia North Site is Wick Harbour, situated approximately 13.2nm northwest at its closest point. The Admiralty Sailing Directions describes Wick Harbour as accommodating to fishing, recreational and commercial traffic. Wick Harbour is also the base for wind farm activities at Beatrice OWF. The nearest port or harbour to the Caledonia South Site is located at Macduff, which hosts commercial activity including tankers and fishing vessels, and lies approximately 19.7nm south of the Caledonia South Site at its closest point.

Other major ports or harbours in proximity to the Proposed Development (Offshore) include Buckie Harbour, Fraserburgh Harbour, as well as several in the Cromarty Firth.

Buckie Harbour is located approximately 29.4nm southwest of the Caledonia North Site and 25.5nm southwest of the Caledonia South Site. It has four basins available for berthing and is described in the Admiralty Sailing Directions to have "*a considerable coastal trade, chiefly in timber and agricultural commodities and has good facilities for repair and servicing*". It also serves as an operational base for activities at Moray West OWF.

Fraserburgh Harbour is situated on the northeast coast of Scotland approximately 30.8nm southeast of the Caledonia North Site and 23nm southeast the Caledonia South Site. It consists of inter-connected basins and harbours of varying depths, with outer anchoring available in Fraserburgh Bay, where vessels can also receive pilotage. The Admiralty Sailing Directions describe Fraserburgh Harbour as "*mainly a fishing port with a large locally-based fishing fleet. There is also commercial traffic*". Fraserburgh serves as an operational base for Moray East OWF.

The Cromarty Firth is located approximately 54nm southwest of the Caledonia North Site and South, and is host to the Port of Cromarty Firth, situated at Invergordon. Nigg Energy Park is a facility within the Cromarty Firth Port Authority limits. It is described in the Admiralty Sailing Directions as "*the largest open port in the Moray Firth area*" as well as a "*major centre of large offshore energy projects*". Cromarty Harbour lies near the entrance to the Cromarty Firth and hosts fishing vessels as well as a ferry which transits to and from Nigg Ferry Pier.

7.2 Key Aids to Navigation

Two AtoNs are located within the Array Area which mark areas of shallower water, as well as the presence of wrecks. Additionally, WTGs with marine AtoNs are present along the periphery of Moray East and Beatrice OWFs. The nearest lighthouse is situated at Wick, approximately 13.2nm northwest of the Array Area.

7.3 Offshore Wind Farms

The Caledonia North Site lies adjacent to the easternmost border of Moray East OWF, over a distance of approximately 10nm. At its closest point, Moray East OWF is located approximately 1nm northwest of the Caledonia South Site. Moray East OWF began construction in May 2019 and was commissioned in May 2022. It covers an area of 86nm^2 and consists of 100 WTGs. Wind farm vessels servicing Moray East OWF generally operate out of Fraserburgh.

Additionally, at its closest point, Beatrice OWF is located approximately 2.6nm west of the Caledonia North Site and 10nm northwest of the Caledonia South Site. Construction activities for Beatrice OWF began in February 2017 and it was commissioned in May 2019. It is approximately 38nm^2 with 84 WTGs in place. Wind farm vessels servicing Beatrice OWF operate out of Wick.

Moray West OWF, which is currently under construction, is located 7.7nm southwest of the Caledonia North Site and 8.9nm west of the Caledonia South Site. Construction for Moray West OWF began in February 2023 and, at the time of writing (September 2024), has completed installation of all monopile foundations, all transition pieces, 45 WTGs, and two Offshore Substation Platforms (OSPs) (Moray West, 2024).

7.4 Charted Wrecks

Numerous charted wrecks are in proximity to the Proposed Development (Offshore) and can be seen in Figure 7.1. Two charted wrecks can be found within the Caledonia South Site, and four within the Caledonia North Site, one of which has been classed as a historic wreck.

7.5 Subsea Cables and Pipelines

Excluding export and inter-array cables associated with nearby OWFs, two subsea cables run in the vicinity of the Proposed Development (Offshore) and are shown in Figure 7.1. These are the Caithness Moray HVDC cable, and the SHEFA-2 communications cable which connects Scotland and the Faroe Islands, and runs between Banff and Manse Bay (Orkney).

Both subsea cables intersect the Caledonia North Site, whilst only the SHEFA-2 intersects the Caledonia South Site on its western-most corner.

Nearby pipelines include those at the decommissioned Jack and Beatrice Oil Fields approximately 14nm west of the Caledonia North Site and South sites, as well as those at the Captain Oil Field located approximately 22nm east.

7.6 Military Practice and Exercise Areas

There are four military firing areas located in proximity to the Proposed Development (Offshore). All firing areas operate under a clear range procedure, i.e. exercises only take place when areas are considered clear of all shipping.

Firing practice area D703 is situated near the coast between the Dornoch Firth and Helmsdale, and covers an area of approximately 187nm^2.

Firing practice area D809 Central lies roughly 3nm and 11nm north of the Caledonia North Site and the Caledonia South Site respectively, and covers an area of approximately 616nm^2. Firing practice area D809 South sits directly south of area D809 Central, and encompasses both the Caledonia North Site and the Caledonia South Site with an area of around 792nm^2.

Firing practice area X5702 covers an area of 0.8nm^2 and extends approximately 1.4nm from the coast between Buckie and Lossiemouth at Binn Hill Rifle Range.

7.7 Anchorage Areas

A charted anchorage area can be found approximately 1.75nm from the coast north of Macduff, in Boyndie Bay, covering an area of 2.3nm^2, with water depths between 25m to 40m, as shown in Figure 7.2. Anchorage points can also be found at numerous bays along the northeast coast as well as at Wick.

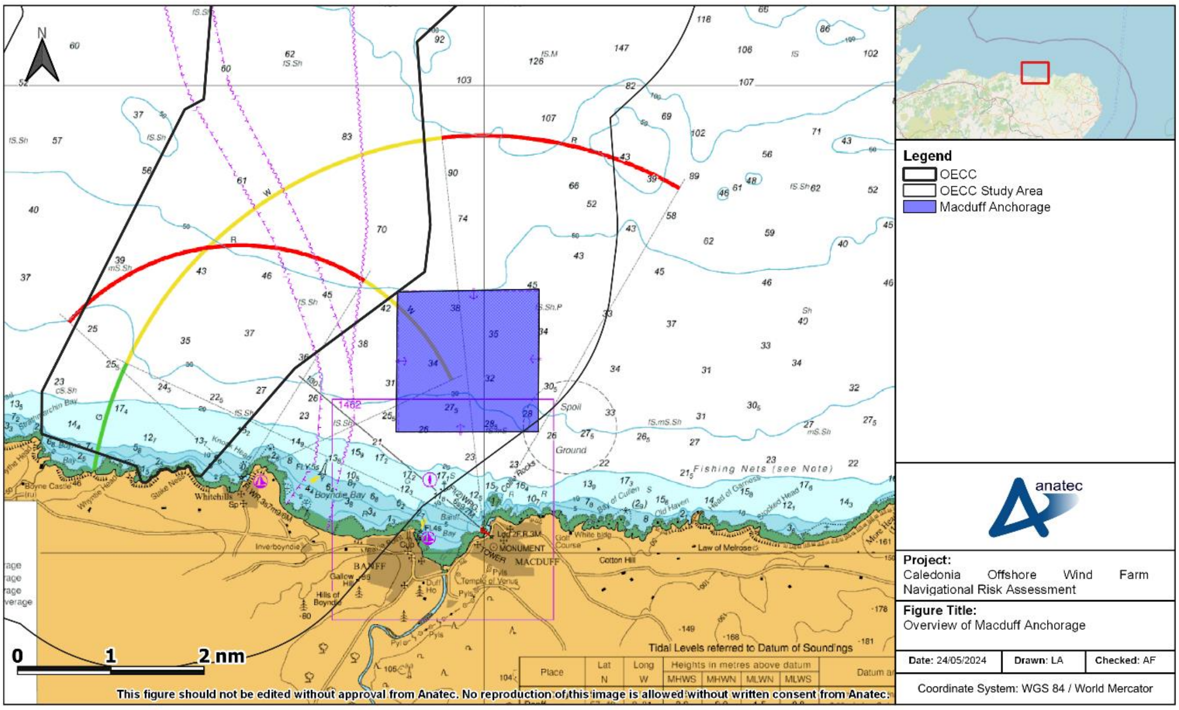

Figure 7.2 Overview of Macduff Anchorage

7.8 Spoil Grounds

Many spoil grounds are located along the northeast coast of Scotland. The closest one to the Caledonia North Site being 11.4nm northwest at Wick. The nearest spoil ground to the Caledonia South Site is 18.2nm south at Macduff.

7.9 Other Navigational Features

Several platforms are noted within the vicinity of the Proposed Development (Offshore), the closest being at the Jacky and Beatrice oil fields. These fields are in the process of being decommissioned within the near future.

The Western European Tanker Reporting System (WETREP) runs east/west approximately 7.2nm north of the Caledonia North Site, and 14.8nm north of the Caledonia South Site. This is a mandatory ship reporting system which applies to all oil tankers over 600 Deadweight Tonnage (DWT) carrying a cargo of heavy crude oil, heavy fuel oils, or bitumen and tar.

8 Meteorological Ocean Data

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

8.1 Wind Direction

Based on wind direction data the proportion of the wind direction within each 30-degree interval is presented in Figure 8.1 in the form of a wind rose. It can be seen that wind is predominantly from the west through to the southeast.

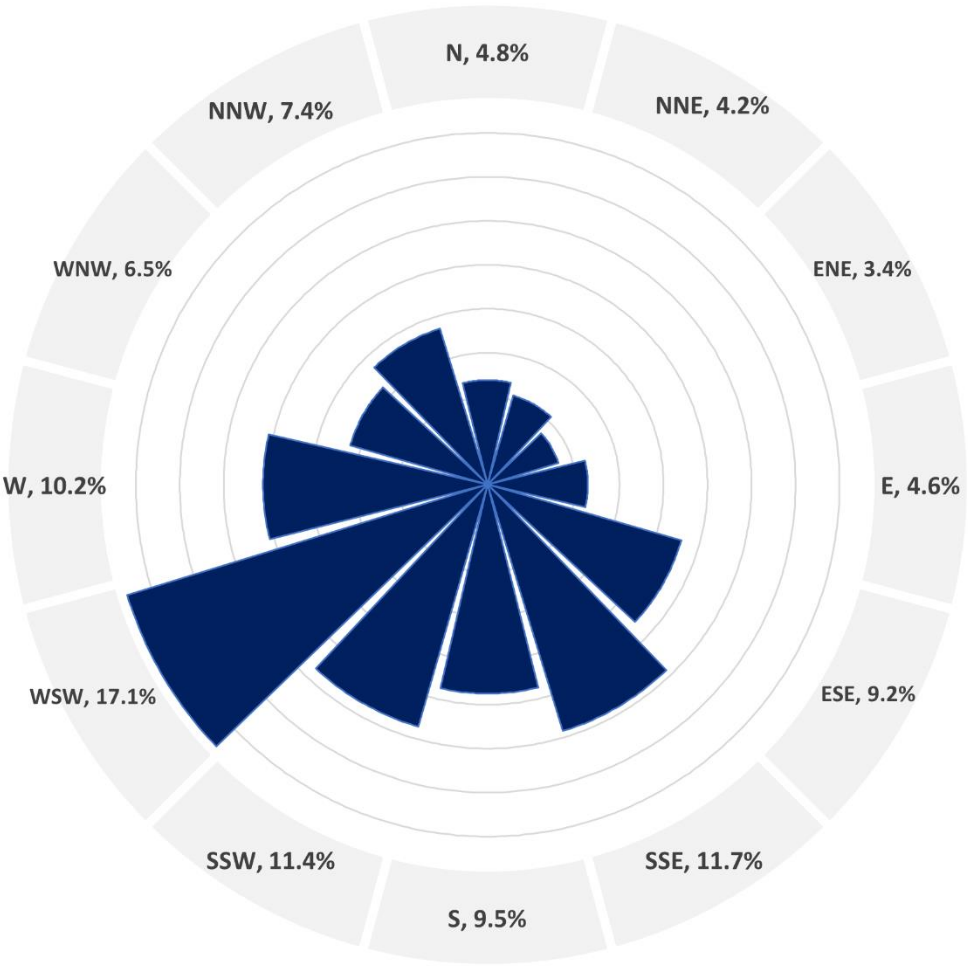

Figure 8.1 Wind Direction Distribution

8.2 Wave

Based on significant wave height data the proportion of the sea state within each of the three defined ranges, where the sea state is based upon significant wave height, is presented in Table 8.1.

Table 8.1 Sea State Distribution

Sea State	Proportion (%)
Calm (< 1m)	43.36
Moderate (1 to 5m)	56.22
Severe (≥ 5m)	0.42

8.3 Visibility

Based on information provided by the Admiralty Sailing Directions (UKHO, 2022), the proportion of poor visibility (defined as the proportion of a year where visibility can be expected to be less than 1km) is 2%.

8.4 Tidal Speed and Direction

From UKHO Admiralty Chart 115 (UKHO, 2024), currents within and in proximity to Caledonia OWF are set in a general southeast/northwest direction on the flood tide and southwest to northwest direction on the ebb tide. The greatest flood peak tidal rate is 2.1 knots (kt) and the greatest peak ebb tidal rate is 1.9 kt. The peak speed and corresponding direction data for the flood and ebb tides for the relevant tidal diamonds on the UKHO Admiralty Chart 115 (UKHO, 2024) are presented in Table 8.2.

Table 8.2 Peak Flood and Ebb Tidal Data

UKHO Admiralty Chart	Tidal Diamond	Flood		Ebb	
		Direction (°)	Speed (kt)	Direction (°)	Speed (kt)
115	F	257	0.5	252	0.5
	G	215	0.3	24	0.4
	H	188	2.1	358	1.9
	K	290	0.6	286	0.7
	M	174	0.8	343	0.7
	N	178	1.2	341	1.2
	Q	150	0.4	323	0.4
	S	359	0.7	179	0.7

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

9 Emergency Response and Incident Overview

This section summarises the existing SAR resources in the region, and issues being considered in relation to the Proposed Development (Offshore).

9.1 Search and Rescue Helicopters

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

The SAR helicopter service is currently operated out of ten base locations around the UK, with the closest to Caledonia OWF located at Inverness, approximately 66nm southwest of Caledonia OWF.

The DfT has produced data on civilian SAR helicopter activity in the UK by the Bristow Group on behalf of the MCA between April 2015 and March 2023.

The locations of SAR helicopter taskings within Caledonia OWF and OECC study areas are presented in Figure 9.1 colour-coded by tasking type.

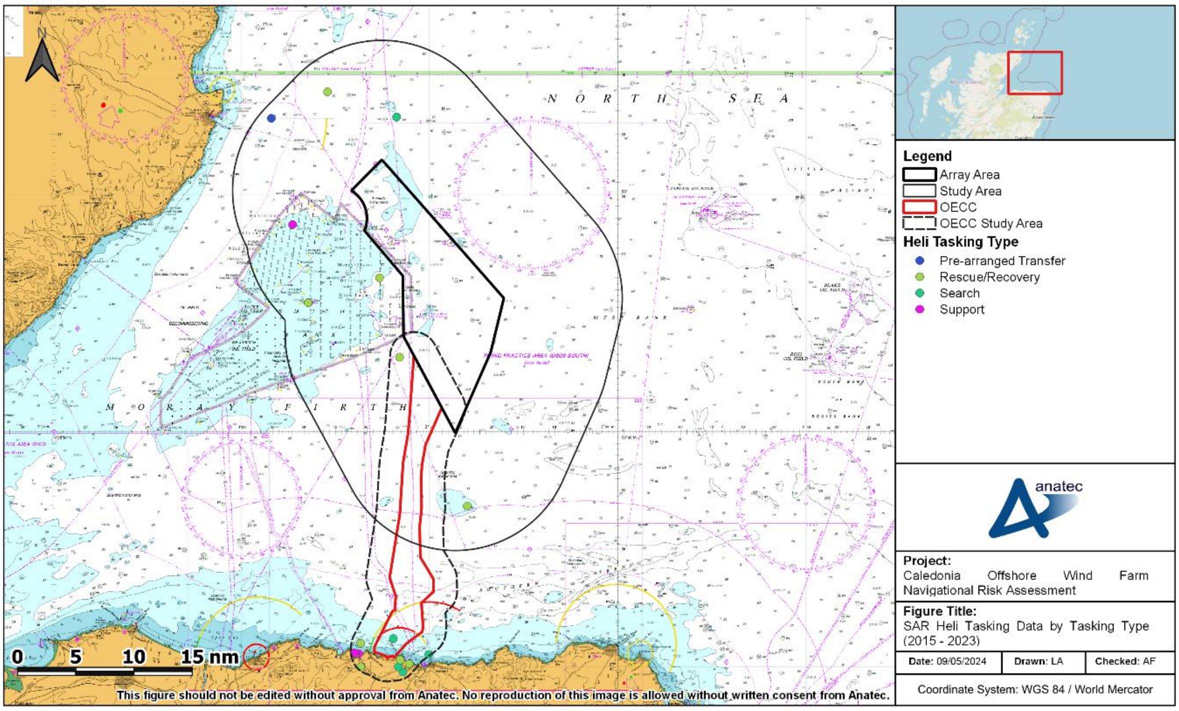

Figure 9.1 SAR Helicopter Taskings by Tasking Type (2015 – 2023)

There were nine SAR taskings within the study area between April 2015 and March 2023, corresponding to an average of one SAR tasking per year. Five were rescue/recovery, with two search operations, one support operation, and one prearranged transfer. All but one were responded to by the Inverness base, the other was responded to by Sumburgh.

There were 14 SAR taskings within the OECC study area between April 2015 and March 2023, mostly located along the coast. There was one tasking within the Caledonia OECC itself which was a search operation responded to by the Inverness base.

9.2 Royal National Lifeboat Institution

The RNLI is organised into six regions, with the relevant region for the Proposed Development (Offshore) being 'Scotland'. Based out of more than 230 stations, there are over 400 active lifeboats across the RNLI fleet, including both All-Weather Lifeboats (ALB) and Inshore Lifeboats (ILB).

Figure 9.2 presents the RNLI stations in proximity to Caledonia OWF as well as the incidents documented by the RNLI that occurred within the offshore and OECC study areas between 2010 and 2022, colour-coded by incident type (no incidents were recorded in the study area post 2019 and therefore the period studied has been extended to begin in 2010). Figure 9.3 presents the same data, colour-coded by casualty type. It is noted that incidents which were deemed hoaxes or false alarms have been excluded from the analysis.

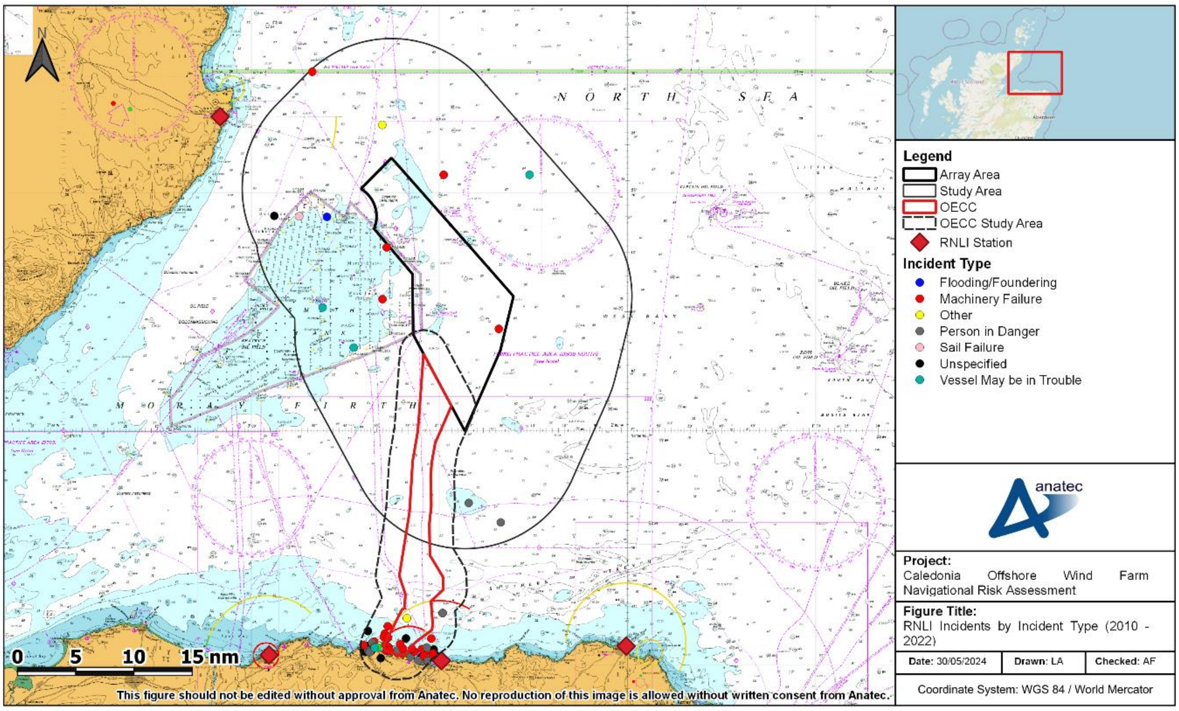

Figure 9.2 RNLI Incident Data by Incident Type (2010-2022)

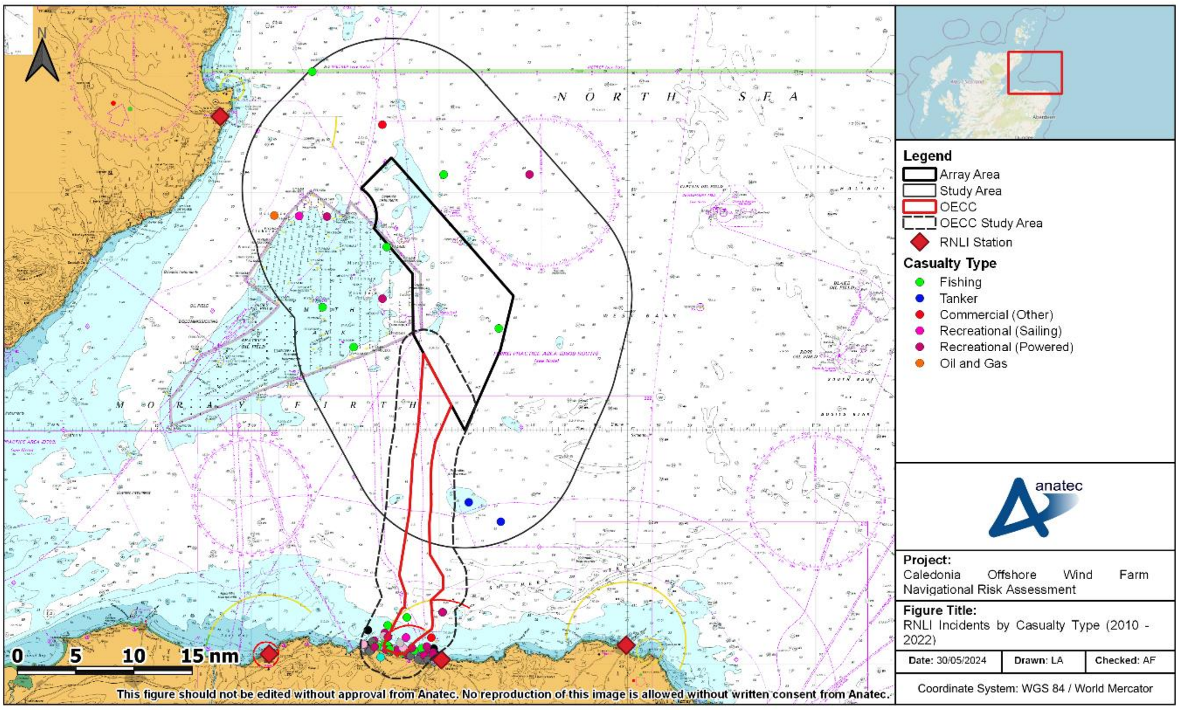

Figure 9.3 RNLI Incident Data by Casualty Type (2010-2022)

The closest RNLI station to Caledonia OWF is at Wick (approximately 13nm northwest), where an ALB is available. Macduff, located approximately 20nm south, also has a RNLI station, where an ILB is available; this station is also the closest to the Caledonia OECC, located approximately 3.2nm west. Other RNLI stations in proximity include Buckie and Fraserburgh.

A total of 14 incidents were responded to by the RNLI within the study area between 2010 and 2022. This corresponds to an average of approximately one incident per year. The most frequent station for incident response was Wick (71%), with Fraserburgh (21%) and Buckie (7%) also used. The most common incident types recorded were "*machinery failure*" (36%) and "*vessel may be in trouble*" (21%), with incident types of "*person in danger"* comprising 14% of incidents. The most common vessel types recorded were fishing vessels (43%) followed by recreational vessels (29%). One incident was responded to by the RNLI within Caledonia OWF itself – a fishing vessel with machinery failure.

A total of 63 incidents were responded to by the RNLI within the OECC study area between 2010 and 2022. This corresponds to an average of four to five incidents per year, with the majority of incidents occurring close to shore. The majority of incidents were responded to by the Macduff station. The most common incident types recorded were "*machinery failure*" (37%) and "*person in danger*" (22%), with incident types of "*other"* comprising 6% of incidents. The most common vessel types recorded were recreational vessels (34%) followed by person in danger (22%) and fishing vessels (14%). Thirteen incidents were responded to by the RNLI within the Caledonia OECC itself.

9.3 Maritime Rescue Coordination Centres and Joint Rescue Coordinate 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).

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

All of the MCA's operations, including SAR, are divided into 18 geographical regions. The 'Area 2: North Scotland' and the 'Area 3: East Scotland' regions covers Caledonia OWF and the Caledonia OECC. The Aberdeen MRCC is located approximately 61nm southeast of the Caledonia North Site and 53nm southeast of the Caledonia South Site, as illustrated in Figure 9.4, and coordinates the SAR response for maritime and coastal emergencies within the district boundary.

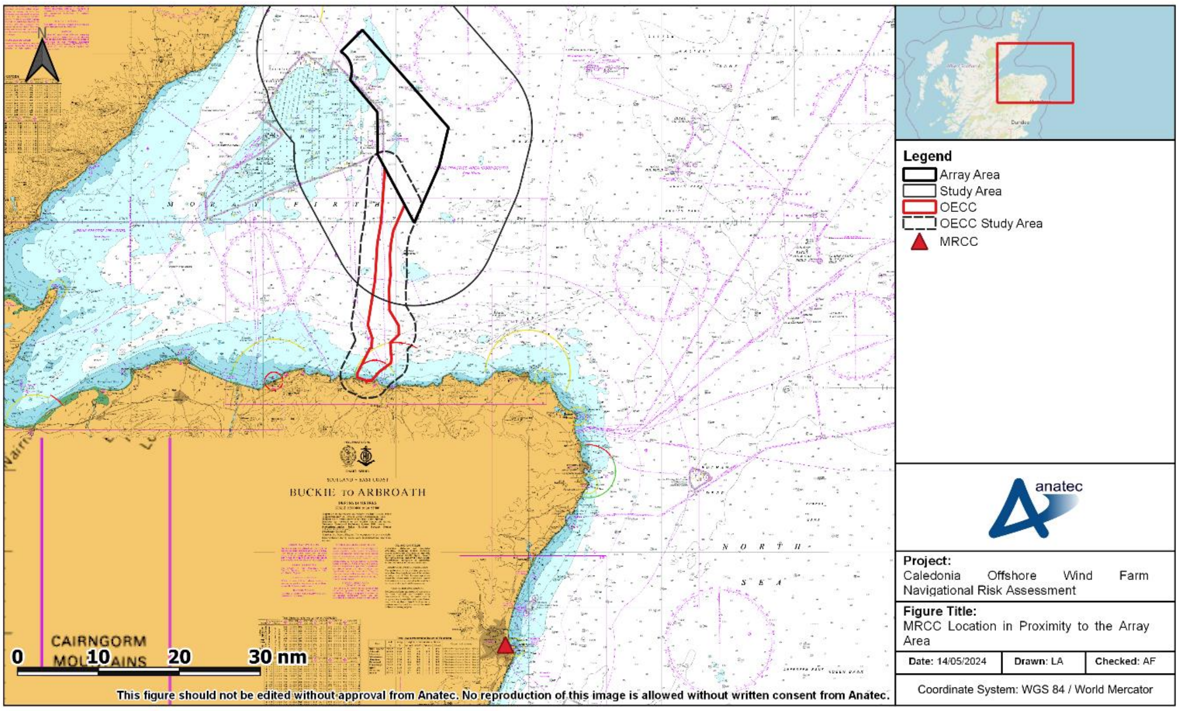

Figure 9.4 MRCC Location in Proximity to the Proposed Development (Offshore)

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 routeing communications and vessel to shore routine communications. It is implemented globally and vessels engaged in international voyages are obliged to carry GMDSS certified communication equipment.

There are four GMDSS sea areas, with the areas applicable in proximity to the UK shown in Figure 9.5. Vessels in proximity to Caledonia OWF would be located within sea area A1.

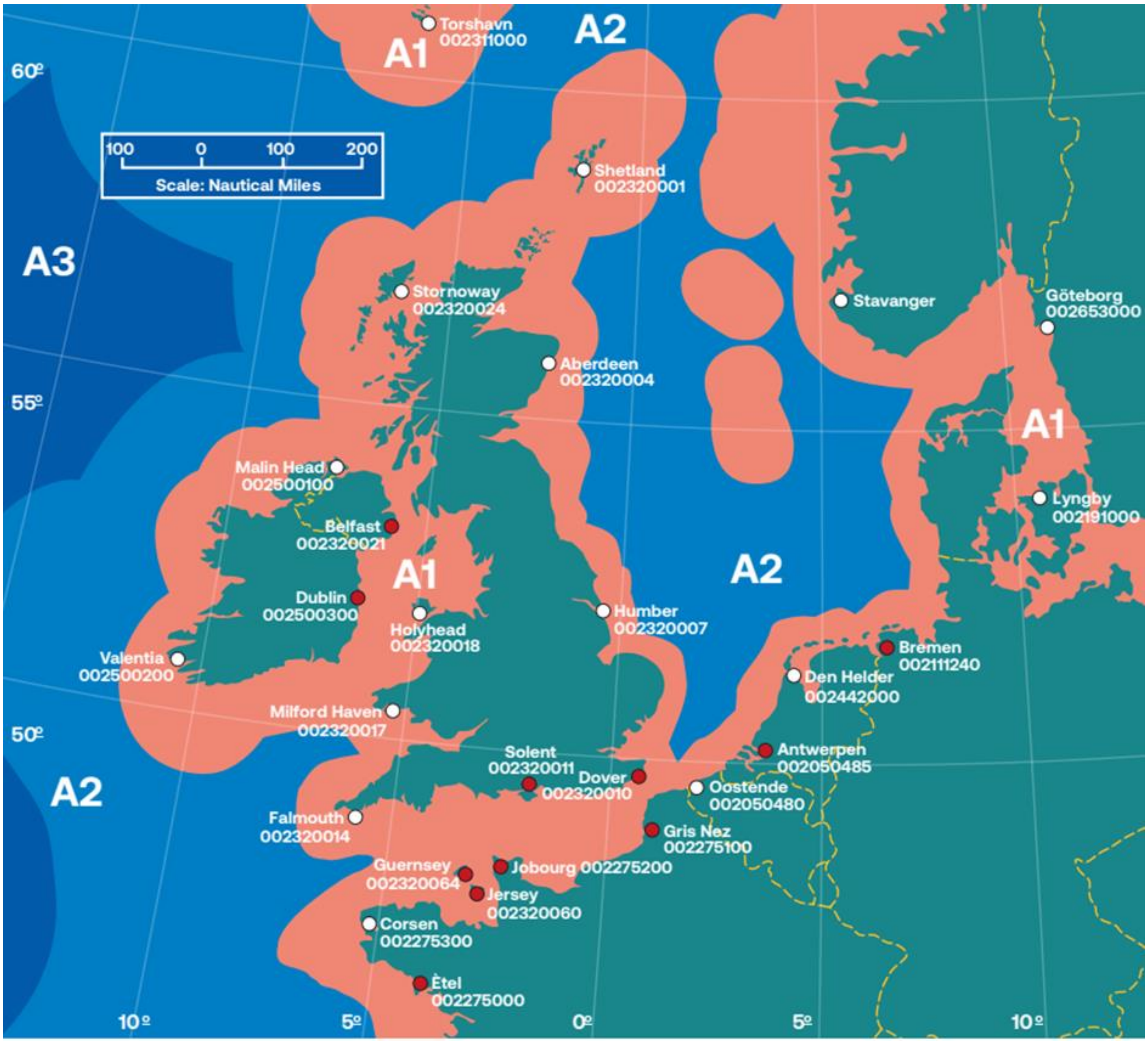

Figure 9.5 GMDSS Sea Areas (MCA, 2021)

In the event of an emergency involving a vessel located further offshore within sea area A1 or A2, vessels are able to contact coastal stations using High Frequency (HF) or Medium Frequency (MF) radio or otherwise contact other offshore resources.

9.5 Marine Accident Investigation Branch

All UK flagged vessels and non-UK flagged vessels in UK territorial waters (12nm), a UK port or carrying passengers to a UK port are required to report incidents to the MAIB. Data arising from these reports are assessed within this section, primarily covering the 10-year period between 2013 and 2022.

The incidents recorded within the MAIB data between 2013 and 2022 occurring within the study area and OECC study area are presented in Figure 9.6, colour-coded by incident type. Following this, Figure 9.7 shows the same data colour-coded by the type of vessel(s) involved in each incident.

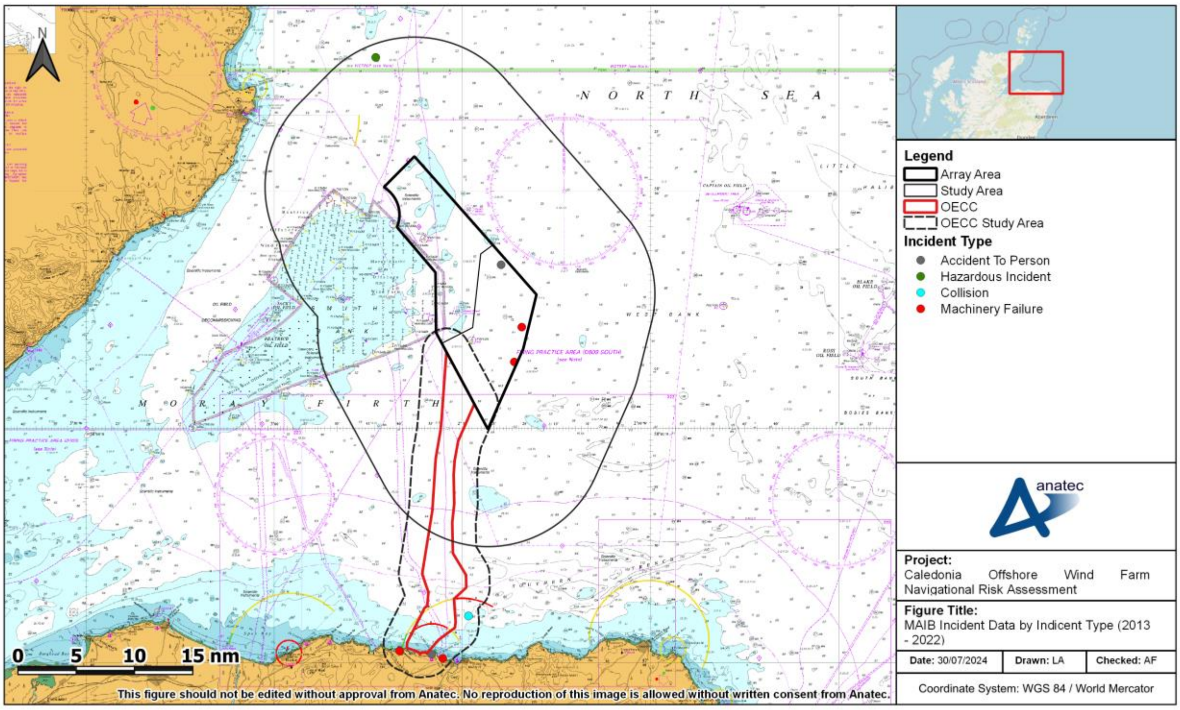

Figure 9.6 MAIB Incident Data by Incident Type (2013 – 2022)

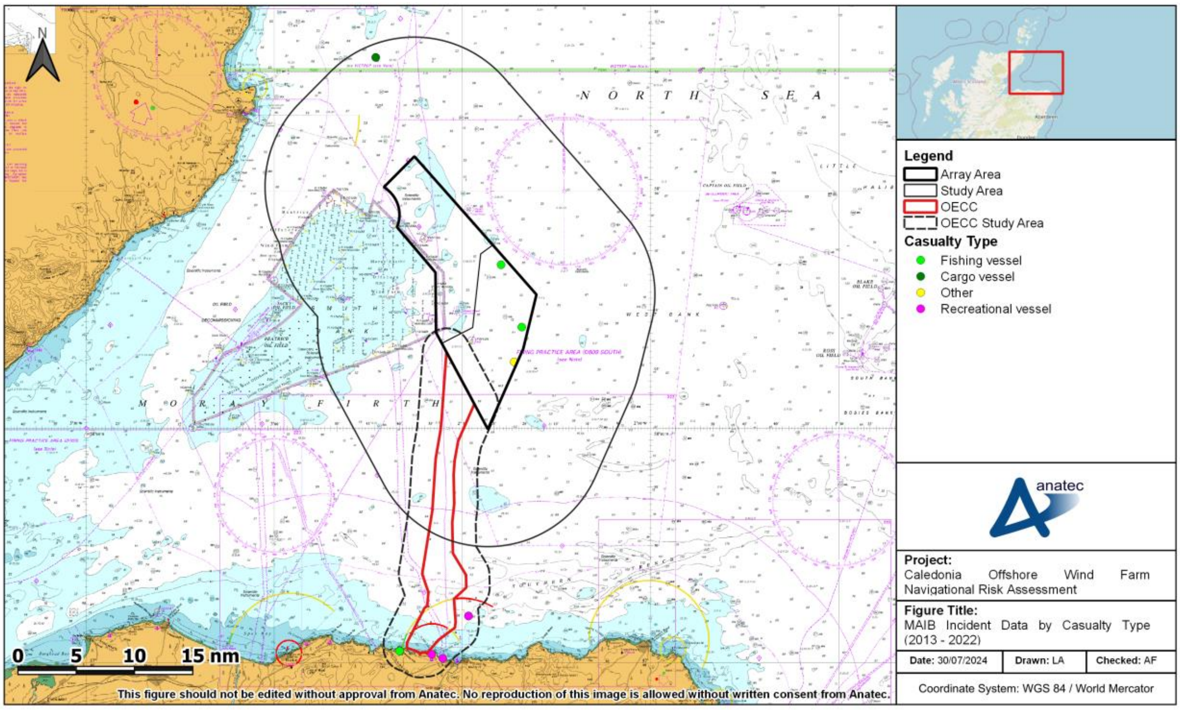

Figure 9.7 MAIB Incident Data by Casualty Type (2013 – 2022)

A total of four unique incidents were recorded within the study area during the period from 2013 to 2022, corresponding to an average of one incident every two and a half years. The most common incident type recorded was "*machinery failure*", with two instances recorded. The other recorded incidents included an "*accident to person"* and a "*hazardous incident*". Three incidents were recorded within Caledonia OWF itself, these were the "*accident to person*" and the "*machinery failure*" incidents. Fishing vessels and cargo vessels were the most common vessel types to be involved in incidents within the study area, at two instances for both vessel types. One service ship was also noted.

A total of four unique incidents were recorded within the OECC study area between 2013 and 2022, corresponding to one every two and a half years. The most common incident type was also "*machinery failure*", with two instances recorded. Other incidents recorded were an "*accident to person*" and a "*collision*". Recreational vessels were the most common vessel type, at three recorded instances. Fishing vessels were also notable at two instances.

A review of older MAIB incident data within the study area between 2003 and 2012 indicates that the number of incidents has decreased in proximity to Caledonia OWF, with a total of 16 incidents within the study area, and nine incidents within the OECC study area recorded. No incidents occurred within Caledonia OWF, and none within the Caledonia OECC, as presented in Figure 9.8.

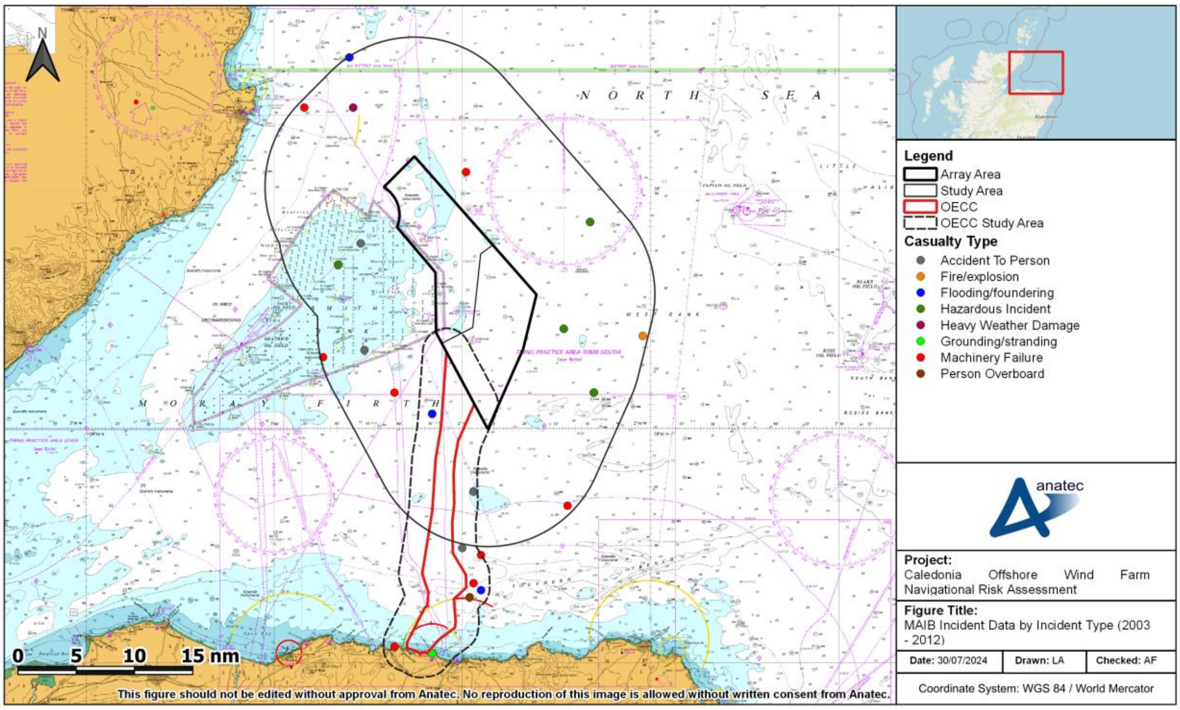

Figure 9.8 MAIB Incident Data by Incident Type (2003 - 2012)

9.6 Historical Offshore Wind Farm Incidents

9.6.1 Incidents Involving UK Offshore Wind Farm Developments

As of May 2024, there are 42 operational OWFs in the UK, ranging from the North Hoyle OWF (fully commissioned in 2003) to the Hornsea Project Two OWF (fully commissioned in 2022). Between them these developments encompass approximately 23,366 fully operational WTG years[3].

MAIB incident data has been used to collate a list of reported historical collision and allision incidents involving UK OWF developments[4], 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.

[3] Calculation based on estimated commissioning dates and number of WTGs per operational project.
[4] Includes only incidents reported to an accident investigation branch or an anonymous reporting service. Unconfirmed incidents have not been considered noting that to date only one further alleged incident has been rumoured but there is no evidence to confirm.

Table 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
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	CTV allision with flotel. Nine persons safely evacuated and transferred to nearby vessel before being brought back into 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	Moderate	None	MAIB

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

(*) As per incident reports.

As of May 2024, there have been no reported third-party collisions directly as a result of the presence of an OWF in the UK. The only reported third-party collision incident in relation to a UK OWF involved a project vessel hitting a third-party vessel whilst in harbour.

As of May 2024, 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 two involving a support vessel for the development and the errant vessel in each case under power rather than drifting. Therefore, there has been an average of 1,797 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).

On an individual project basis, there has been an average of 0.015 allision incidents per operational OWF year, noting this is an average across the 20-year period since the first UK OWF became operational.

The presence of OWFs and associated activities does increase the likelihood of an incident occurring based on consideration of existing datasets (see Section 9.6.1). This includes the Proposed Development (Offshore) given that it will represent new offshore infrastructure and activities. The analysis above incorporates only collision and allision incidents since these are more likely to result in notable consequences and thus are more comprehensively reported, and are also of primary interest to the NRA. The worst consequences reported for vessels involved in a collision or allision incident involving a UK OWF development has been flooding, with no life-threatening injuries to persons reported.

Other types of incident (such as medical incidents) may also require emergency response and therefore the rates reported above should not be considered comprehensive for all emergency response incidents. An accident to person requiring medical attention (which may include emergency response) is considered the most likely type of incident that may occur at an OWF.

9.6.2 Incidents Involving Non-UK Offshore Wind Farms

There have also been collision and allision incidents involving non-UK OWF developments. However, it is not possible to maintain a comprehensive list of such incidents and the associated operational hours.

One high profile non-UK incident of relevance involved a bulk carrier in January 2022 which broke its anchor chain during a storm in Dutch waters and collided with a nearby anchored vessel. The vessel began to take on water, leading to all crew members being evacuated by helicopter. The vessel then continued to drift towards shore including through an under construction OWF where it allided with a WTG foundation and a platform foundation before being taken under tow (Marine Safety Investigation Unit, 2024).

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

Although the presence of OWFs and associated activities does increase the likelihood of an incident requiring emergency response it is also acknowledged that the presence of project vessels can aid with emergency response efforts, particularly for OWFs located further offshore where a project vessel is more likely to be able to serve as the first responder to an incident.

From news reports, web searches and experience working with existing OWF developments, a list has been collated of historical incidents responded to by vessels associated with UK OWF developments, which is summarised in Table 9.2. The initial cause of these incidents is not related to the OWF in question.

Table 9.2 comprises known incidents that were responded to by a wind farm vessel. Additional incidents associated with the construction or operation of OWFs 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 Vessels Associated with UK OWF Developments

Incident Type	Date	Related Development	Description of Incident	Source
Capsize	21 June 2018	Walney	HMCG issued mayday relay broadcast following trimaran capsize. Support vessel for Walney arrived and recovered two persons from the water who were then winched onboard a Coastguard helicopter.	Web search (4C Offshore, 2018)
Capsize	5 November 2018	Race Bank	Fishing vessel capsized resulting in two persons in the water. Vessel operating at the nearby Race Bank reported to have assisted with the rescue which also involved a Belgian military helicopter and the RNLI.	Web search (British Broadcasting Corporation (BBC), 2018)
Vessel in distress	15 May 2019	London Array	Yacht in difficulty sought shelter by tying up to a 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	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)
Machinery failure	28 September 2019	Race Bank	Fishing vessel suffered mechanical failure and launched flares. Guard vessel and SOV for Race Bank both immediately offered assistance until the MCA's arrival on-scene.	Internal daily progress report received by Anatec
Vessel in distress	13 December 2019	Race Bank	Passing vessel got into difficulty and guard vessel for Race Bank was requested to assist. The Coastguard later requested that the guard vessel tow the casualty vessel into port.	Internal daily progress report received by Anatec
Search	21 May 2020	Walney	Coastguard contacted guard vessel for Walney reporting red flare sighting at the wind farm.	Internal daily progress report

Incident Type	Date	Related Development	Description of Incident	Source
			Guard vessel proceeded to undertake search but did not find anything to report.	received by Anatec
Aircraft crash	15 June 2020	Hornsea Project One	United States of America (USA) jet crashed into sea during routine flight. CTVs and SOVs for Hornsea Project One joined the search for the missing pilot.	Web search (4C Offshore, 2020)
Fire / explosion	15 December 2020	Dudgeon	Fishing vessel experienced explosions on board with crew injured. SOV for Dudgeon deployed its Fast Rescue Boat (FRB) and evacuated the casualty vessel.	Web search (Offshore WIND, 2020)
Vessel in distress	3 July 2021	Robin Rigg	Wind farm CTV fire alarm sounded, with the engine then shut down. A support vessel for Robin Rigg was able to assist in escorting the vessel to port.	Web search (Vessel Tracker, 2021)
Drifting	17 July 2021	Neart na Gaoithe	Small dinghy with two children aboard drifted offshore due to strong winds. A guard vessel associated with Neart na Gaoithe was able to retrieve the children.	Web search (Edinburgh Evening News, 2021)
Allision	9 June 2022	Westermost Rough	Fishing vessel allided with a WTG at Westermost Rough. A supply vessel was among the responders as an RNLI lifeboat escorted the vessel under its own power to port.	Web search (Vessel Tracker, 2022)

It is clear that the presence of OWFs create new emergency response resources which can be mobilised to attend a third-party incident in liaison with HMCG. This includes the Proposed Development (Offshore), with project vessel compliance with international marine regulations including SOLAS (IMO, 1974) and pollution planning included as embedded mitigation measures (see Section 17). Additionally, an ERCoP will be completed post consent in consultation with the MCA.

10 Vessel Traffic Movements

This section presents an analysis of vessel traffic movements in relation to Caledonia OWF and Caledonia OECC. The methodology for vessel traffic data collection including details of the on-site traffic surveys is provided in Section 5.2.

10.1 Array Area

A number of vessel tracks recorded during Caledonia OWF survey periods were classified as temporary (non-routine), such as tracks of the survey vessel and vessels undergoing other surveys within the study area during the data periods. These vessels have therefore been excluded from the analysis.

A plot of the vessel tracks recorded during the 14-day winter survey period in January through February 2023, colour-coded by vessel type and excluding any temporary traffic, is presented in Figure 10.1. Following this, a plot of the vessel tracks recorded during the further 14-day summer survey period in July through August 2023, colour-coded by vessel type and excluding any temporary traffic, is presented in Figure 10.2.

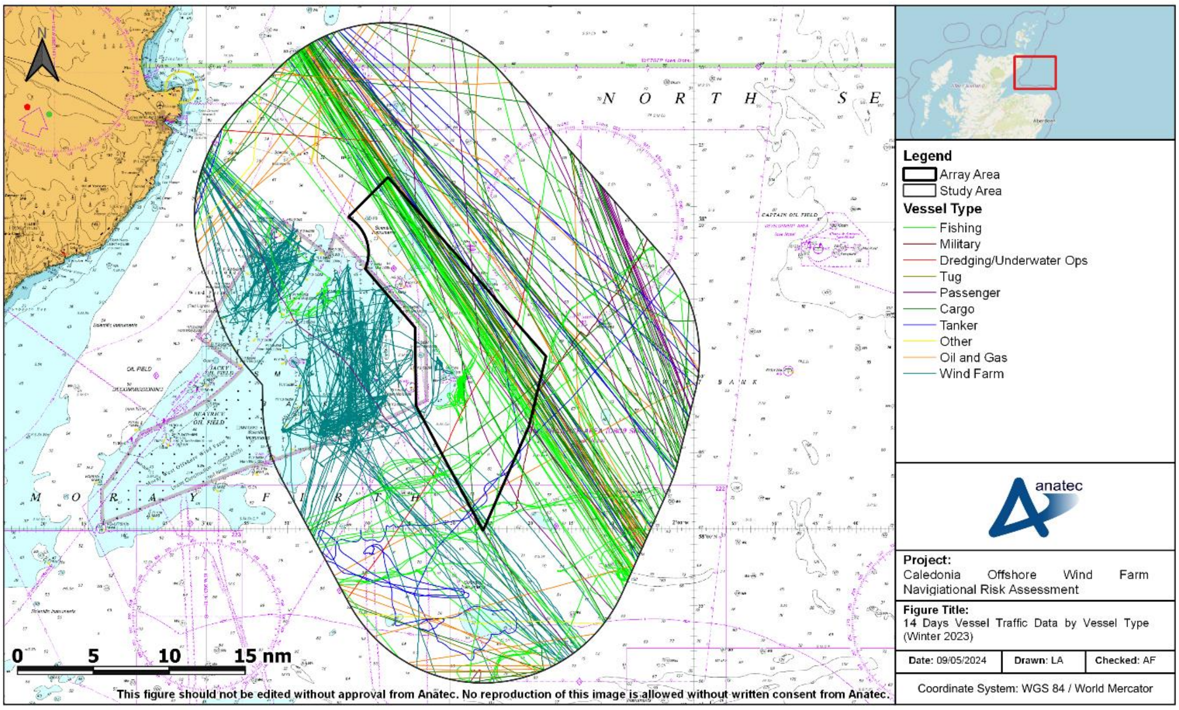

Figure 10.1 14 Days Vessel Traffic Data by Vessel Type (Winter 2023)

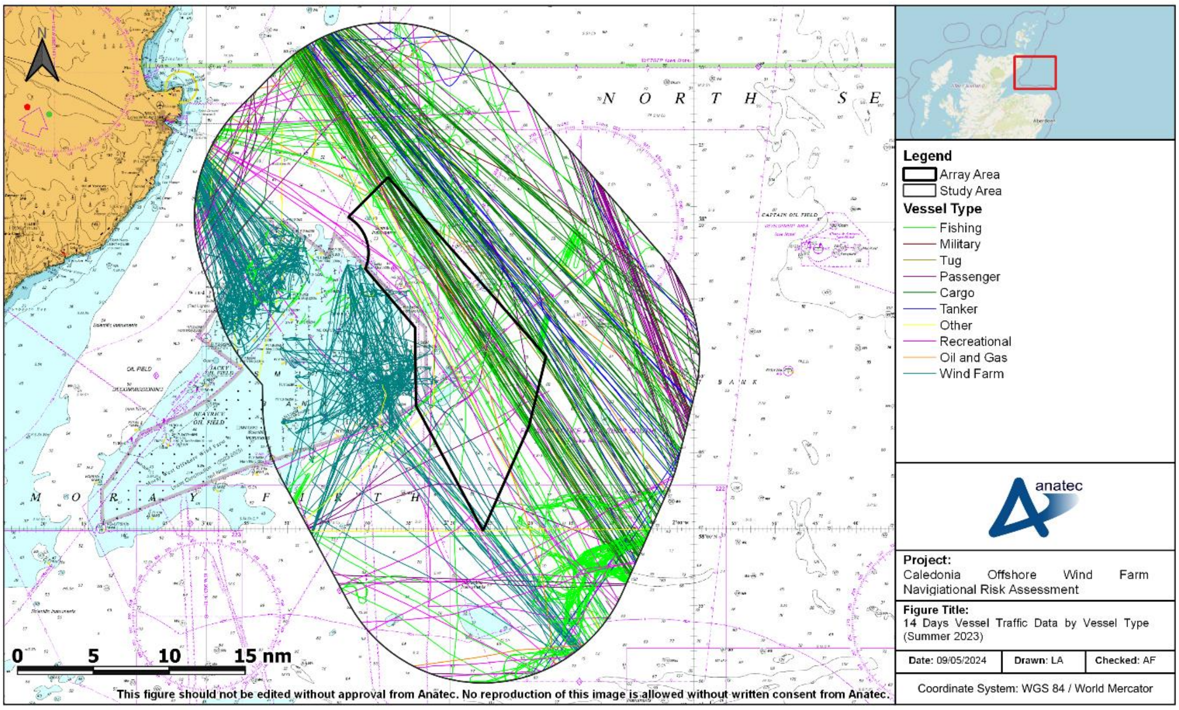

Figure 10.2 14 Days Vessel Traffic Data by Vessel Type (Summer 2023)

Plots of the vessel tracks for the winter and summer survey periods converted to density heat maps are presented in Figure 10.3 and Figure 10.4, respectively. It is noted that the same density brackets were used for both survey periods to allow for direct comparison in vessel density.

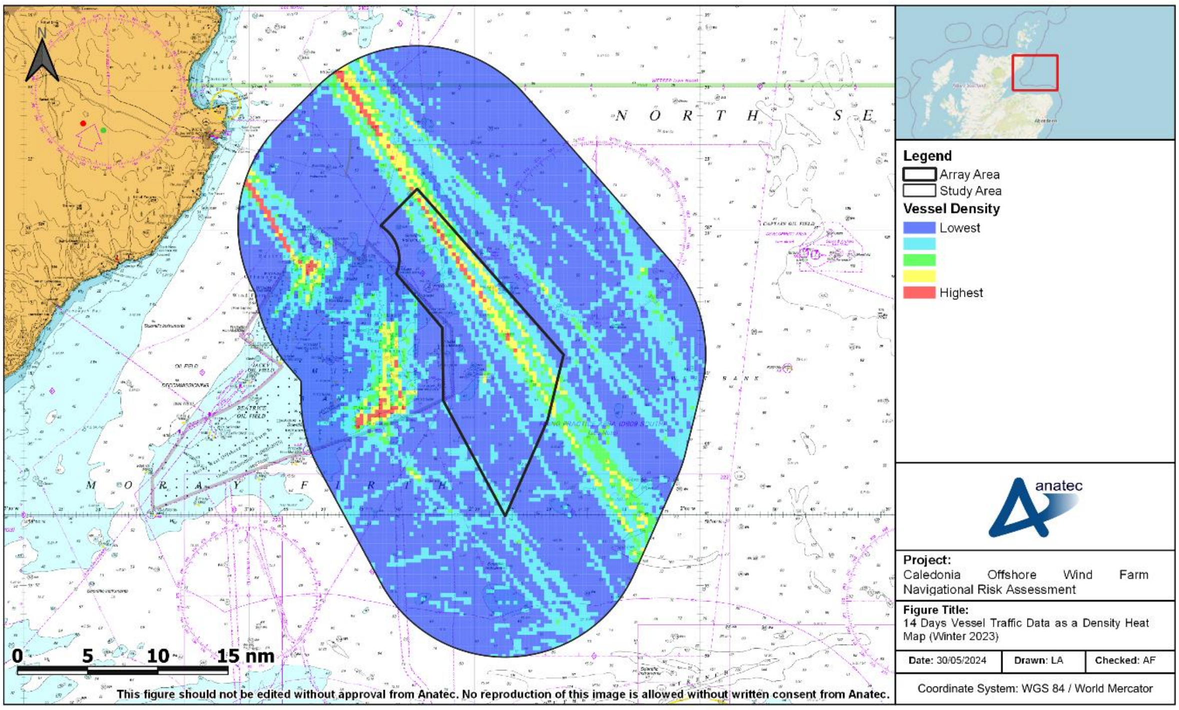

Figure 10.3 14 Days Vessel Traffic Data as a Density Heat Map (Winter 2023)

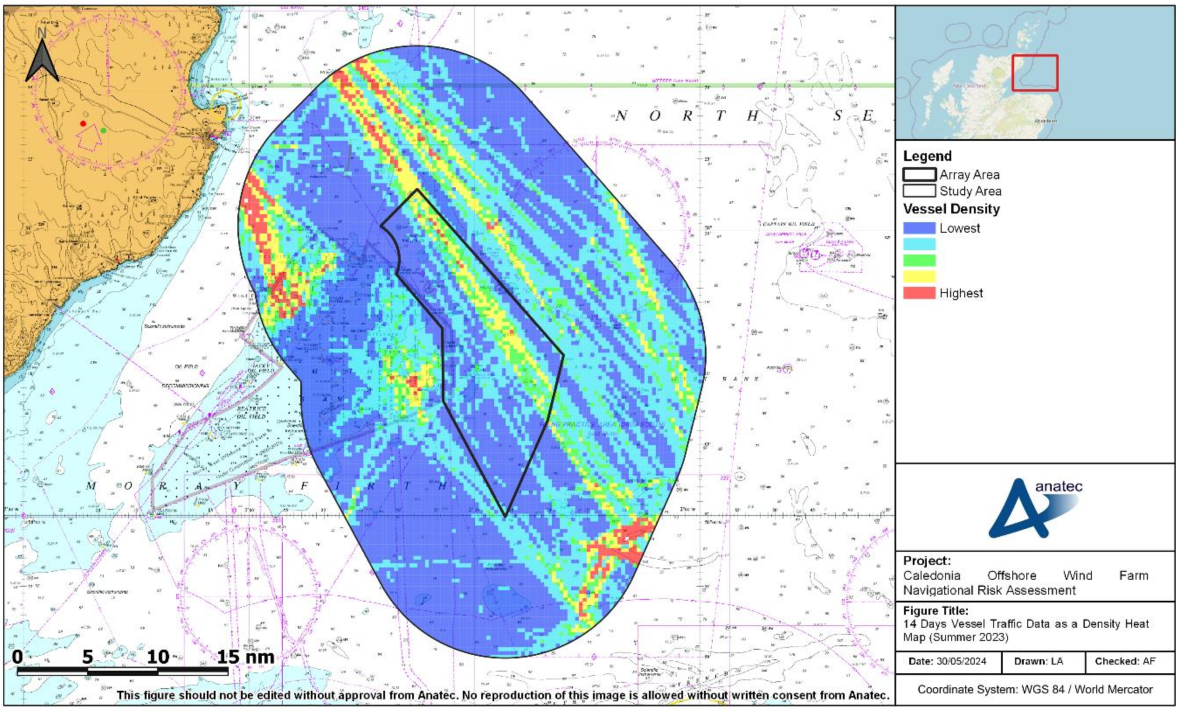

Figure 10.4 14 Days Vessel Traffic Data as a Density Heat Map (Summer 2023)

10.1.1 Vessel Counts

For the 14-days analysed during the winter survey period, there was an average of 17 unique vessels recorded per day within the study area. In terms of vessels intersecting Caledonia OWF itself, there was an average of six to seven unique vessels per day during the survey period. As mentioned in Section 5.2, due to severe weather, the survey vessel had to leave the survey site between the 31 January and the 1 February 2023, and thus additional survey time was appended to make up a total effective survey period of 14 days. Due to this, vessel numbers recorded on these days are not wholly representative of the vessel traffic activity on that day.

The daily number of unique vessels recorded within the study area and Caledonia OWF itself during the winter survey period are presented in Figure 10.5.

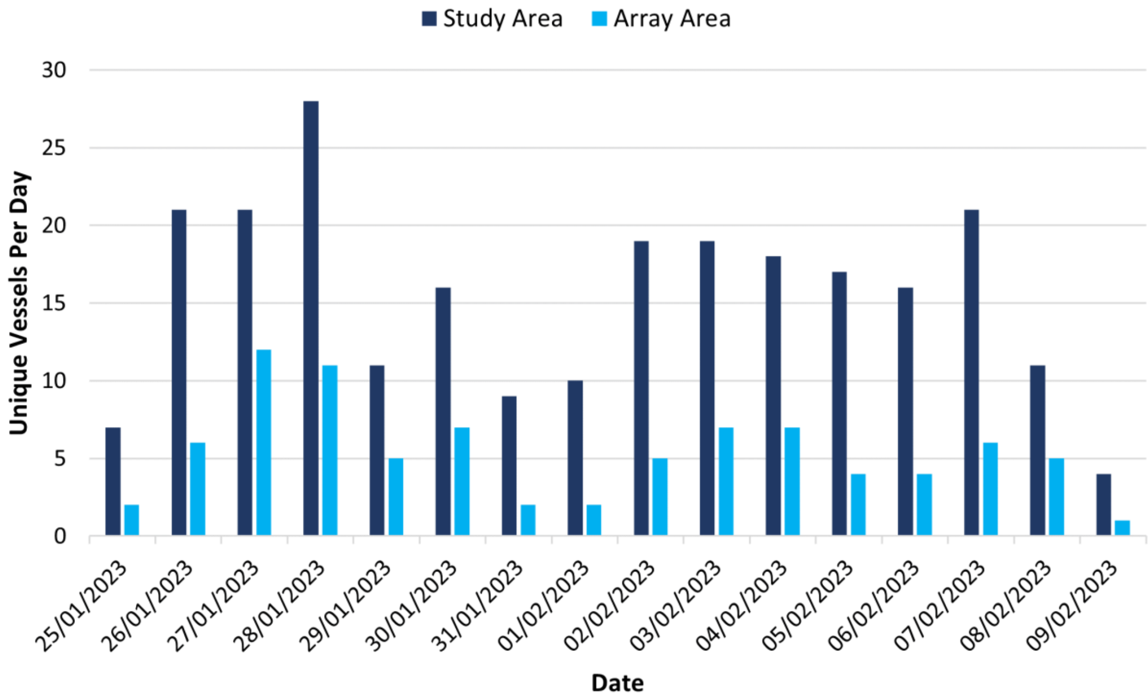

Figure 10.5 Unique Vessels Per Day Within Study Area and Array Area (14 Days Winter 2023)

Throughout the winter survey period, approximately 35% of unique vessel tracks recorded within the study area intersected Caledonia OWF.

The busiest full day recorded within the study area throughout the winter survey period was 28 January 2023, during which 28 unique vessels were recorded. The busiest full day recorded within Caledonia OWF during the winter survey period was 27 January 2023, during which 12 unique vessels were recorded.

The quietest full day recorded within the study area throughout the winter survey period was 29 January and 8 February 2023, during which 11 unique vessels were recorded. The quietest full days recorded within Caledonia OWF during the winter survey period were 5 and 6 February 2023, during each four unique vessels were recorded.

For the 14-days analysed during the summer survey period, there was an average of 29 to 30 unique vessels recorded per day within the study area. In terms of vessels intersecting Caledonia OWF itself, there was an average of seven to eight unique vessels per day during the survey period.

The daily number of unique vessels recorded within the study area and Caledonia OWF itself during the summer survey period are presented in Figure 10.6.

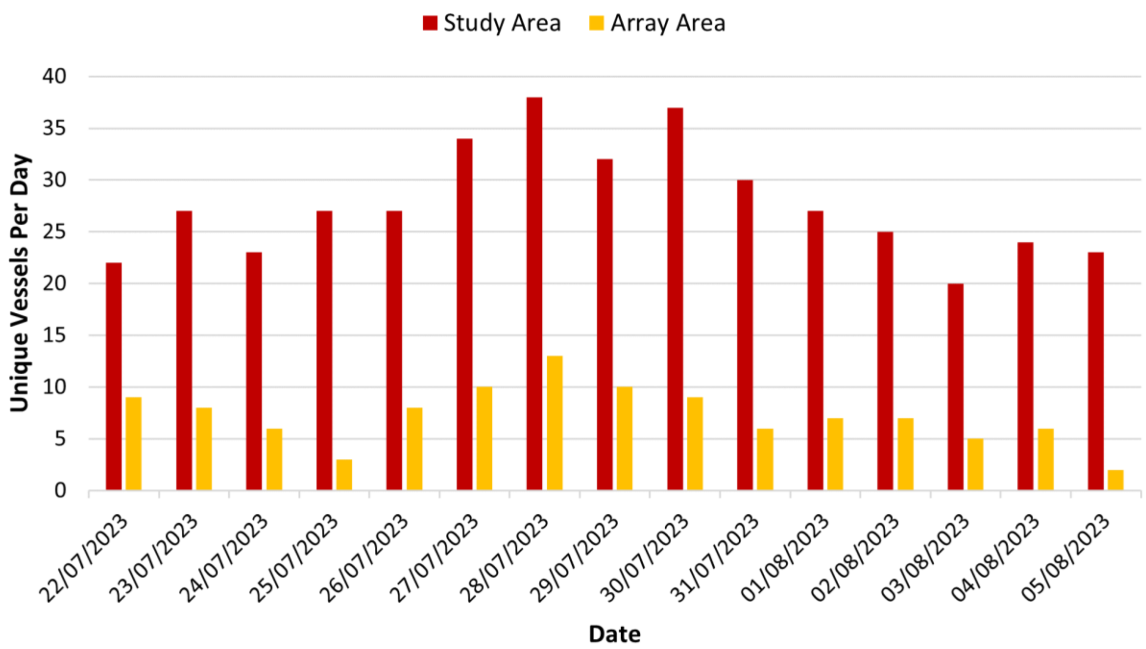

Figure 10.6 Unique Vessels Per Day Within Study Area and Array Area (14 Days Summer 2023)

Throughout the summer survey period, approximately 26% of unique vessel tracks recorded within the study area intersected Caledonia OWF.

The busiest full day recorded within the study area throughout the summer survey period was 28 July 2023, during which 38 unique vessels were recorded. The busiest full day recorded within Caledonia OWF during the summer survey period was also 28 July 2023, during which 13 unique vessels were recorded.

The quietest full day recorded within the study area throughout the summer survey period was 3 August 2023, during which 20 unique vessels were recorded. The quietest full day recorded within Caledonia OWF during the summer survey period was 25 July 2023 during which three unique vessels were recorded.

10.1.2 Vessel Types

The percentage distribution of the main vessel types recorded within the study area and Caledonia OWF is presented in Figure 10.7.

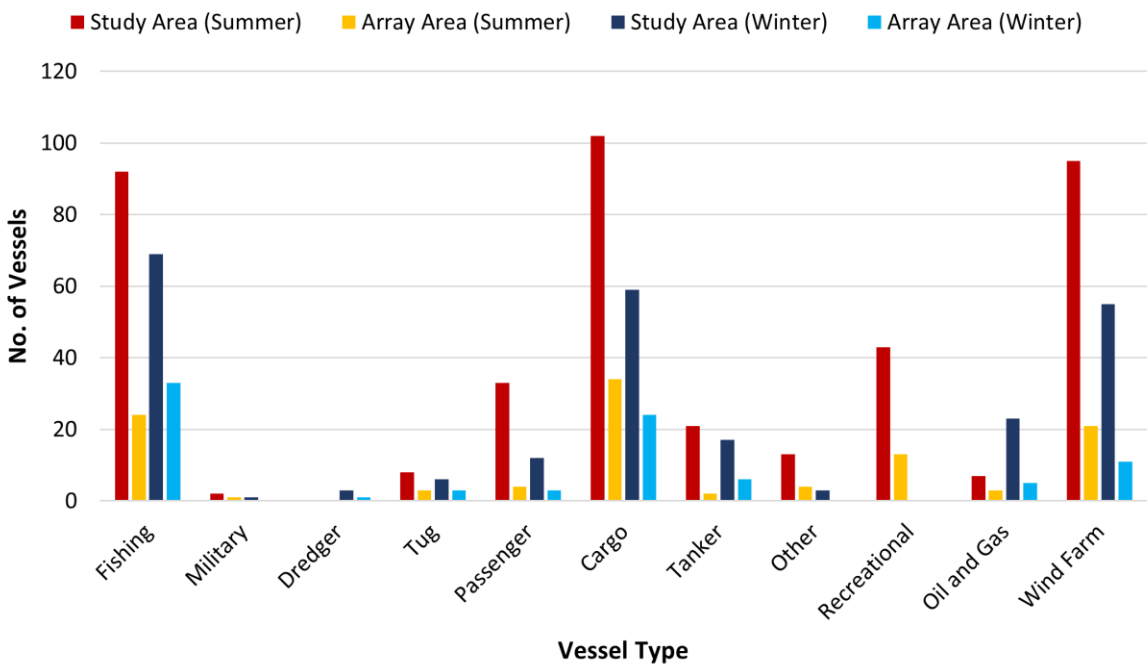

Figure 10.7 Vessel Type Distribution within the Study Area and Array Area (28 Days Winter and Summer 2023)

Throughout the winter survey period, the most common vessel types within the study area were fishing vessels (28%) and cargo vessels (24%). Throughout the summer survey period, the most common vessel types within the study area were cargo vessels (25%) and wind farm vessels (23%). These vessel types were also the most common types to intersect Caledonia OWF during the respective winter and summer survey periods.

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

10.1.2.1 Cargo Vessels

The tracks of cargo vessels within the study area throughout the winter and summer survey periods combined are presented in Figure 10.8.

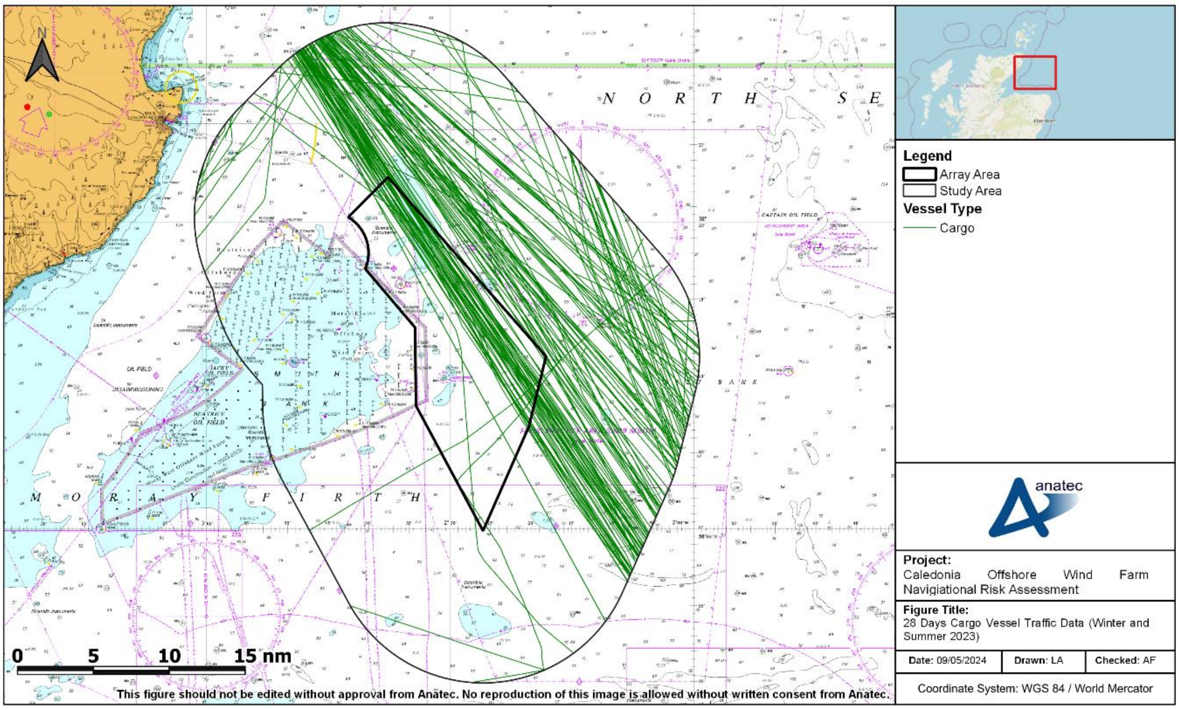

Figure 10.8 28 Days Cargo Vessel Traffic Data (Winter and Summer 2023)

During both survey periods, cargo vessels were noted to transit predominantly on a northwest/southeast course through Caledonia OWF to and from the Pentland Firth, with an additional route on a north/south course within the east of the study area (this route includes Serco NorthLink Ferries, as discussed further below).

During the winter survey period, an average of four to five unique cargo vessels per day were recorded within the study area with an average of one to two unique cargo vessels per day intersecting Caledonia OWF itself. The most common cargo sub types within the study area were Roll-on/Roll-off (RoRo) container carriers (25%), part containerised (24%), and general cargo (19%).

During the summer survey period, an average of between seven and eight unique cargo vessels per day were recorded within the study area with an average of between two and three unique cargo vessels per day intersecting Caledonia OWF. The most common cargo sub types within the study area were bulk carriers (20%), container vessels (20%), and RoRo container carriers (18%).

Regular routeing involving RoRo vessels was recorded within the study area and was attributed to vessels operated by Smyril Line and Serco NorthLink Ferries. Smyril Line vessels were seen routeing between the Netherlands, Iceland, and the Faroe Islands, whilst Serco NorthLink Ferries vessels were noted to transit between Kirkwall (UK) and Aberdeen (UK) and are shown in Figure 10.9. These routes were also identified within the long-term dataset (see Appendix E).

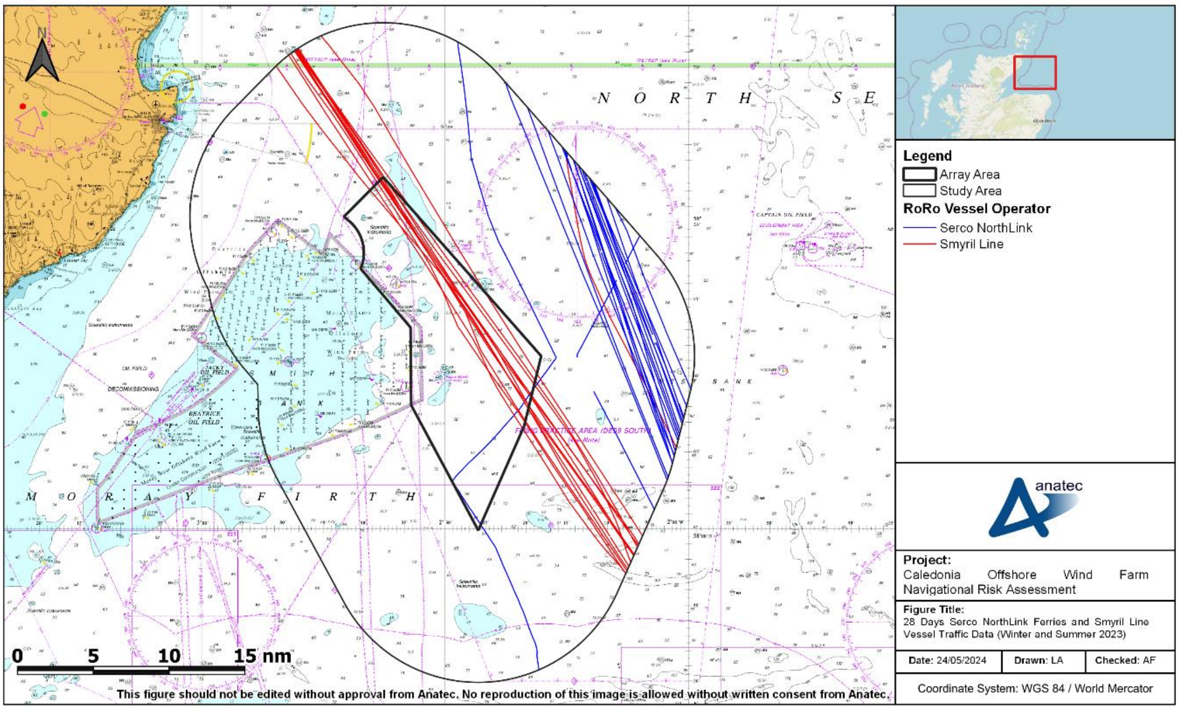

Figure 10.9 28 Days Serco NorthLink and Smyril Line Vessel Traffic Data (Winter and Summer 2023)

10.1.2.2 Fishing Vessels

As a general rule, fishing vessels transiting below 6kts have the potential to be actively fishing. The tracks of fishing vessels recorded within the study area throughout both survey periods are presented in Figure 10.10, colour-coded by average vessel speed.

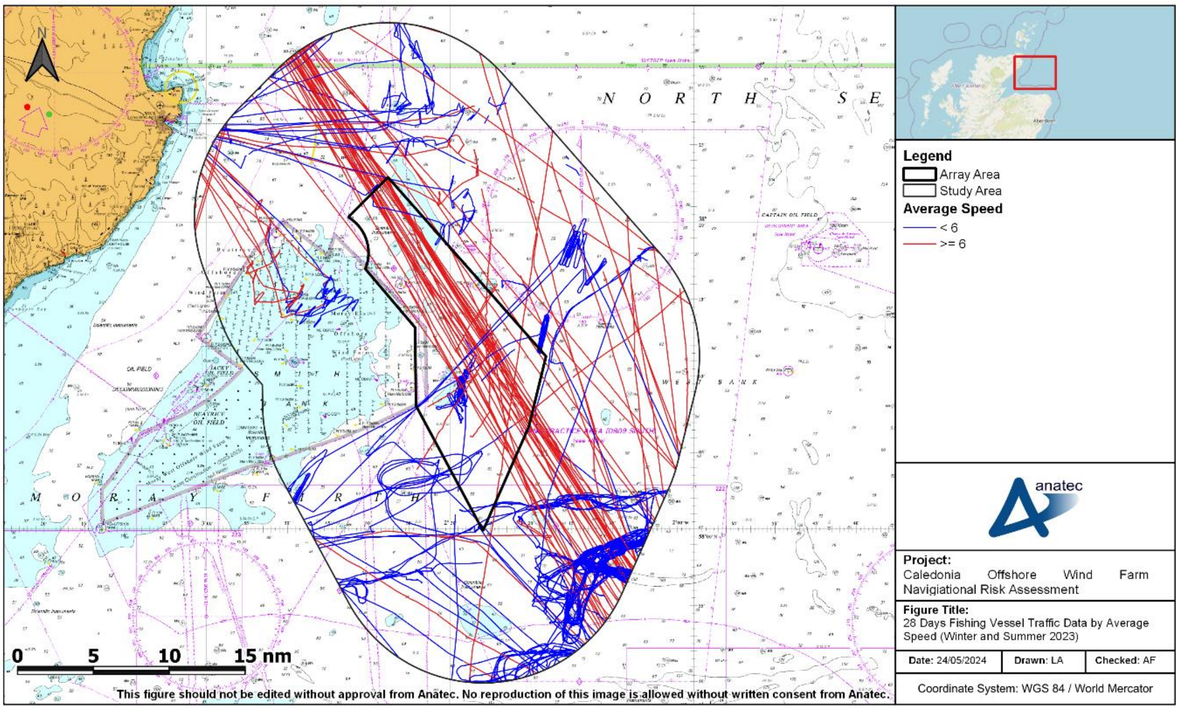

Figure 10.10 28 Days Fishing Vessel Traffic Data by Average Speed (Winter and Summer 2023)

Fishing vessels can be seen throughout the study area as well as transiting on a northwest/southeast course through Caledonia OWF.

During the winter survey period, an average of four to five unique fishing vessels per day were recorded within the study area with an average of two to three unique fishing vessels per day intersecting Caledonia OWF. Many fishing vessels displayed potential active fishing behaviour, which was notable throughout the study area, although slightly more prominent to the west of Caledonia OWF. Notable gear types within the study area include demersal (otter) trawlers which accounted for approximately 58% of known gear types, as well as pelagic trawlers which accounted for approximately 34%.

Fishing vessels were more common during the summer survey period, with an average of six to seven unique fishing vessels per day recorded within the study area, and an average of between one and two unique fishing vessels per day intersecting Caledonia OWF. Potential active fishing behaviour was most notable to the south and east of Caledonia OWF during summer. Notable gear types within the study area included demersal (otter) trawlers which accounted for approximately 85% of known gear types.

In addition to the vessel traffic survey data, Vessel Monitoring System data can provide a wider picture of fishing activity within and around Caledonia OWF. VMS data recorded within the study area throughout 2023 was analysed, and all vessels recorded on VMS were operating below 6kts. A plot of this VMS data is presented in Figure 10.11.

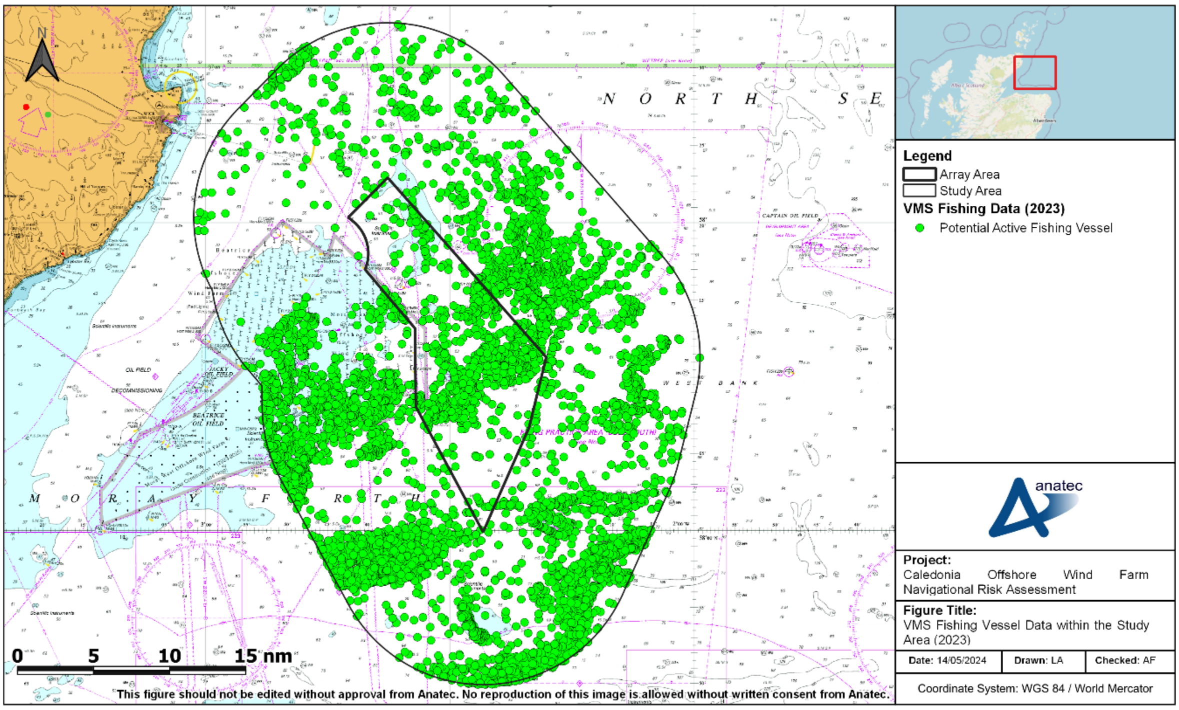

Figure 10.11 VMS Fishing Vessel Data within the Study Area

As can be seen, the highest fishing vessel activity occurs in the southern extent of the study area with notable activity within Moray East OWF as well as within Caledonia OWF itself. This correlates well with the long-term AIS data for fishing vessels presented in Appendix E.

10.1.2.3 Wind Farm Vessels

The tracks of wind farm vessels recorded within the study area throughout both survey periods are presented in Figure 10.12.

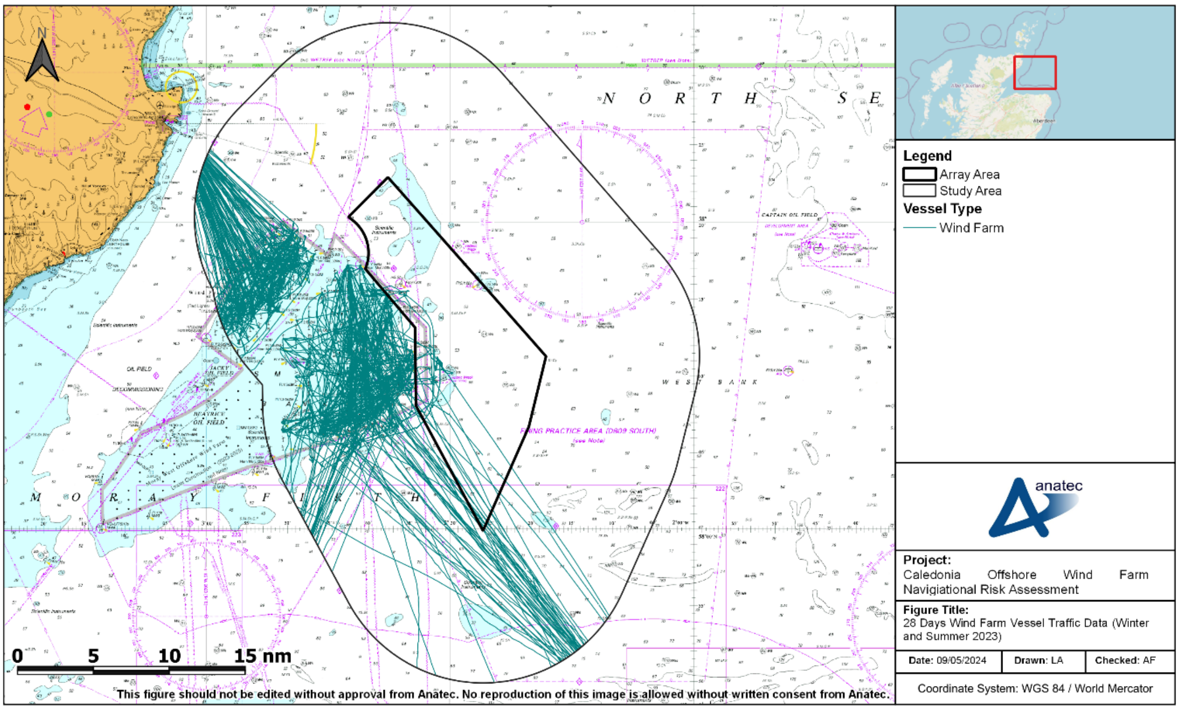

Figure 10.12 28 Days Wind Farm Vessel Traffic Data (Winter and Summer 2023)

Wind farm vessels were heavily prominent within the study area during both survey periods due to the presence of Beatrice OWF and Moray East OWF. During the winter survey period there was between three and four unique wind farm vessels recorded per day within the study area, and one recorded every one to two days within Caledonia OWF.

During the summer survey period, between six and seven unique wind farm vessels were recorded per day within the study area, and between one and two recorded per day within Caledonia OWF itself.

Vessels noted within the study area operate out of Fraserburgh (UK), Wick (UK), and Buckie (UK), with the majority of those intersecting Caledonia OWF operating out of Fraserburgh.

10.1.2.4 Passenger Vessels

The tracks of passenger vessels recorded within the study area throughout both survey periods are presented in Figure 10.13.

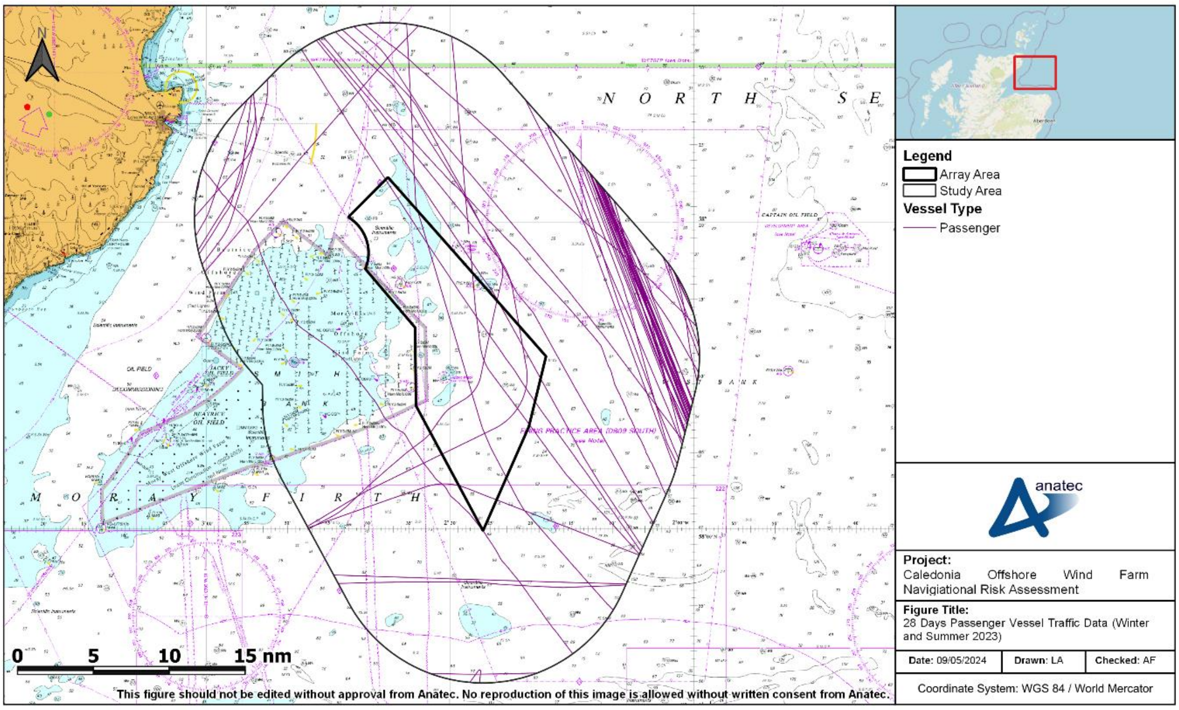

Figure 10.13 28 Days Passenger Vessel Traffic Data (Winter and Summer 2023)

Passenger vessels were observed throughout the study area during both survey periods with a clear route observed to the east of Caledonia OWF. This was primarily attributed to Serco NorthLink Ferries Roll-on/Roll-off passenger (RoPax) vessels on route between Aberdeen and Kirkwall.

During the winter survey period, one unique passenger vessel was recorded every one to two days within the study area, with one recorded every four to five days within Caledonia OWF itself. Whereas during the summer period, approximately between two and three unique passenger vessels were recorded per day within the study area, with one recorded in Caledonia OWF every three to four days.

10.1.2.5 Recreational Vessels

The tracks of recreational vessels recorded within the study area throughout both survey periods are presented in Figure 10.14.

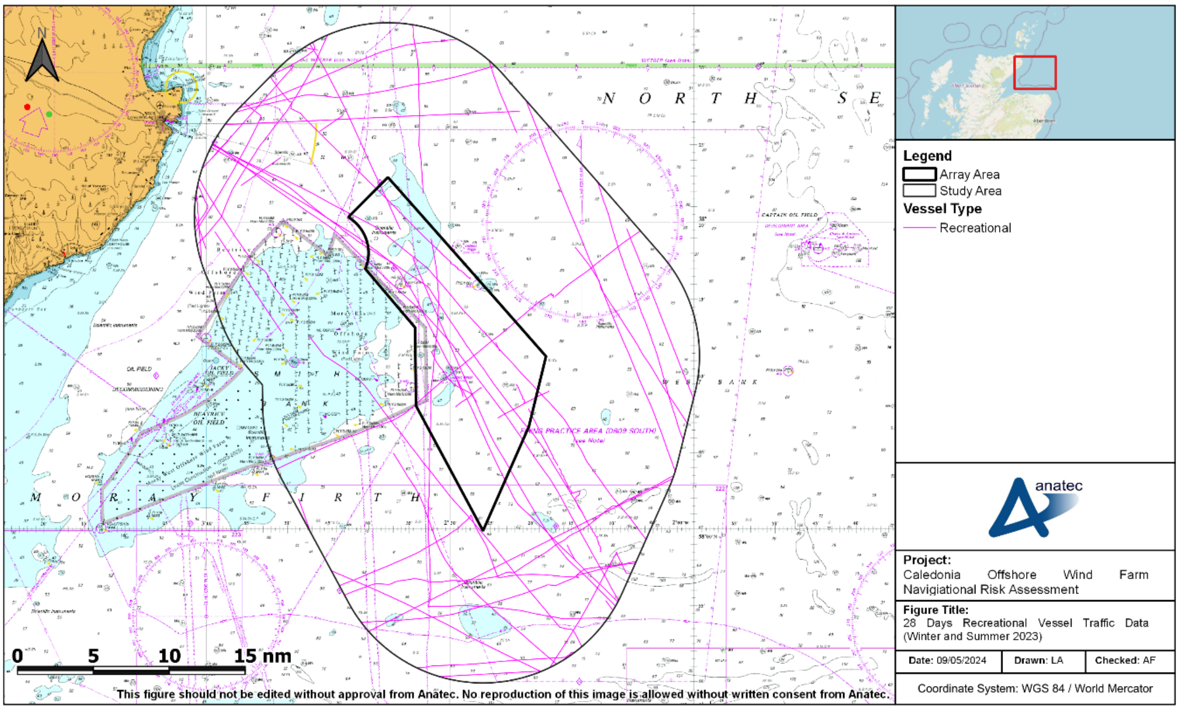

Figure 10.14 28 Days Recreational Vessel Traffic Data (Winter and Summer 2023)

During the summer survey period, recreational activity was observed throughout the study area and Array Area, with approximately three unique recreational vessels recorded per day within the study area, and approximately one per day within Caledonia OWF itself. No recreational vessels were recorded during the winter survey period.

In addition to the vessel traffic survey data, the RYA Coastal Atlas of Recreational Boating (RYA, 2019 (a)) has been reviewed for the region. The RYA Coastal Atlas may be used to "*help identify and protect areas of importance to recreational boaters, to advise on new development proposals and in discussions over navigational safety*". The RYA Coastal Atlas includes a heat map indicating the density of recreational activity around the UK coast as well as features relevant to recreational boating such as general boating areas, clubs, training centres and marinas.

Figure 10.15 presents the RYA Coastal Atlas heat map relative to the Array Area and OECC. Following this, Figure 10.16 presents the RYA features relevant to recreational boating.

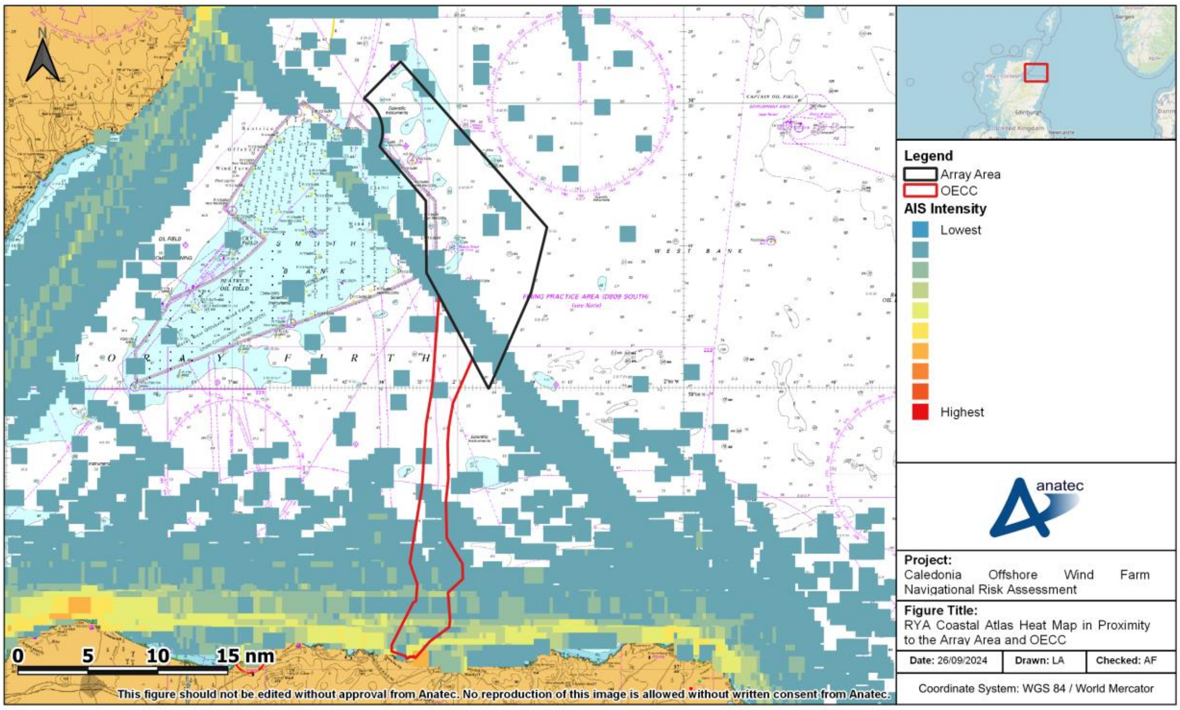

Figure 10.15 RYA Coastal Atlas Heat Map in Proximity to the Array Area and OECC

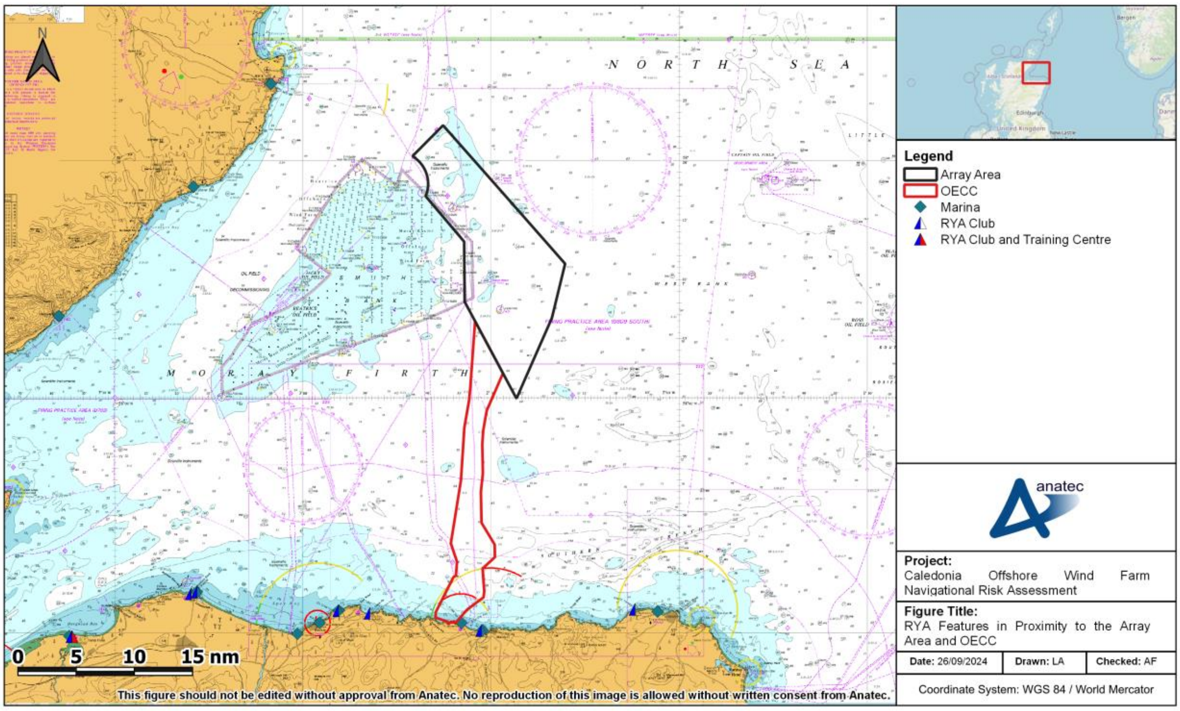

Figure 10.16 RYA Features in Proximity to the Array Area and OECC

Higher density of recreational traffic is noted close to the coast within the Moray Firth. The areas of highest density generally align with key RYA recreational boating features such as RYA Clubs and marinas. Lossiemouth and Banff are key hotspots for recreational users, with both locations hosting at least one RYA Club and one marina. The closest marina to the OECC is located at Whitehills, approximately 0.4nm to the east of the OECC. The nearest RYA Club to the OECC is at Banff at approximately 2.3nm to the east of the OECC landfall.

Wick hosts the closest marina to the Array Area, at 13.4nm northwest. Banff and Fraserburgh host the nearest RYA Clubs to the Array Area, at 20nm south and 21nm southeast of the Array Area respectively. The closest RYA Club and Training Centre to the Array Area is at Thurso, which also hosts a marina, at 31.2nm northwest. The nearest RYA Club and Training Centre to the OECC is located at Findhorn, approximately 31.2nm west of the OECC landfall, where a marina is also located.

10.1.3 Vessel Size

10.1.3.1 Vessel Length

Vessel length information was available for 99% of all vessels recorded throughout the combined winter and summer survey periods. A plot of all vessel tracks (excluding temporary traffic) recorded within the study area throughout the survey periods, colour-coded by length, is presented in Figure 10.17. Following this, the distribution of these length classes, by survey period, is presented in Figure 10.18.

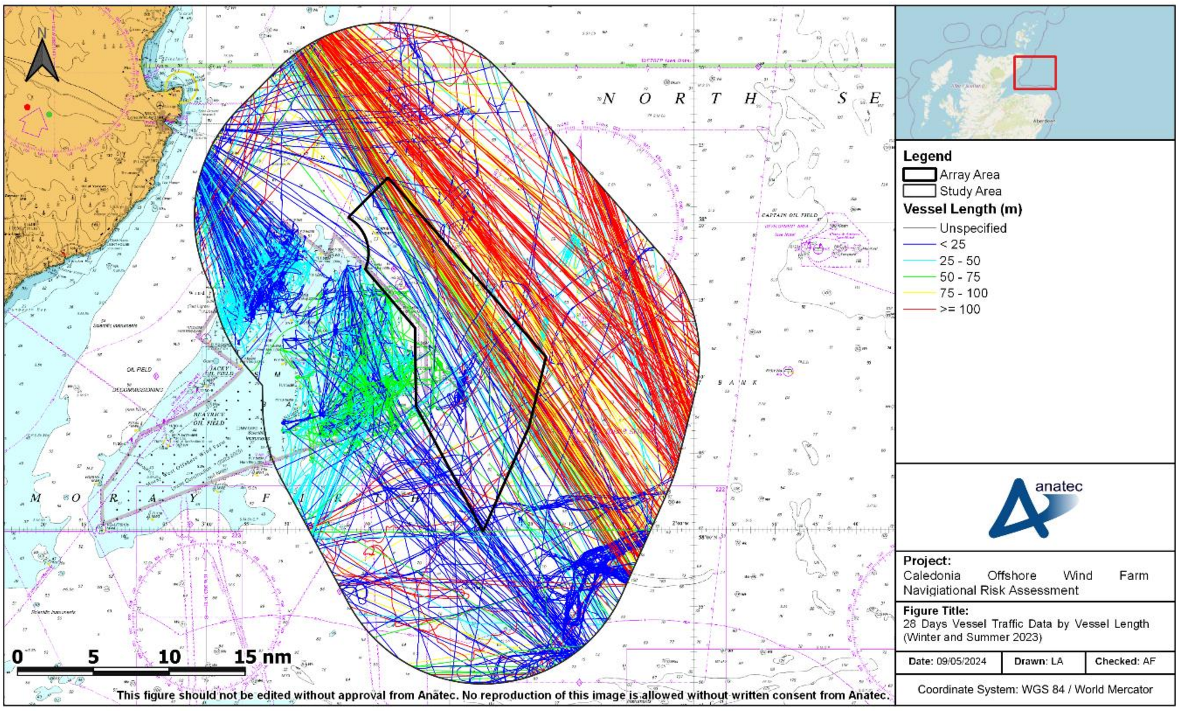

Figure 10.17 28 Days Vessel Traffic Data by Vessel Length (Winter and Summer 2023)

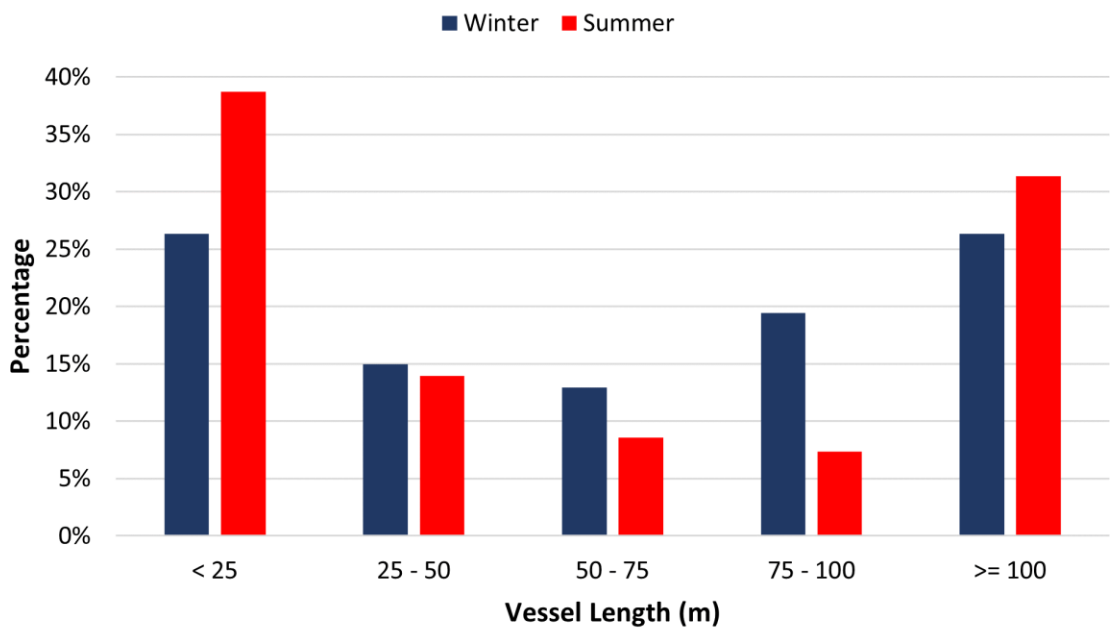

Figure 10.18 28 Days Vessel Length Distribution within Study Area (Winter and Summer 2023)

Excluding the proportion of vessels for which length information was not available, the average length of vessels within the study area was 74m and 80m for the winter and summer surveys respectively. Over the survey periods, vessel length ranged between an 8m search and rescue vessel and a 333m cruise liner vessel.

Vessels of greater lengths were primarily cargo vessels, passenger vessels and tankers with vessels of smaller lengths being fishing vessels and wind farm vessels.

10.1.3.2 Vessel Draught

Vessel draught information was available for 86% of all vessels recorded throughout the combined summer and winter survey periods. A plot of all vessel tracks (excluding temporary traffic) recorded within the study area throughout the survey periods, colour-coded by vessel draught, is presented in Figure 10.19. Following this, the distribution of these draught classes is presented in Figure 10.20.

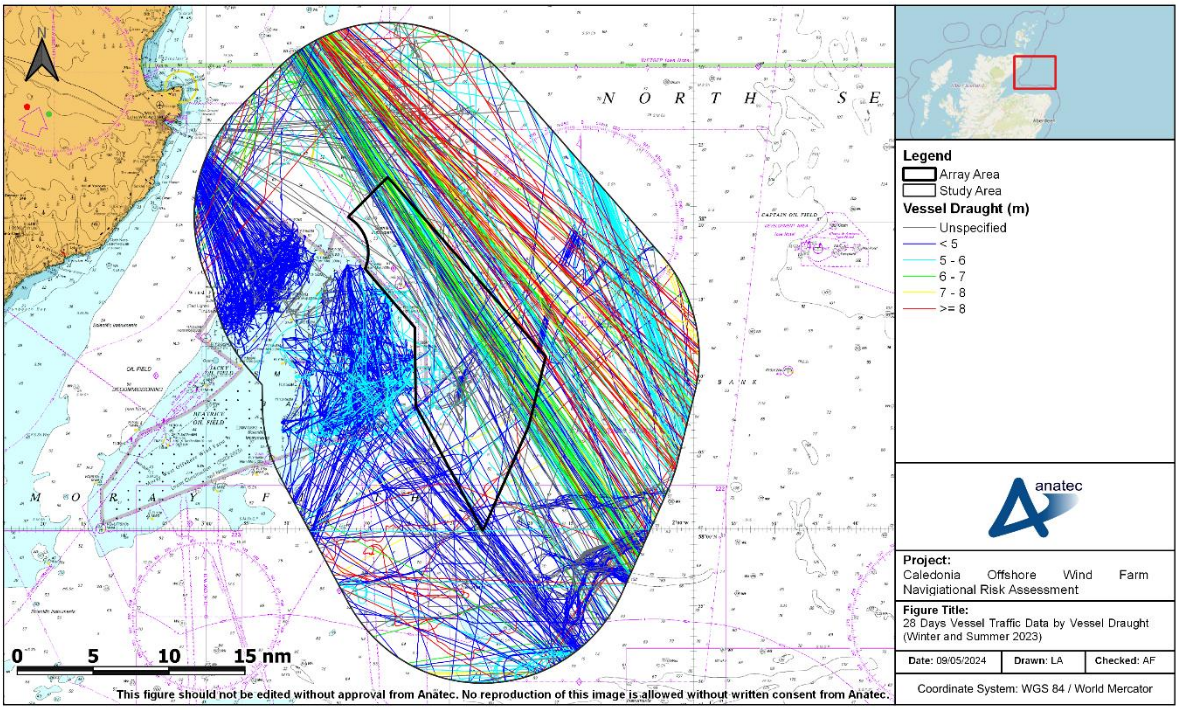

Figure 10.19 28 Days Vessel Traffic Data by Vessel Draught (Winter and Summer 2023)

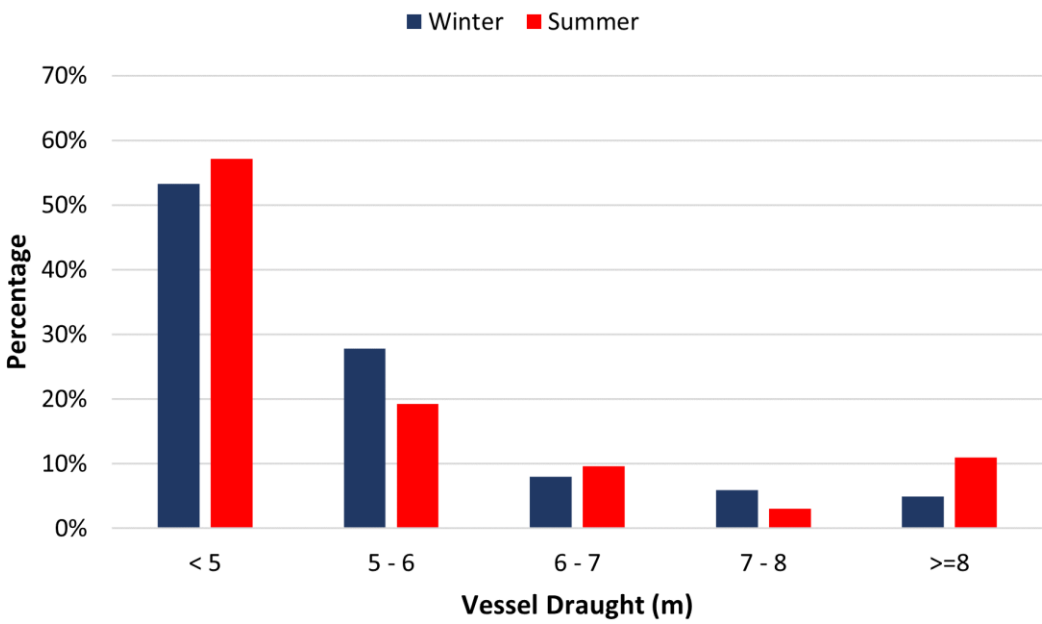

Figure 10.20 28 Days Vessel Draught Distribution within Study Area (Winter and Summer 2023)

Excluding the proportion of vessels for which vessel draught was not available, the average draught of vessels within the study area was 4.1m and 4.3m for the winter and summer survey periods respectively. Over the survey periods, transmitted draughts ranged between 1m for a wind farm vessel and 14.6 m for a container carrier.

Vessels of greater draughts were primarily cargo vessels and tankers whilst vessels of smaller draughts were fishing vessels and wind farm vessels.

10.1.4 Anchoring Activity

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 1kt for more than 30 minutes had their corresponding vessel tracks individually checked for patterns characteristic of anchoring activity. After applying these criteria, no vessels were deemed to be at anchor within the study area.

10.2 Offshore Export Cable Corridor

This section presents an overview of vessel traffic movements within the OECC study area based on AIS data alone. A number of tracks recorded during the data periods were classified as temporary (non-routine). These vessels have been excluded from the analysis in line with the approach taken for the assessment of Caledonia OWF (Section 10.1).

A plot of vessel tracks recorded during the 14-day data period in January through February 2023 (winter), colour-coded by vessel type and excluding any temporary traffic, is presented in Figure 10.21. A plot of vessel tracks recorded during the 14-day data period in July through August 2023 (summer), colour-coded by vessel type, is presented in Figure 10.22.

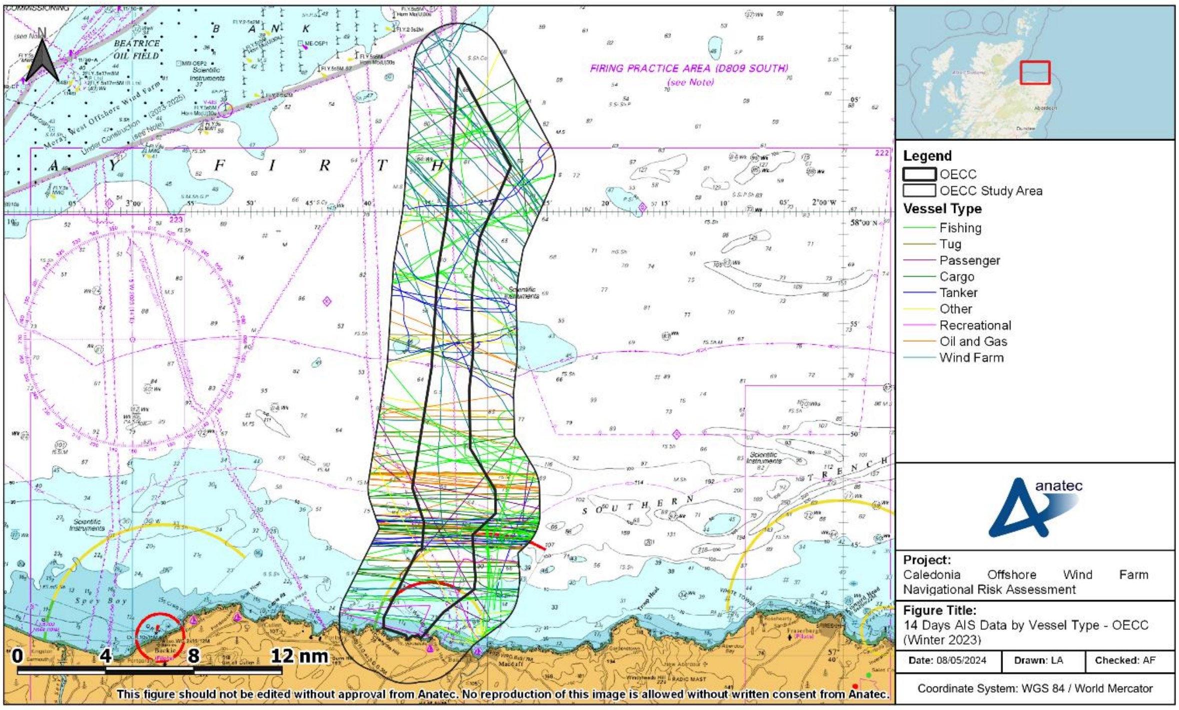

Figure 10.21 Vessel Traffic Data within OECC Study Area by Vessel Type (14 Days Winter 2023)

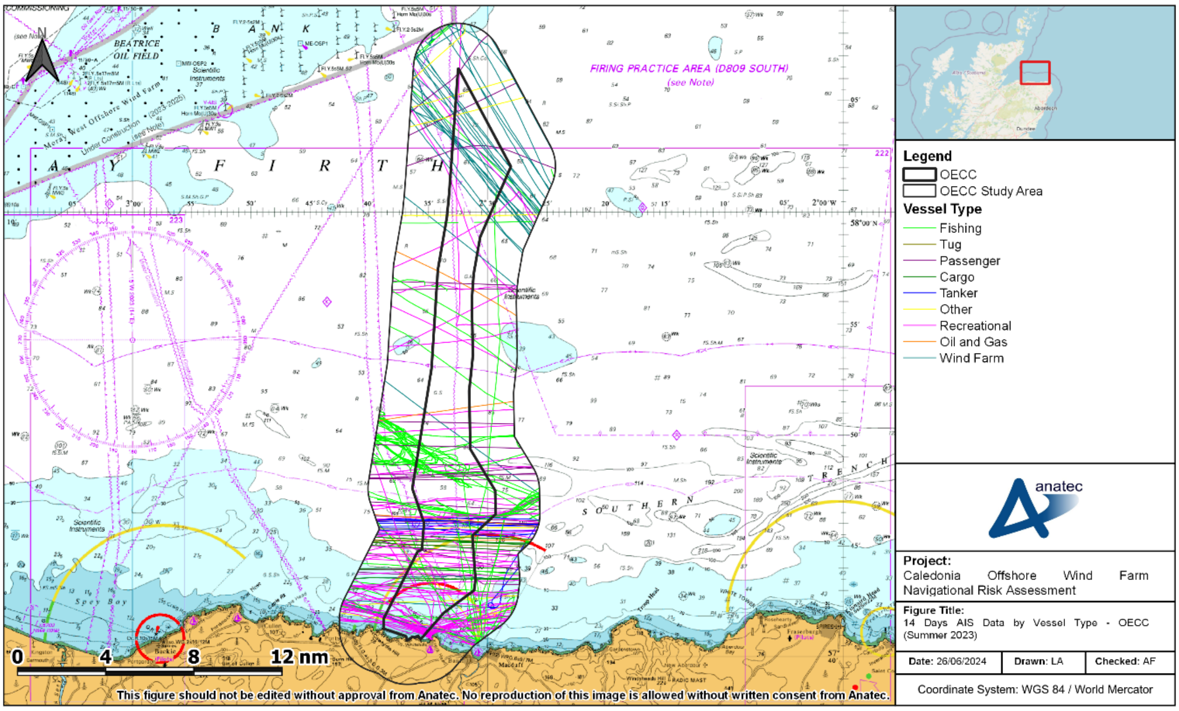

Figure 10.22 Vessel Traffic Data within OECC Study Area by Vessel Type (14 Days Summer 2023)

Plots of the vessel tracks for the winter and summer data periods converted to a density heat map are presented in Figure 10.23 and Figure 10.24 respectively. It is noted that the same density brackets were used for both data periods as well as in relation to Caledonia OWF to allow for direct comparison in vessel density.

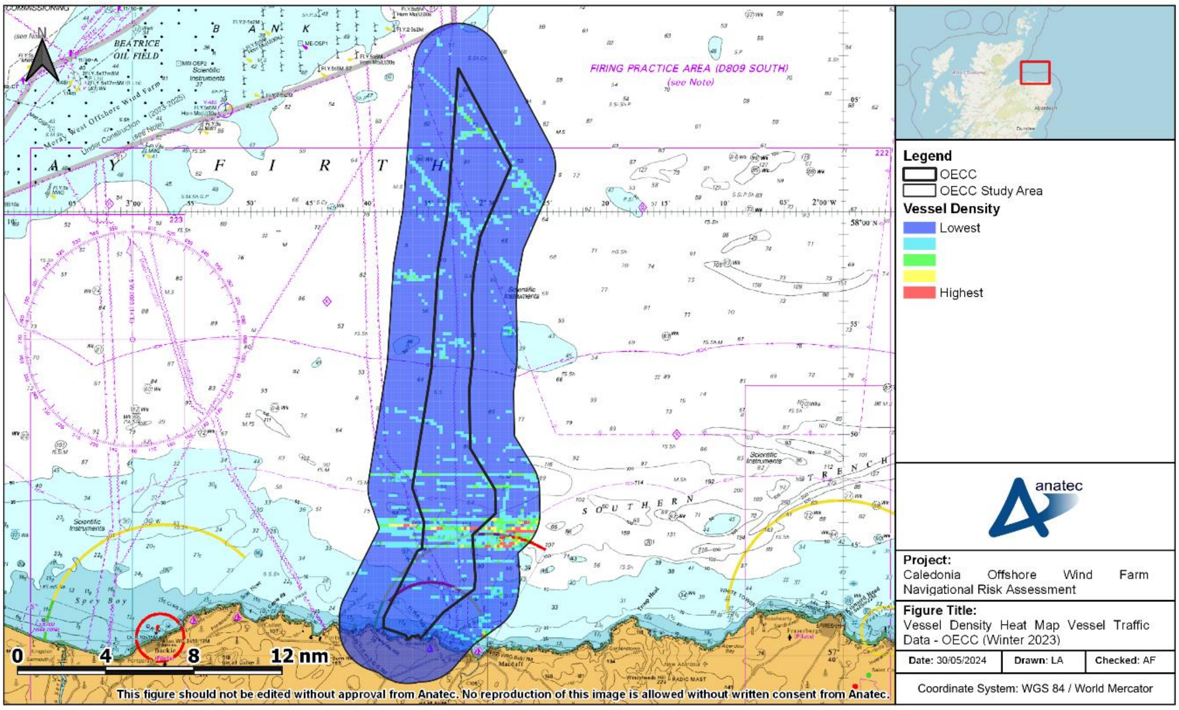

Figure 10.23 Vessel Density Heat Map within the OECC Study Area (14 Days Winter 2023)

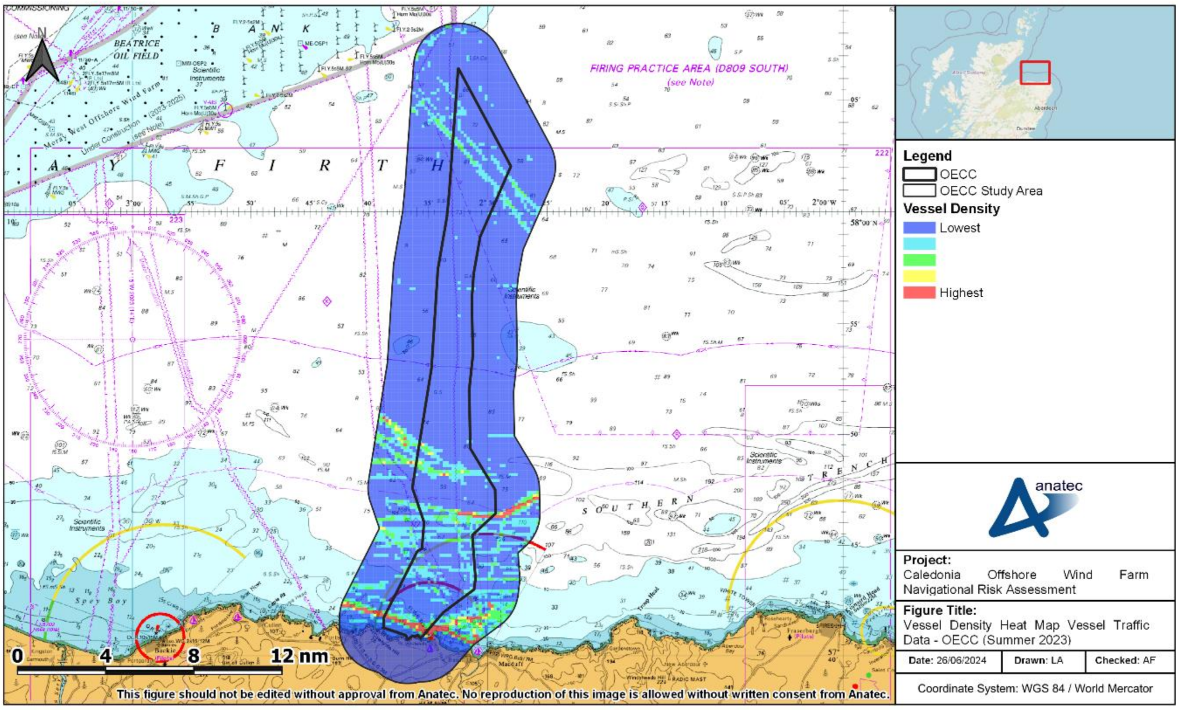

Figure 10.24 Vessel Density Heat Map within the OECC Study Area (14 Days Summer 2023)

10.2.1 Vessel Counts

For the 14 days analysed during the winter data period, there was an average of 11 unique vessels recorded per day within the OECC study area. In terms of vessels intersecting the Caledonia OECC itself, there was an average of nine unique vessels per day within the Caledonia OECC during the data period.

The daily number of unique vessels recorded within the OECC study area and the Caledonia OECC itself during the winter data period are presented in Figure 10.25.

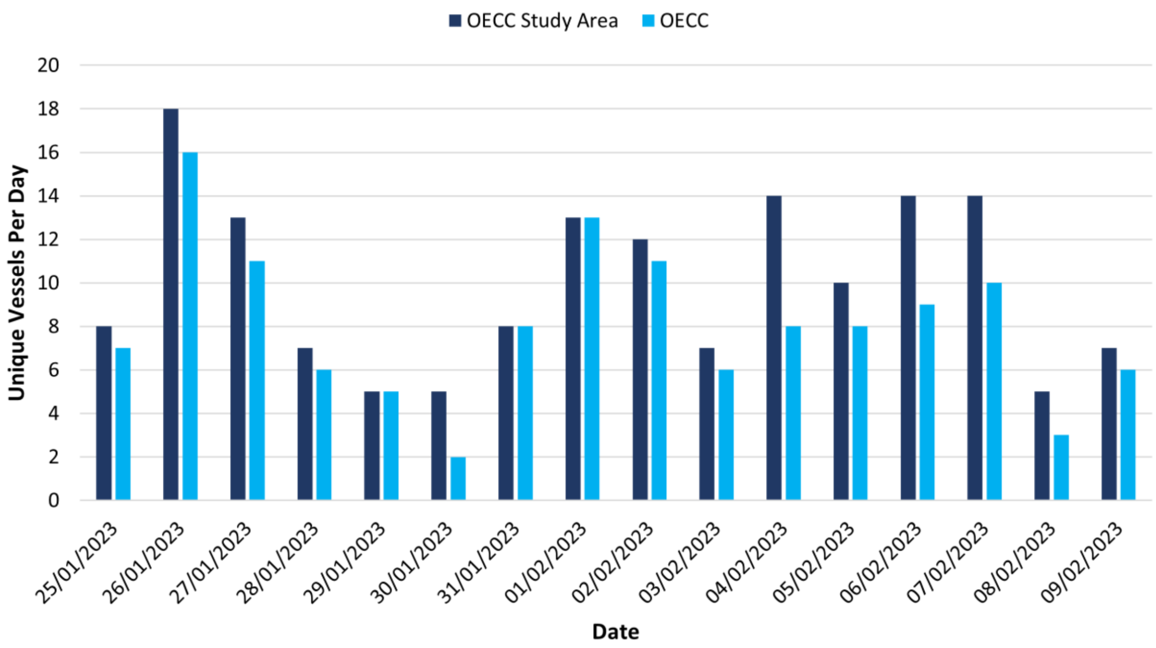

Figure 10.25 Unique Vessels per Day within OECC Study Area and Caledonia OECC (14 Days Winter 2023)

Approximately 80% of vessel tracks recorded within the OECC study area intersected the Caledonia OECC during the winter period.

The busiest day recorded during winter was the 26 January 2023, during which 18 unique vessels were recorded within the OECC study area and 16 were recorded within the Caledonia OECC itself. The quietest day was the 30 January 2023, where five unique vessels were recorded within the OECC study area, and only two were recorded within the Caledonia OECC itself.

For the 14 days analysed during the summer data period, there was an average of 14 unique vessels recorded per day within the OECC study area. In terms of vessels intersecting the Caledonia OECC itself, there was an average of 11 unique vessels per day within the Caledonia OECC during the data period.

The daily number of unique vessels recorded within the OECC study area and the Caledonia OECC itself during the summer data period are presented in Figure 10.26.

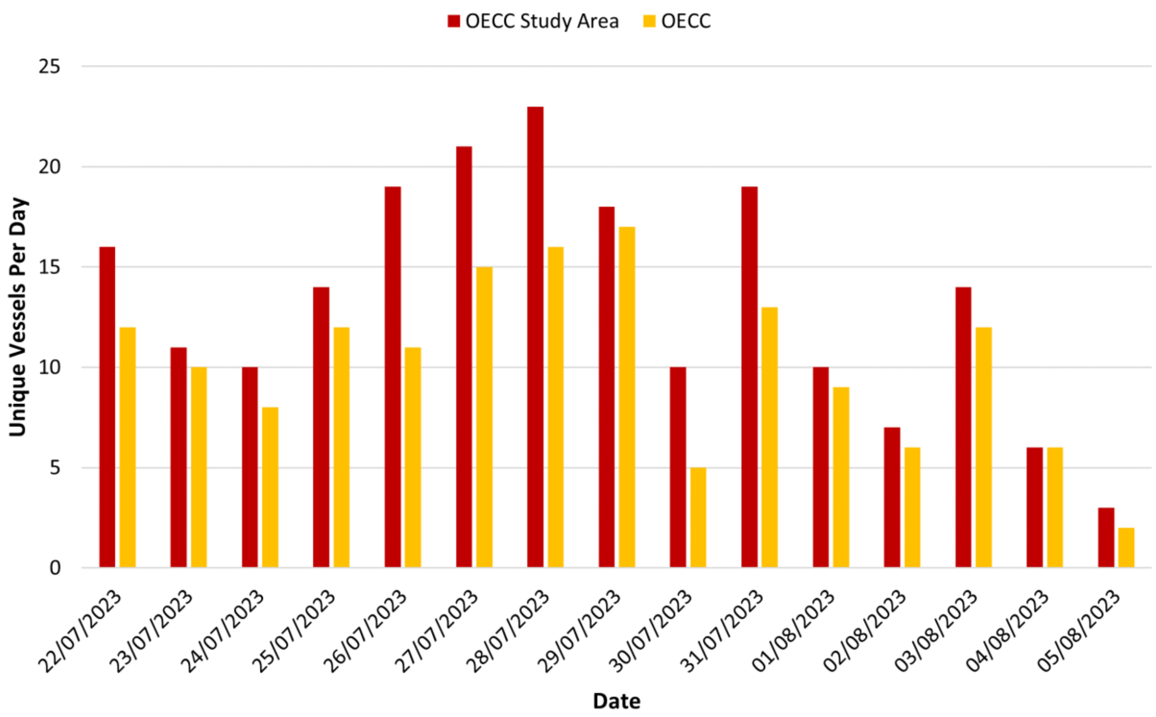

Figure 10.26 Unique Vessels per Day within the OECC Study Area and Caledonia OECC (14 Days Summer 2023)

Approximately 77% of vessel tracks recorded within the OECC study area intersected the Caledonia OECC during the summer period.

The busiest day recorded within the Caledonia OECC during summer was the 28 July 2023, during which 23 unique vessels were recorded within the OECC study area and 16 were recorded within the Caledonia OECC itself. The quietest day was the 5 August 2023, where three unique vessels were recorded within the OECC study area, and only two were recorded within the Caledonia OECC.

10.2.2 Vessel Type

The percentage distribution of the main vessel types recorded within the OECC study area and the Caledonia OECC itself is presented in Figure 10.27.

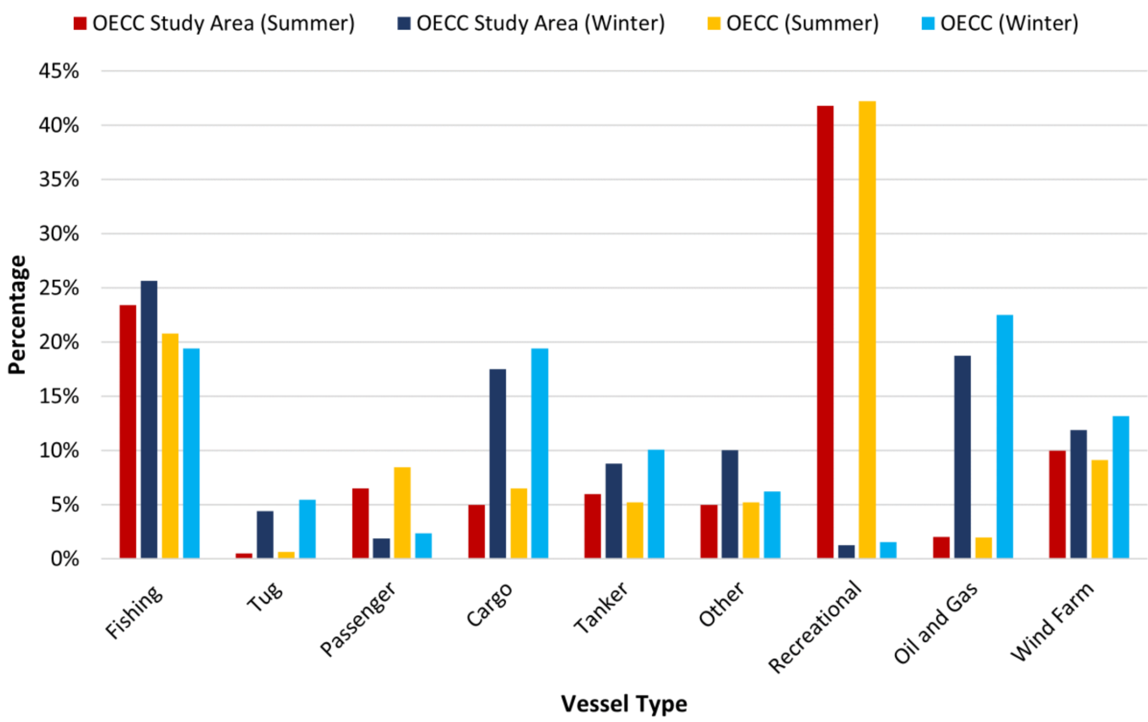

Figure 10.27 Vessel Type Distribution within OECC Study Area and Caledonia OECC (28 Days Winter and Summer 2023)

Throughout the summer data period, the most common vessel types within the OECC study area were recreational vessels (42%), fishing vessels (23%), and wind farm vessels (10%). Throughout the winter data period, the most common vessel types within the OECC study area were fishing vessels (26%), oil and gas vessels (19%), and cargo vessels (18%). Within the Caledonia OECC itself, the most common vessel types followed the same trends as the OECC study area for each data period, with the exception of oil and gas vessels being the most common within the Caledonia OECC during the winter period.

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

10.2.2.1 Recreational Vessels

The tracks of recreational vessels within the OECC study area throughout the summer and winter data periods combined are presented in Figure 10.28. Analysis of the RYA Coastal Atlas is provided in Section 10.1.2.5.

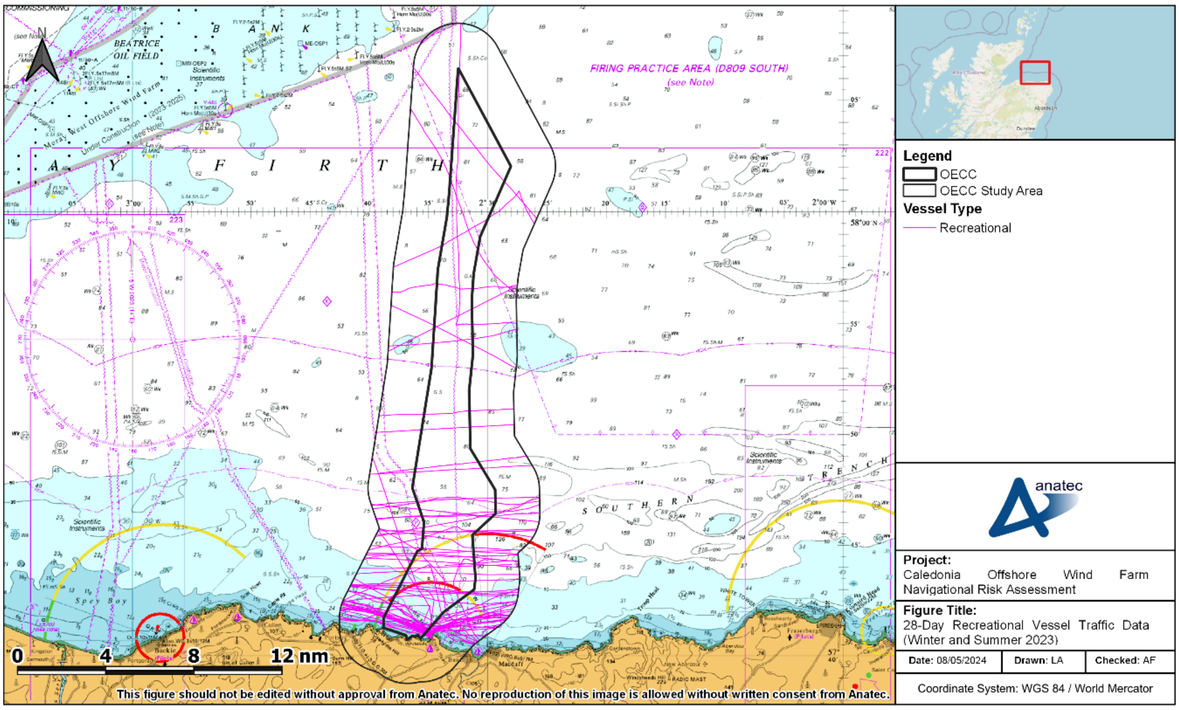

Figure 10.28 Recreational Vessel Traffic within OECC Study Area (28 Days Winter and Summer 2023)

Recreational vessels were predominantly seen during the summer data period, during which they were recorded at an average of six unique vessels per day. Whereas during the winter period, recreational vessels were recorded on average once per week.

Recreational vessels were noted to generally transit close to the coast as well as being active within and around Whitehills marina.

10.2.2.2 Fishing Vessels

The tracks of fishing vessels within the OECC study area throughout the summer and winter data periods combined are presented in Figure 10.29, colour-coded by average vessel speed.

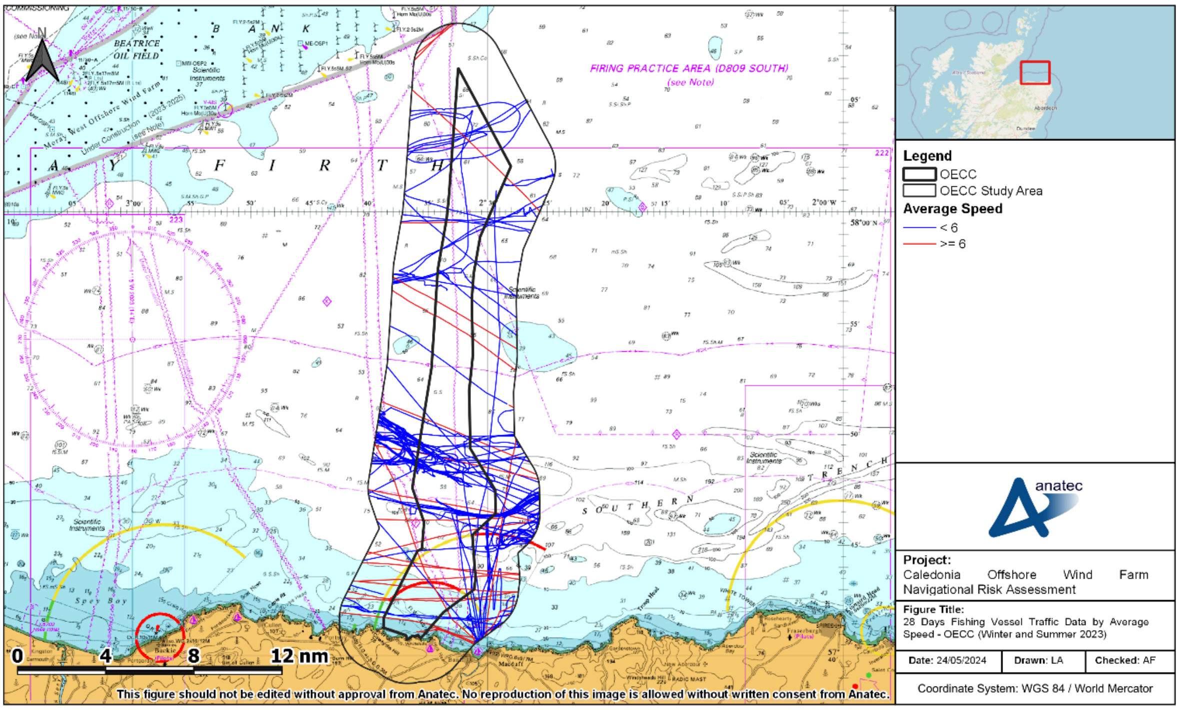

Figure 10.29 Fishing Vessel Traffic within OECC Study Area by Average Speed (28 Days Winter and Summer 2023)

Fishing vessels were observed throughout the OECC study area, and were seen operating out of Banff (UK) to the east of the Caledonia OECC landfall. On average, between one and two fishing vessels were recorded within the OECC study area per day of the winter survey period, with between one and two recorded within the Caledonia OECC itself. During the summer survey period, between three and four unique vessels were recorded within the OECC study area per day, with between two and three recorded per day within the Caledonia OECC itself.

Several vessels also displayed potential active fishing behaviour within the Caledonia OECC during both data periods. Of those vessels displaying active fishing behaviour, the vast majority utilised demersal trawling gear.

10.2.2.3 Cargo Vessels

The tracks of cargo vessels within the OECC study area throughout the summer and winter data periods combined are presented in Figure 10.30.

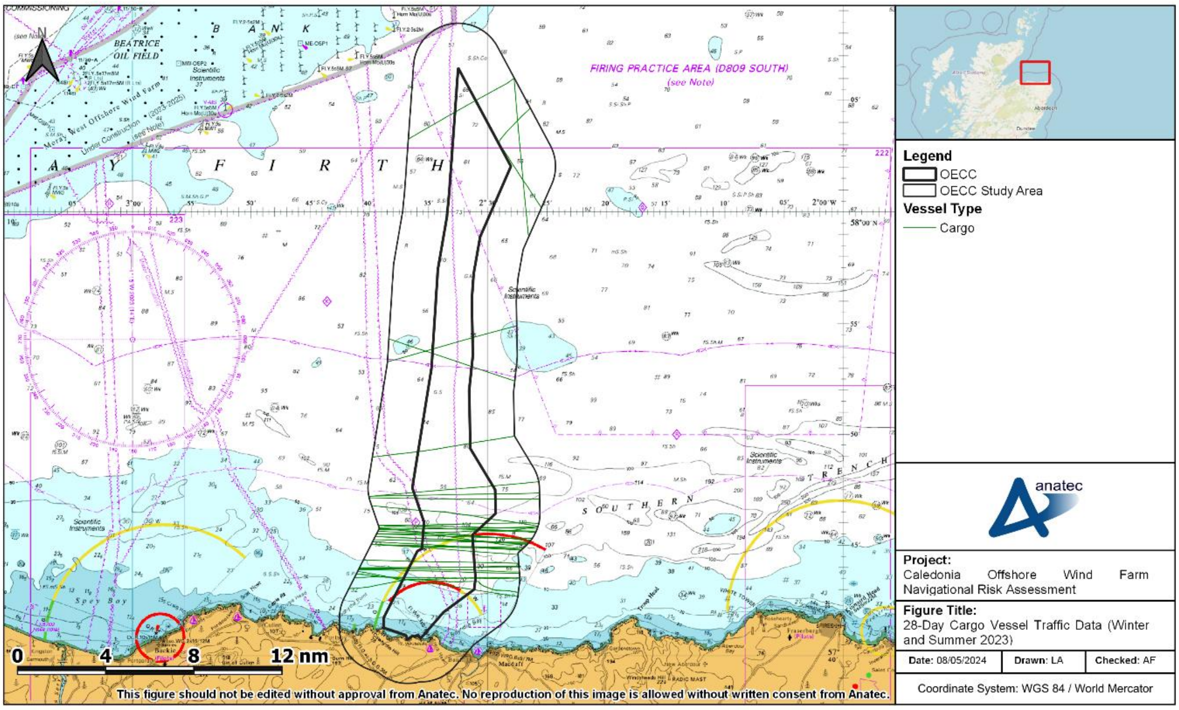

Figure 10.30 Cargo Vessel Traffic within OECC Study Area (28 Days Winter and Summer 2023)

Generally, cargo vessels were noted to transit through the near-shore section of the OECC study area on an east/west course.

During the winter period, two unique cargo vessels were recorded within the OECC study area per day of the data period. Between one and two unique cargo vessels were recorded within the Caledonia OECC itself. The most common cargo sub-types recorded within the OECC study area were part containerised cargo (61%) and general cargo (25%).

During the summer period there was less cargo activity recorded within the OECC study area, at an average of one unique cargo vessel every one to two days, all of which were noted to transit the Caledonia OECC itself. The most common cargo sub-types recorded during the summer period were general cargo (70%) and part containerised cargo (30%).

10.2.2.4 Oil and Gas Vessels

The tracks of oil and gas vessels within the OECC study area throughout the summer and winter data periods combined are presented in Figure 10.31.

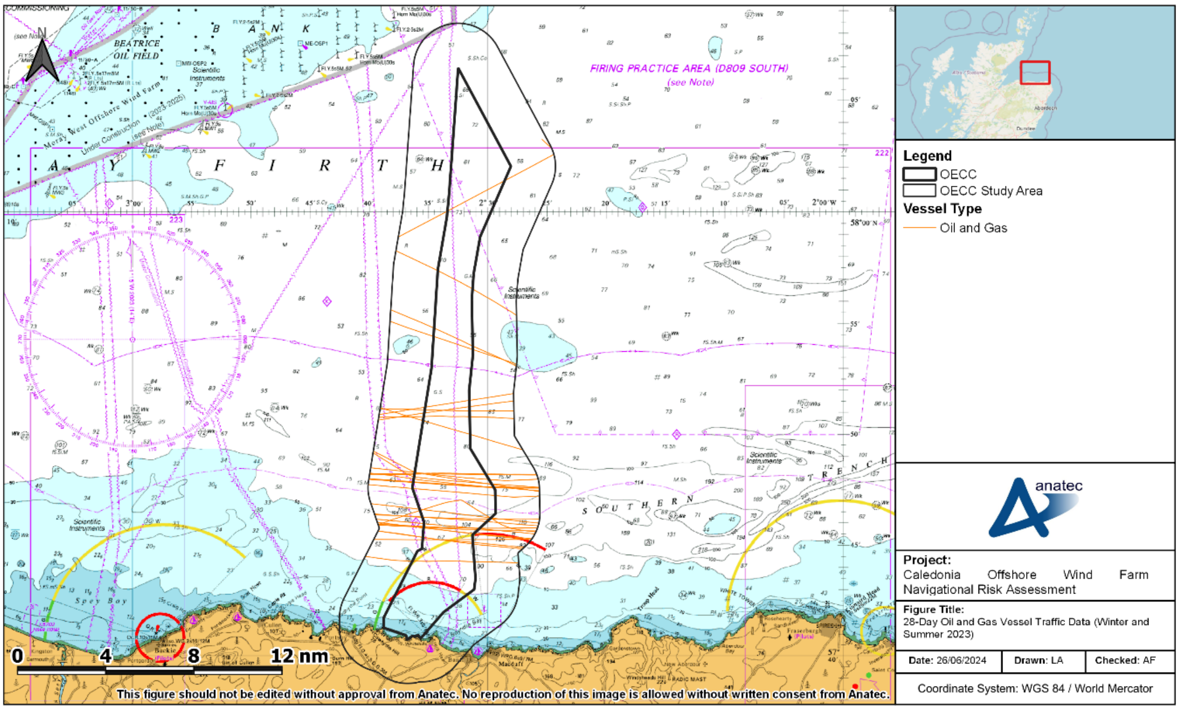

Figure 10.31 Oil and Gas Vessel Traffic within OECC Study Area and Caledonia OECC (28 Days Winter and Summer 2023)

Oil and gas vessels were predominantly noted within the mid-section of the OECC study area, transiting in a general east/west course across the Caledonia OECC.

Unique oil and gas vessels were recorded on average every three to four days within the OECC study area and every four to five days within the Caledonia OECC itself during the summer period, whereas two were recorded per day within the Caledonia OECC during the winter period, noting that all oil and gas vessels present within the OECC study area were also present within the Caledonia OECC itself.

10.2.2.5 Wind Farm Vessels

The tracks of wind farm vessels within the OECC study area throughout the summer and winter data periods combined are presented in Figure 10.32.

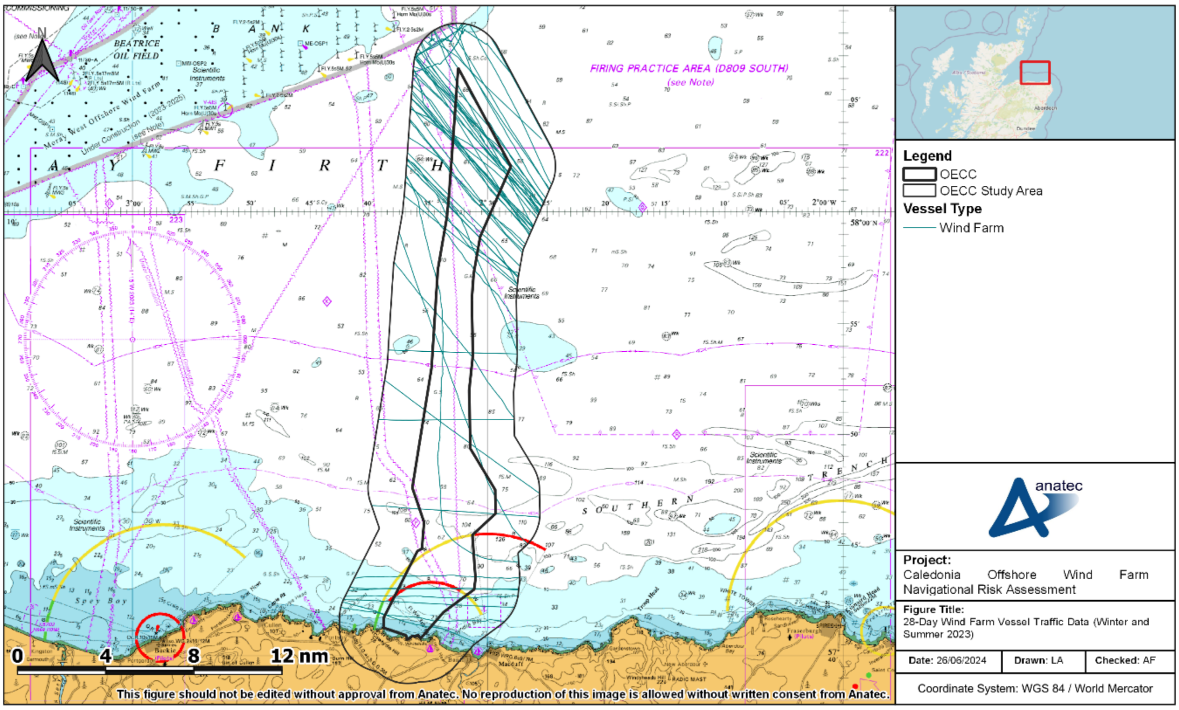

Figure 10.32 Wind Farm Traffic within OECC Study Area and Caledonia OECC (28 Days Winter and Summer 2023)

Wind farm vessels were predominantly recorded transiting between Moray Firth wind farms and Fraserburgh (UK), with several tracks noted transiting parallel to the coast.

On average, one to two unique wind farm vessels were recorded within the OECC study area per day of both the winter and summer data periods. Similar numbers were also recorded within the Caledonia OECC itself for both data periods.

10.2.2.6 Tankers

The tracks of tankers within the OECC study area throughout the summer and winter data periods combined are presented in Figure 10.33.

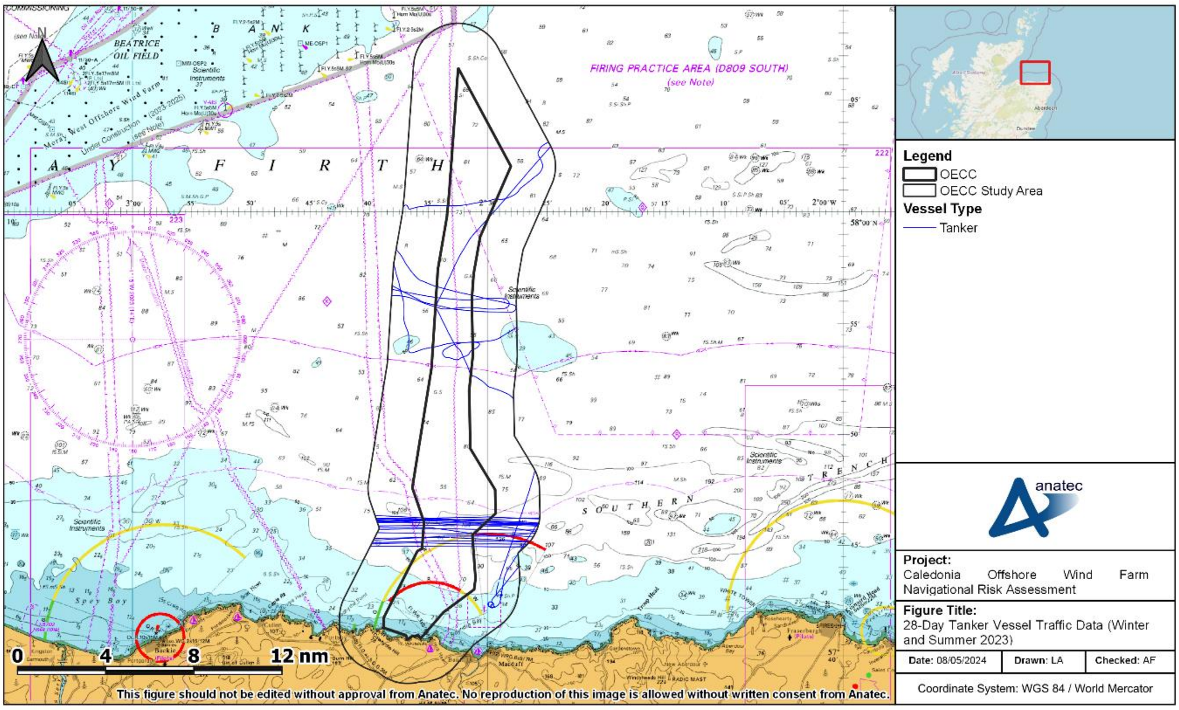

Figure 10.33 Tanker Traffic within OECC Study Area and Caledonia OECC (28 Days Winter and Summer 2023)

Tankers were mostly recorded to transit on an east/west course close to the Caledonia OECC landfall, with one vessel noted to transit within the Caledonia OECC further north. On average, one tanker was recorded every day of the winter period, with one recorded on average every one to two days of the summer period.

The most common tanker types recorded during the winter period was product tankers (43%), crude oil carriers (36%), and chemical carriers (21%). During the summer period, product tankers were attributed to 50%, crude oil carriers accounted for 33%, and chemical carriers were recorded at 17%.

10.2.3 Vessel Size

10.2.3.1 Vessel Length

Vessel length information was available for approximately 97% of all vessels recorded throughout the combined summer and winter data periods. A plot of all vessel tracks (excluding temporary traffic) recorded within OECC study area throughout the data periods, colour-coded by vessel length, is presented in Figure 10.34. Following this, the distribution of these lengths is presented, by data period, in Figure 10.35.

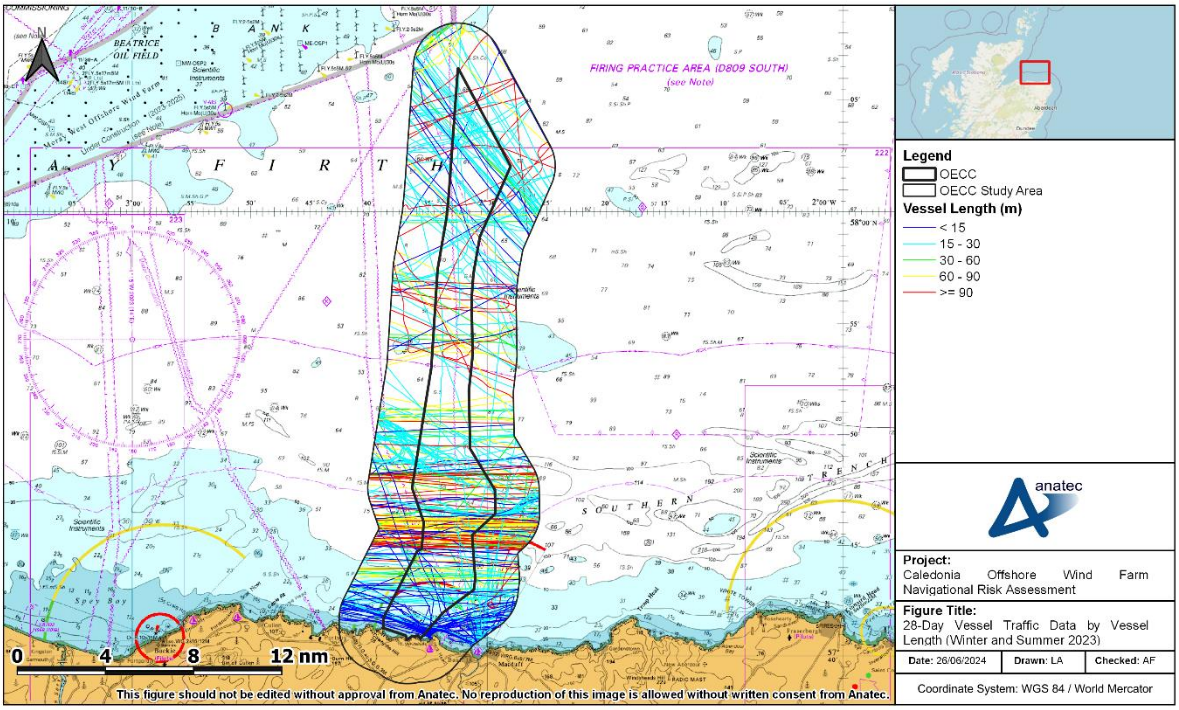

Figure 10.34 Vessel Traffic Data within the OECC Study Area and Caledonia OECC by Vessel Length (28 Days Winter and Summer 2023)

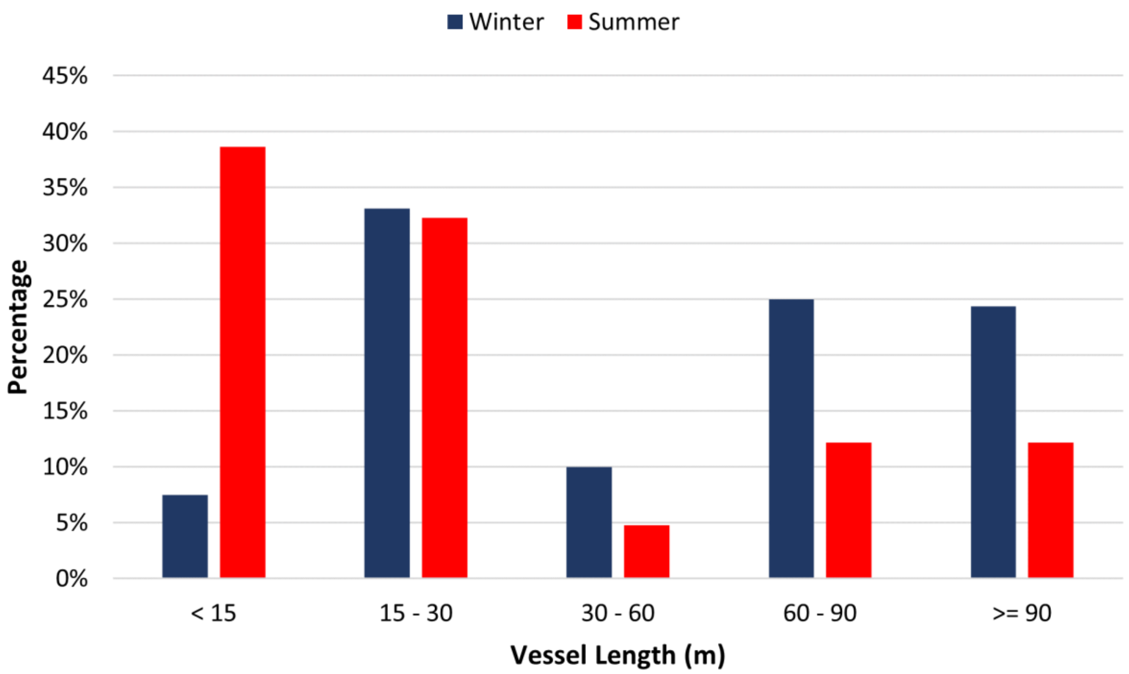

Figure 10.35 Vessel Length Distribution within the OECC Study Area (28 Days Winter and Summer 2023)

The average length of vessels recorded within the OECC study area was 62m during the winter period, and 47m during the summer period. Over the two data periods, vessel length ranged from a 5m un-manned vessel to a 333m cruise liner recorded heading for Hamburg (Germany). Larger vessels were predominantly passenger vessels, cargo vessels, and tankers. Whereas smaller vessels were recreational vessels and fishing vessels.

10.2.3.2 Vessel Draught

Vessel draught information was available for 71% of all vessels recorded throughout the combined summer and winter data periods. A plot of all vessel tracks (excluding temporary traffic) recorded within the OECC study area throughout the data periods, colour-coded by vessel draught, is presented in Figure 10.36. Following this, the distribution of these draught classes is presented, by data period, in Figure 10.37.

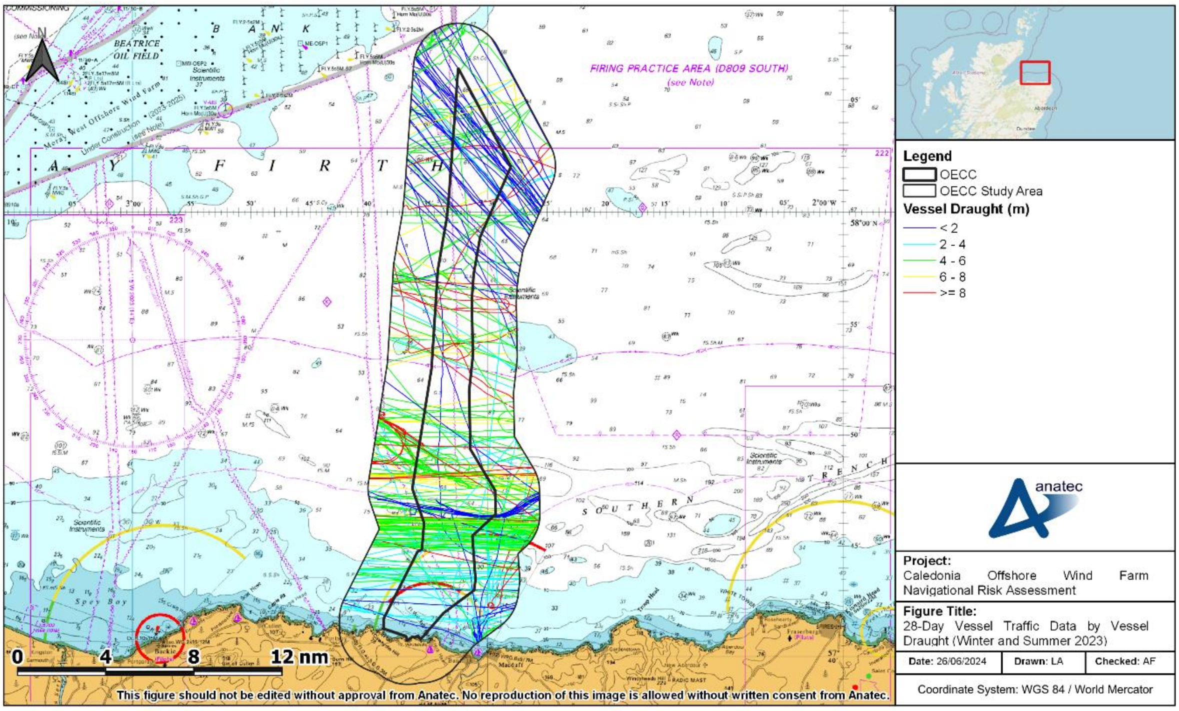

Figure 10.36 Vessel Traffic Data within the OECC Study Area and Caledonia OECC by Vessel Draught (28 Days Winter and Summer 2023)

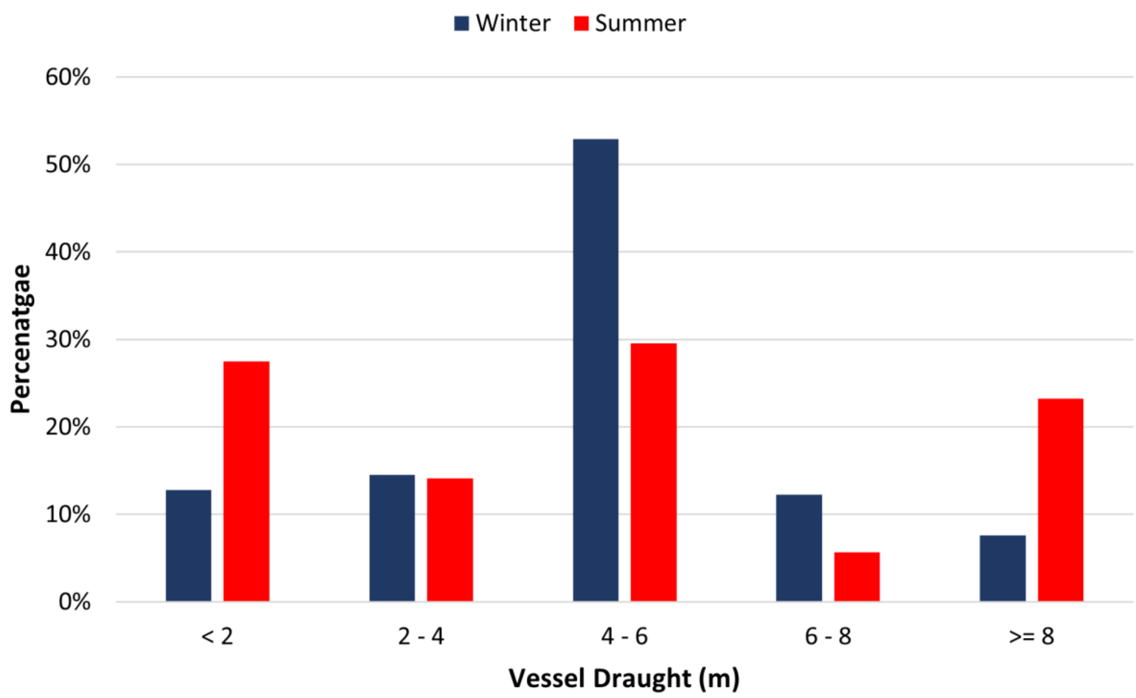

Figure 10.37 Vessel Draught Distribution within OECC Study Area (28 Days Summer and Winter 2023)

Excluding the proportion of vessels for which vessel draught was not available, the average draught of vessels within the OECC study area was 4.8m and 5m for winter and summer periods respectively. Over the data periods, vessel draughts ranged from 1m for a windfarm vessel to 15m for an oil and gas platform under tow.

In general, tankers, oil and gas vessels, and passenger vessels reported the deepest draughts, whereas wind farm vessels and recreational vessels reported the shallowest draughts.

10.2.4 Anchoring Activity

Applying the methodology described in Section 10.1.4, two vessels were deemed to be at anchor during the data periods. Figure 10.38 shows the vessel tracks of vessels recorded to be at anchor within the OECC study area during the winter and summer data periods, colour-coded by vessel type.

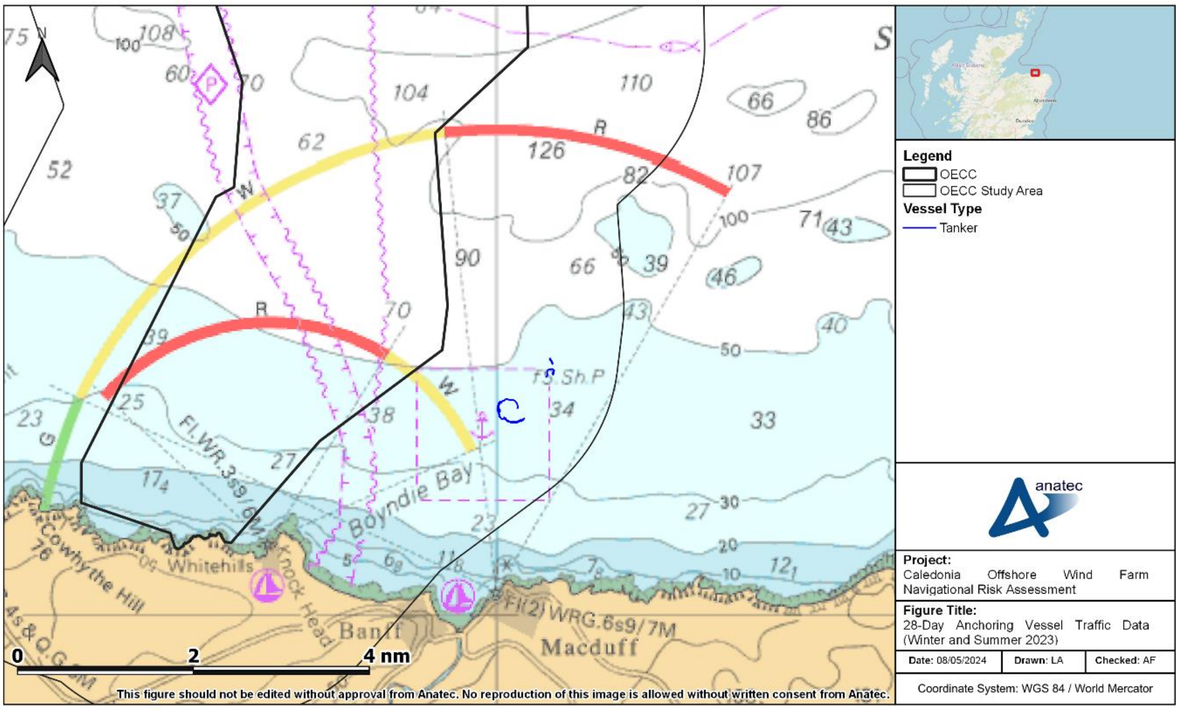

Figure 10.38 Anchoring Vessel Traffic within OECC Study Area (28 Days Winter and Summer 2023)

Two tankers were recorded to be at anchor during the data period, one of which was recorded at anchor during winter and the other during summer. Both vessels were observed to utilise the designated anchorage area within Boyndie Bay, off the coast of Banff and Macduff (UK).

It Is noted that longer term analysis undertaken as part of earlier site selection work indicated that the anchorage was used by an average of 15 unique vessels per year between January 2020 and December 2022.

11 Base Case Vessel Routeing

11.1 Definition of a Main Commercial Route

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. Additionally, the outputs of consultation undertaken with local stakeholders assisted in the identification of the main commercial routes.

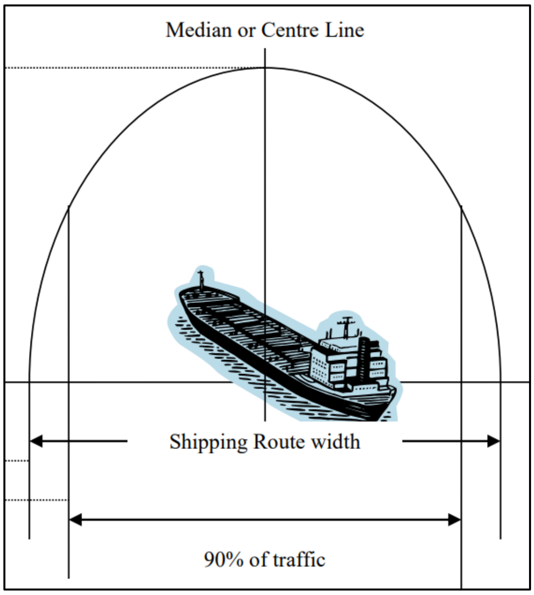

Figure 11.1 Illustration of Main Route Calculation (MCA, 2021)

11.2 Pre Wind Farm Main Commercial Routes

A total of 10 main commercial routes were identified within the routeing study area from the vessel traffic data. These main commercial routes and corresponding 90th percentiles within the routeing study area are shown relative to Caledonia OWF in Figure 11.2. Following this, a description of each route is provided in Table 11.1, including the average number of vessels per day, start and end locations, and main vessel types. It is noted that the start and end locations are based on the most common destinations transmitted via AIS by vessels on those routes (i.e., there may be vessels on any given route bound for destinations other than those listed).

To ensure all main commercial routes are captured, the long-term vessel traffic AIS data has been used to validate the main commercial routes identified from the vessel traffic survey data. This also ensured low use routeing (less than one vessel a week) was still identified and captured within the modelling (see Section 16).

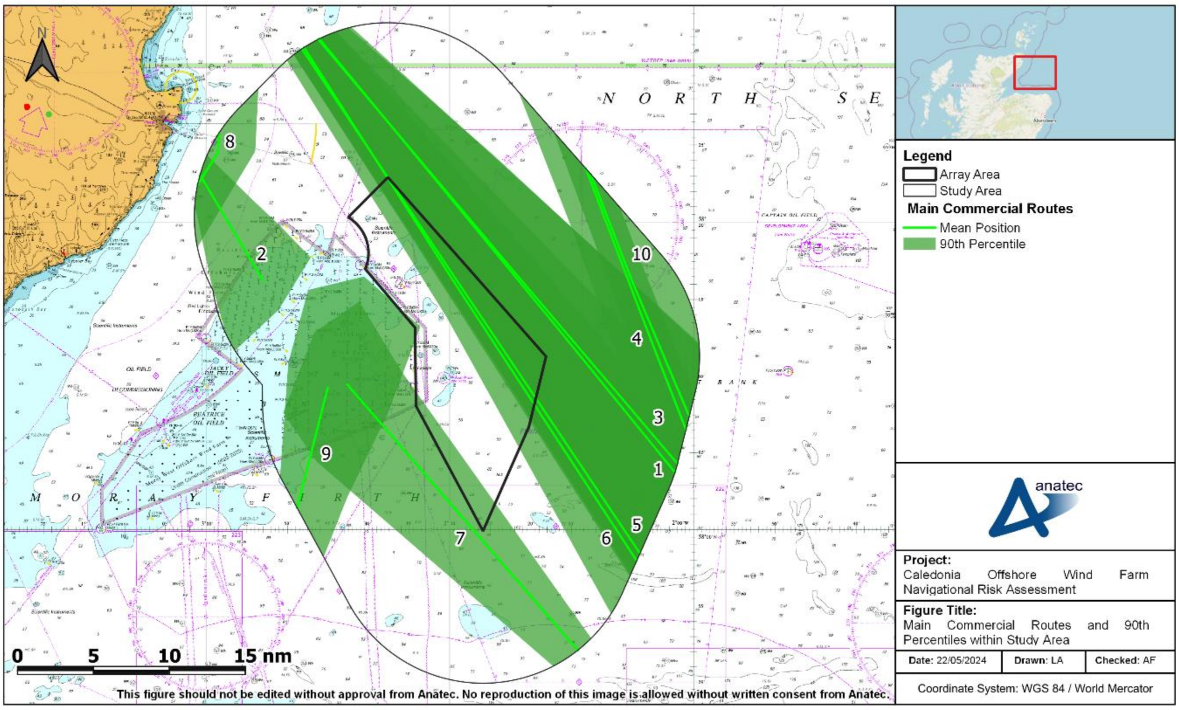

Figure 11.2 Main Commercial Routes and 90th Percentiles within the Study Area

The majority of vessels on main routes were identified to pass to the east of Caledonia OWF (Routes 1, 3, 4, 5, 6, and 10). These routes equate to a total of approximately eight to nine vessels per day.

Table 11.1 Main Commercial Route Descriptions

Route Number	Average Vessels Per Week	Average Vessels Per Day	Description
1	22	3	**Rotterdam to Pentland Firth.** Mainly cargo vessels including Smyril Line RoRo vessels.
2	14	2	**Wick – Beatrice OWF.** Wind farm vessels.
3	11	2	**Pentland Firth to Rotterdam.** Mainly cargo vessels including Smyril Line RoRo vessels.
4	8	1	**Aberdeen – Kirkwall.** NorthLink cargo and passenger vessels.
5	8	1	**Pentland Firth to East England.** Mainly cargo vessels.
6	6	1	**Pentland Firth to East Scotland.** Mainly oil and gas vessels and cargo vessels.
7	6	1	**Fraserburgh – Moray East OWF.** Wind farm vessels
8	5	1	**Inverness – Scrabster.** Mainly cargo vessels.

Route Number	Average Vessels Per Week	Average Vessels Per Day	Description
9	4	1	**Buckie – Moray East OWF.** Wind farm vessels.
10	3	< 1	**East Scotland – Kirkwall.** Mainly passenger and cargo vessels.

12 Adverse Weather Vessel Traffic Movements

Some vessels and vessel operators currently operate alternative routes infrequently during periods of adverse weather after considering weather forecasts, as part of the passage planning process required by Chapter V of the International Convention for the Safety of Life at Sea (SOLAS) Chapter V (IMO, 1974).

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

Review of the 12 months of AIS data studied for the NRA (Appendix E) showed instances of Serco NorthLink ferries passing further inshore than the typical routeing undertaken. Subsequent consultation with Serco NorthLink (see Section 4) confirmed that these inshore transits were undertaken during periods of adverse weather.

Figure 12.1 shows the Serco NorthLink ferries (both RoRo and RoPax) recorded over the 12 months of AIS relative to the Array Area.

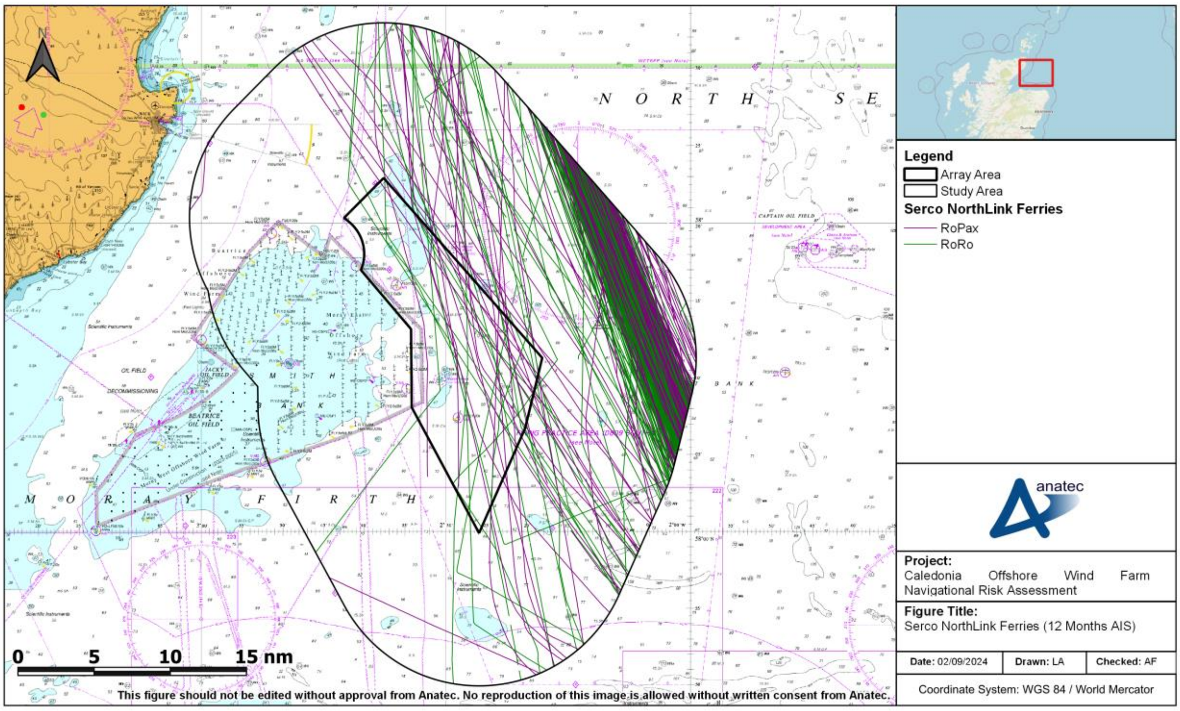

Figure 12.1 Serco NorthLink Ferries (12 Months AIS)

A total of 37 interactions with the Array Area were recorded over the 12 months. Following initial consultation with Serco NorthLink, the period of interest was extended to cover a total of five years of AIS to ensure the adverse weather routeing was fully understood and characterised.

Based on the assessment of the five years of data, the number of intersections with Caledonia North, Caledonia South, and the Caledonia OWF are presented in Table 12.1, split by vessel type. As shown, the infrastructure within Caledonia South would likely have a larger impact than Caledonia North.

Table 12.1 Summary of Transit Assessment - Average per Year (2019-2023)

Vessel	Caledonia North	Caledonia South	Caledonia OWF
Passenger	9	16	16
Freight	19	26	28
Total	**28**	**42**	**44**

The five years of AIS data was also studied to identify any cases where a Serco NorthLink ferry passed inshore of the existing wind farms (Moray East, Moray West and Beatrice), as input from Serco NorthLink was that this is an alternate adverse weather deviation used in certain conditions, albeit very infrequently as it leads to a large deviation.

A total of six such transits were identified over the five years, one per year during 2021 and 2022, and two per year during 2020 and 2023. These tracks are shown in Figure 12.2. It is noted that all transits occurred prior to the construction buoyage for Moray West being deployed.

The transits identified in Figure 12.2 were used to identify potential journey increases for Serco NorthLink ferries when using the inshore routeing compared to the usual routeing for both the Aberdeen / Kirkwall (referred to as Route 1 in this section) and Aberdeen / Lerwick (referred to as Route 2 in this section) routeing. This assessment considered Anatec's ShipRoutes (2024) database to extrapolate likely port to port routeing patterns. The adverse weather deviations (Routes 1a and 2a) are shown relative to the typical routeing (Routes 1 and 2) in Figure 12.3.

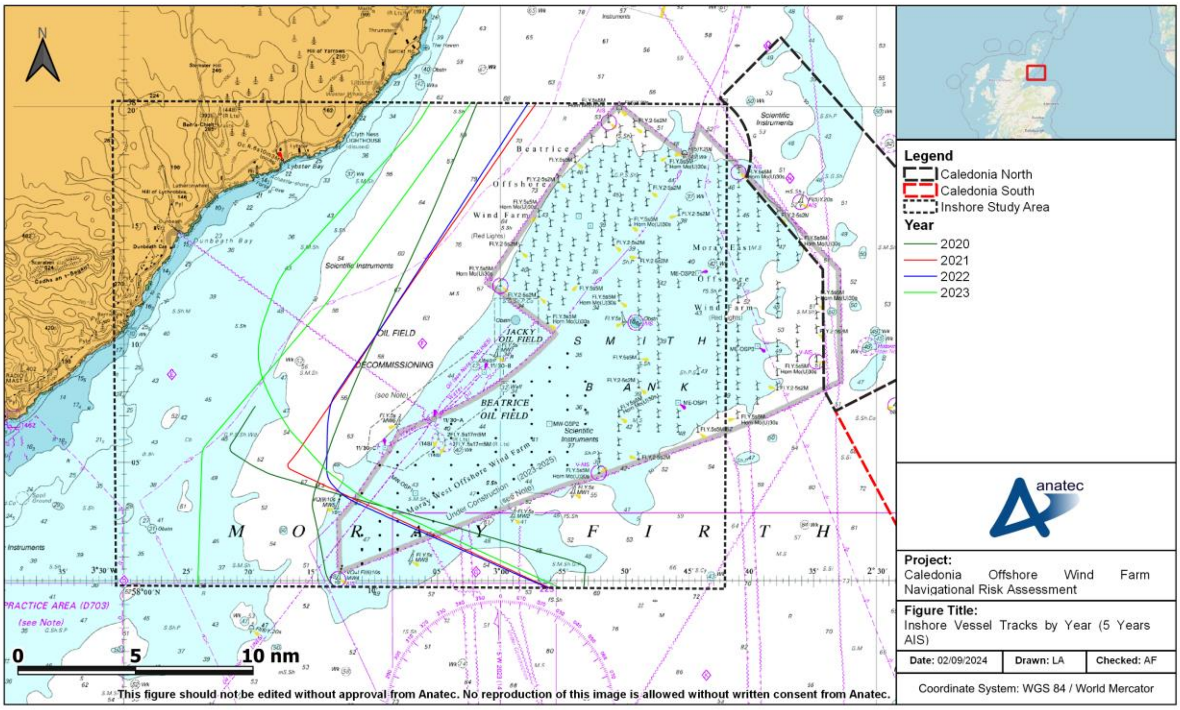

Figure 12.2 Inshore Vessel Tracks by Year (5 Years AIS)

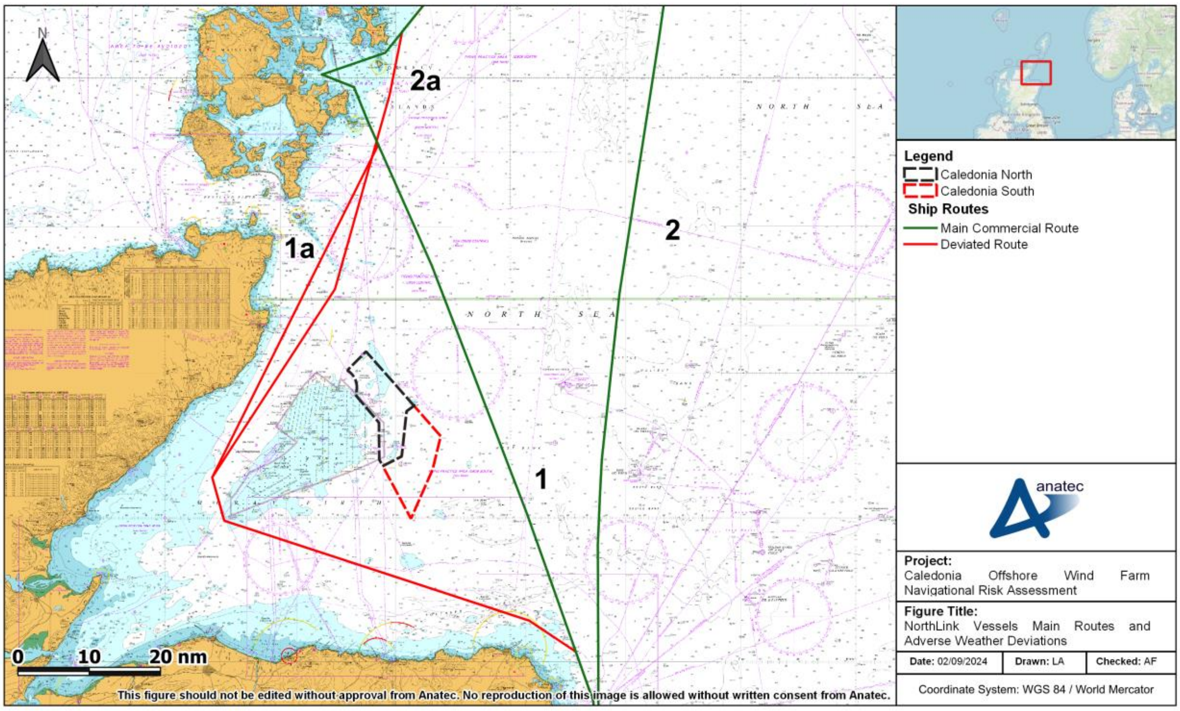

Figure 12.3 NorthLink Vessels Main Routes and Adverse Weather Deviations

Based on the extrapolated route deviations, there is a 28% increase in route length between Route 1 and Route 1a, corresponding to an increase of approximately 35nm. There is a 29% route length increase between Route 2 and Route 2a, corresponding to an increase of approximately 55nm. It is noted that these calculations are based on the length of the entire extrapolated route. This broadly aligns with input from NorthLink who indicate an increase of around 40nm may be expected when this deviation was utilised.

Further assessment of the post wind farm scenario is provided in Section 15.6.

13 Navigation, Communication and Position Fixing Equipment

13.1 Very High Frequency Communications (including Digital Selective Calling)

In 2004, trials were undertaken at the North Hoyle OWF, 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 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 array. No effects were recorded using any system provider (MCA and QinetiQ, 2004).

Furthermore, as part of SAR trials carried out at North Hoyle in 2005, radio checks were undertaken between the Sea King helicopter and both Holyhead and Liverpool coastguards. The aircraft was positioned offshore of the array 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 OWF 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 Proposed Development (Offshore) is anticipated to have no significant impact upon VHF communications.

13.2 Very High Frequency Direction Finding

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

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

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

13.3 Automatic Identification System

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

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

13.4 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 Proposed Development (Offshore).

13.5 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 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 WTG to the GPS antenna, there were always enough satellites elsewhere in the sky to cover for any that might be shadowed by the WTG 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 Proposed Development (Offshore), noting that there have been no reported issues relating to GPS within or in proximity to any operational OWFs to date.

13.6 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 may 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 Proposed Development (Offshore) would have a significant impact on vessel navigation. However, some smaller craft (fishing or leisure) may rely on it as their sole means of navigation.

13.6.1 Subsea Cables

The sub-sea cables for the Proposed Development (Offshore) will be Alternating Current (AC). Direct Current (DC) is not under consideration.

Studies indicate that AC does not emit an EMF significant enough to impact marine magnetic compasses (Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), 2008). Therefore, electromagnetic interference due to cables associated with the Proposed Development (Offshore) are not considered any further.

13.6.2 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.

13.6.3 Experience at Operational Offshore 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 OWFs.

13.7 Marine Radar

This section summarises the results of trials and studies undertaken in relation to Radar effects from OWFs 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. It is noted that other Radar interference effects (including aviation) are discussed within Volume 2, Chapter 11: Military and Civil Aviation.

13.7.1 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 North Hoyle (MCA, 2005) 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 1.5nm) and with large objects. Side lobe echoes form either an arc on the Radar screen similar to range rings, or a series of echoes forming a broken arc, as illustrated in Figure 13.1.

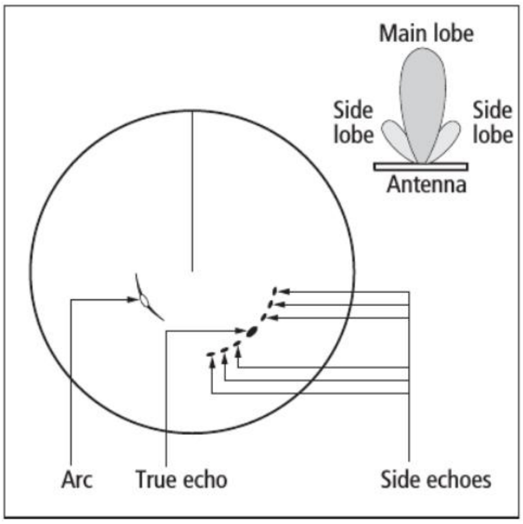

Figure 13.1 Illustration of Side Lobes on Radar Screen

Multiple reflected echoes are returned from a real target by reflection from some object in the Radar beam. Indirect echoes or 'ghost' images have the appearance of true echoes but are usually intermittent or poorly defined; such echoes appear at a false bearing and false range, as illustrated in Figure 13.2.

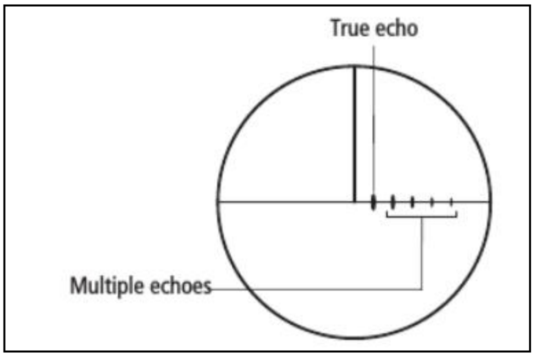

Figure 13.2 Illustration of Multiple Reflected Echoes on Radar Screen

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 OWFs. However, as experience of effects associated with use of marine Radar in proximity to OWFs grew, the MCA refined their guidance, offering more flexibility within the most recent Shipping Route Template contained within MGN 654 (MCA, 2021).

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

Theoretical modelling of the effects of the development of the proposed Atlantic Array OWF, 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[5]. The main outcomes of the modelling were the following:

- Multiple and indirect echoes were detected under all modelled parameters;
- The main effects noticed were stretching of targets in azimuth (horizontal) and appearance of ghost targets;
- There was a significant amount of clear space amongst the returns to ensure recognition of vessels moving amongst the 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;
- 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 vessels 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 Automatic Radar Plotting Aid (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 OWFs become operational. Based on this experience, the mariner can interpret the effects correctly, noting that effects are the same as those experienced by mariners in other environments such as in close proximity to other vessels or structures. Effects may be effectively mitigated by “*careful adjustment of Radar controls*”.

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

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 (a)). The interference buffers presented in Table 13.1 are based on MGN 654 (MCA, 2021), MGN 371 (MCA, 2008 (a)), MGN 543 (MCA, 2016), MGN 372 Amendment 1 (MCA, 2022) and MGN 372 (MCA, 2008 (b)).

Table 13.1 Distances at which Impacts on Marine Radar Occur

Distance at Which Effect Occurs (nm)	Identified Effects
0.5	▪ Intolerable impacts may be experienced. ▪ X-Band Radar interference is intolerable under 0.25nm. ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45nm.
1.5	▪ Under MGN 654, impacts on Radar are considered to be tolerable with mitigation between 0.5 and 3.5nm. ▪ S-Band Radar interference starts at 1.5nm. ▪ Echoes develop at approximately 1.5nm, with progressive deterioration in the Radar display as the range closes. Where a main vessel route passes within this range considerable interference may be expected along a line of 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 13.1, the onset range from the WTGs of false returns is approximately 1.5nm, with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) *Rule 6 Safe Speed* are particularly applicable and must be observed with due regard to the prevailing circumstances (IMO, 1972/77). In restricted visibility, *Rule 19 Conduct of Vessels in Restricted Visibility* applies and compliance with *Rule 6* becomes especially relevant. In such conditions mariners are required, under *Rule 5 Look-out* to take into account information from other sources which may include sound signals and VHF information, for example from a Vessel Traffic Service (VTS) or AIS (MCA, 2016).

13.7.2 Experience from Operational Developments

The evidence from mariners operating in proximity to existing OWFs is that they quickly learn to adapt to any effects. Figure 13.3 presents the example of the Galloper and Greater Gabbard OWFs, which are located in proximity to IMO routeing measures. Despite this proximity to heavily trafficked Traffic Separation Scheme (TSS) lanes, there have been no reported incidents or issues raised by mariners operating in close proximity. The interference buffers presented in Figure 13.3 are as per Table 13.1.

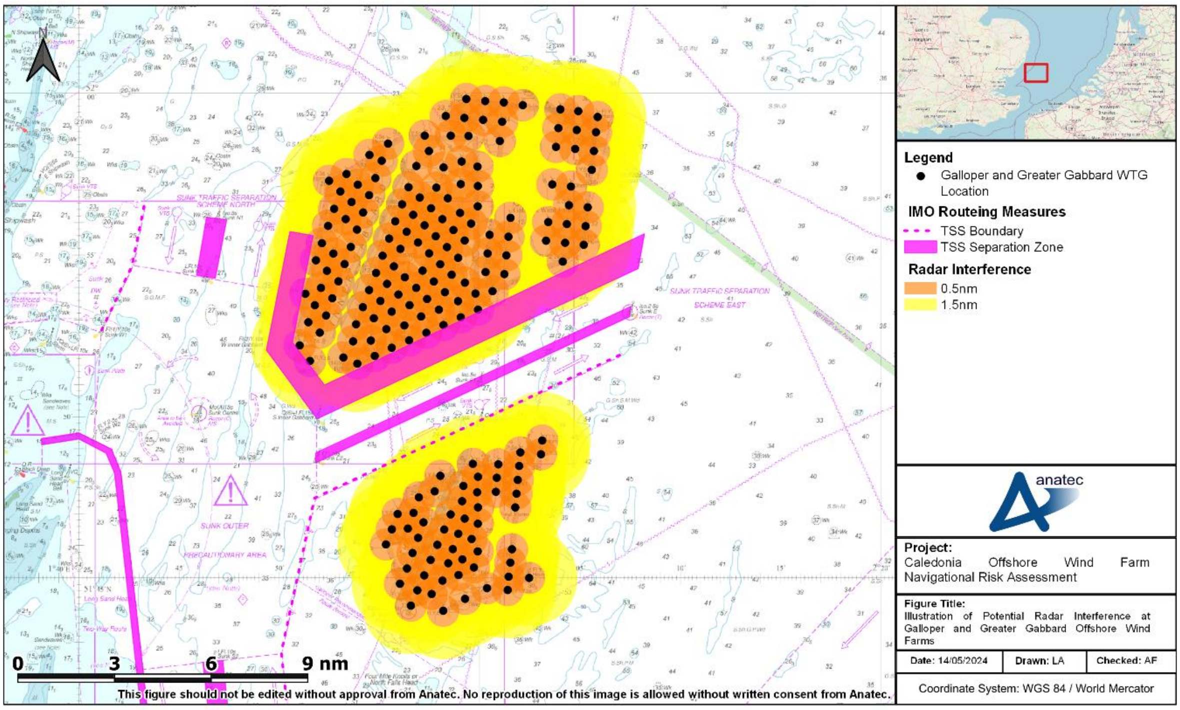

Figure 13.3 Illustration of Potential Radar Interference at Galloper and Greater Gabbard Offshore Wind Farms

As indicated by Figure 13.3, vessels utilising these TSS lanes would experience some Radar interference based on the available guidance. Both developments are operational, and the lanes are used by a minimum of eight vessels per day on average. However, to date, there have been no incidents recorded (including any related to Radar use) or concerns raised by the users.

AIS information may also be used to verify the targets of larger vessels (generally vessels over 15m LOA – the minimum threshold for fishing vessel AIS carriage requirements). Approximately 9% of the vessel traffic recorded within the study area was under 15m in length, although throughout the vessel traffic surveys approximately 99% of vessel tracks were recorded on AIS, indicating a high level of AIS take-up among vessels for which AIS carriage is not mandatory.

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 OWF.

13.7.3 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) would return greater target sizes and / or stronger false targets. However, there is a limit to which the vertical beam width would be affected (20° to 25°) dependent upon the distance from the target, and at closer distances this five degree width would be limited much further. Therefore, increased WTG height in Caledonia OWF would 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 may be managed effectively.

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

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

13.7.5 Application to the Proposed Development (Offshore)

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

Figure 13.4 presents an illustration of potential Radar interference due to the Proposed Development (Offshore). The Radar effects have been applied to the indicative full build out array layout of Caledonia OWF introduced in Section 6.2.1.1, as this layout presents the greatest spatial extent of potential Radar interference for passing vessels.

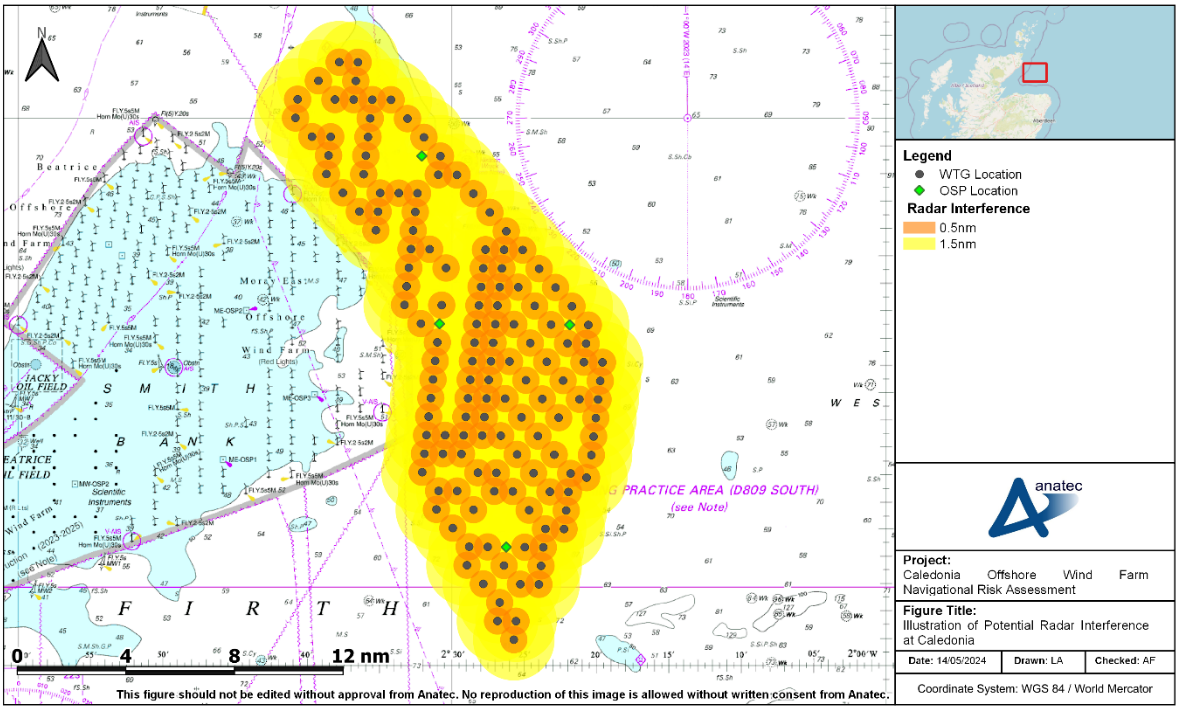

Figure 13.4 Illustration of Potential Radar Interference at Caledonia OWF

Vessels passing within 1.5nm of Caledonia OWF would be subject to a greater level of interference with impacts becoming more substantial in close proximity to WTGs. This would require additional mitigation by any vessels including consideration of the navigational conditions (visibility) when passage planning and compliance with the COLREGs (IMO, 1972/77) would be essential.

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

13.8 Sound Navigation Ranging Systems

No evidence has been found to date with regard to existing OWFs 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 Proposed Development (Offshore).

13.9 Noise

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

13.10 Summary of Potential Effects on Use

Based on the detailed technical assessment of the effects due to the presence of the Proposed Development (Offshore) on navigation, communication and position fixing equipment in the previous subsections, Table 13.2 summarises the assessment of frequency of occurrence and severity of consequence and the resulting significance of risk for each component of this hazard as per the FSA methodology referenced in Section 3.2.

Table 13.2 Summary of Risk to Navigation, Communication, and Position Fixing Equipment

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

On the basis of these findings, associated risks are screened out of the Risk Assessment undertaken in Section 18.

14 Cumulative and Transboundary Overview

Cumulative risks have been considered for activities in combination and cumulatively with the Proposed Development (Offshore). This section provides an overview of the baseline used to inform the cumulative risk assessment including the pre wind farm vessel routeing and developments and proposed developments screened into the cumulative risk assessment based upon the criteria outlined in Section 3.3.

Given the unique nature of shipping and navigation users the bespoke tiering system outlined in Section 3.3 has been applied.

It is noted that port developments (and specifically the subsequent changes in vessel traffic movements) are considered as part of the future case vessel traffic scenarios (see Section 15).

Transboundary effects arise when impacts from a development within one European Economic Area (EEA) state's territory affects the environment of another EEA state(s).

Transboundary impacts in terms of vessel routeing (including to international ports are considered to have been assessed for the Proposed Development (Offshore) in isolation and on a cumulative basis. Individual transits may have the potential to be associated with vessels that are internationally owned or located; however, any such transits have been captured within the baseline assessment of vessel traffic noting that AIS carriage requirements are set by the IMO and apply across EEAs.

Since international commercial routeing is captured in the existing environment, the environmental assessment for the Proposed Development (Offshore) suitably considers effects in transboundary terms.

14.1 Screened-in Other Developments

In addition to the Proposed Development (Offshore), there are a number of other developments located in the region. Table 14.1 includes details of these developments, whether they are screened into the cumulative risk assessment and the cumulative tier applied (where applicable). The statuses listed are correct as of May 2024.

As per the cumulative risk assessment methodology (see Section 3.3), any development greater than 50nm from Caledonia OWF is not considered.

Figure 14.1 presents the locations of the developments screened into the cumulative assessment.

Assessment approach per Tier is provided in Section 3.3.

Table 14.1 Cumulative Screening

Development	Development Type	Development Status	Closest Distance		Data Confidence	Tier
			Caledonia OWF (nm)	Caledonia OECC (nm)		
Ayre OWF	OWF	Pre Planning	26	41.7	Low	3
Broadshore OWF	OWF	Scoped	13	18.9	Medium	1
Buchan OWF	OWF	Scoped	30.2	38.1	Medium	3
Flora OWF	OWF	Pre Planning	50	43.8	Low	2
Marram OWF	OWF	Scoped	45.6	51.4	Medium	3
Pentland Floating OWF	OWF	Consented	40.2	52.4	High	3
Salamander OWF	OWF	Consent Application Submitted	43.4	40.2	Medium	1
Scaraben OWF	OWF	Pre Planning	18.9	26.2	Low	2
Sinclair OWF	OWF	Pre Planning	15.4	24.2	Low	2
Stromar OWF	OWF	Scoped	11.7	21.4	Medium	1
West of Orkney OWF	OWF	Consent Application Submitted	49.9	63.7	High	3

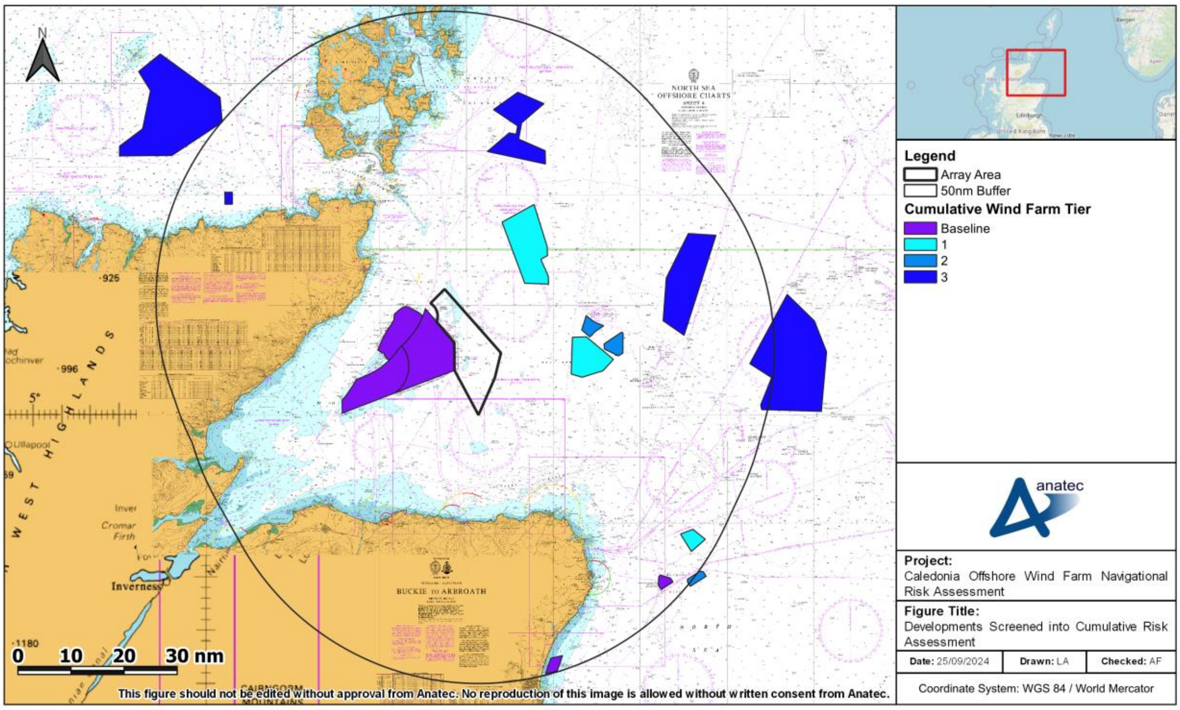

Figure 14.1 Cumulative Developments

14.2 Routeing Interaction with Screened in Developments

As per the methodology for re-routeing due to the Proposed Development (Offshore) in isolation (see Section 15.4), it is assumed that any main commercial route within 1nm of a surface piercing installation will require a deviation. The only developments screened into the cumulative risk assessment that may lead to deviations to the main routes identified are Salamander OWF and Stromar OWF, which would require deviation of Routes 1, 3, and 10. Routeing assessment is undertaken in Section 15.5.

15 Future Case Vessel Traffic

The characterisation of vessel traffic established in the baseline (see Section 10 and Section 11) is used as input to the risk assessment (see Section 18). However, it is also necessary to consider potential future case vessel traffic, in terms of general volume and size changes, port developments which may influence movements, and changes to movements associated with the presence of the Proposed Development (Offshore) (the post wind farm scenario).

The following subsections provide details of high-level future case scenarios which have been used to inform the risk assessment.

15.1 Increases in Commercial Vessel Activity

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

Therefore, two independent scenarios of potential growth in commercial vessel movements of 10% and 20% have been estimated throughout the lifetime of the Proposed Development (Offshore).

15.2 Increases in Commercial Fishing Vessel and Recreational Vessel Activity

There is similar uncertainty associated with long-term predictions for commercial fishing vessel and recreational vessel transits given the limited reliable information on future trends upon which any firm assumption could be made. There are no known major developments which would increase commercial fishing or recreational vessel activity in the region.

Therefore, a conservative potential growth in commercial fishing vessel and recreational vessel movements of 10% and 20% has been estimated throughout the lifetime of the Proposed Development (Offshore).

15.3 Increases in Traffic Associated with the Proposed Development (Offshore) Operations

During the O&M phase, five round trips to port per day may be made by vessels involved in the O&M phase of the Proposed Development (Offshore) (see Section 6.5).

15.4 Commercial Traffic Routeing (the Proposed Development (Offshore) in Isolation)

15.4.1 Methodology

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

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

Annex 2 of MGN 654 defines as methodology for assessing passing distance from OWF boundaries but states that it 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 (e.g., Anatec, 2016) show that vessels do pass consistently and safely within 1nm of established OWFs (including between distinct developments) and these distances vary depending upon the sea room available as well as the prevailing conditions. This evidence also demonstrates that the Mariner defines their own safe passing distance based upon the conditions and nature of the traffic at the time, but they are shown to frequently pass 1nm off established developments.

Evidence also demonstrates that commercial vessels do not transit through OWF arrays. On this basis, it has still been assumed for the purposes of worst-case assessment that all commercial vessels on the main routes identified will deviate.

The NRA also aims to establish the WCS based on navigational safety parameters, and when considering this the most conservative realistic scenario for vessel routeing is when main commercial routes pass 1nm off developments. Evidence collected during numerous assessments at an industry level confirms that it is a safe and reasonable distance for vessels to pass; however, it is likely that a large number of vessels would instead choose to pass at a greater distance depending upon their own passage plan and the current conditions. In the case of the Proposed Development (Offshore), it is considered very conservative to assume that deviated vessels will pass at this distance from the Caledonia OWF given that there is ample sea room further offshore. This aligns with feedback from the Hazard Workshop (Section 4.2), which indicated that the available space offshore was more than sufficient to accommodate the likely number of users, including in a cumulative scenario.

15.4.2 Main Commercial Route Deviations – Caledonia OWF

An illustration of the anticipated worst-case shift in the mean positions of the main commercial routes (see Figure 11.2) within the study area following the development of Caledonia OWF is colour-coded on if the route will be required to deviate due to the Proposed Development (Offshore), and presented in Figure 15.1. These deviations are based on

Anatec's assessment of the WCS and the methodology set out in Section 15.4.1.

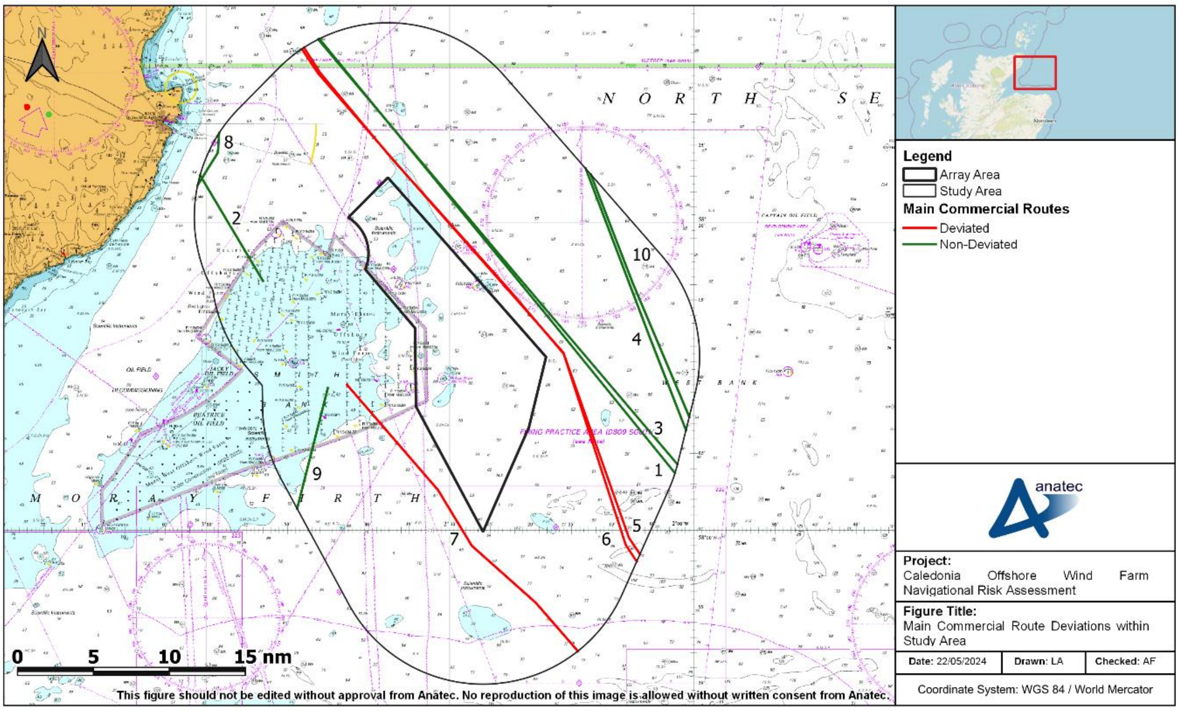

Figure 15.1 Main Commercial Route Deviations within Study Area – Caledonia OWF

Deviations from the pre wind farm scenario would be required for three out of the 10 main commercial routes identified, with the level of deviation varying between a 0.1nm increase for Route 7, and a 0.7nm increase for Route 6. For the displaced routes, the increase in distance from the pre wind farm scenario is presented in Table 15.1.

Table 15.1 Summary of Caledonia OWF Post Wind Farm Main Commercial Deviations

Route Number	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)	Nature of Deviation
5	0.6	1%	Passing further east of Caledonia OWF.
6	0.7	1%	Passing further east of Caledonia OWF.
7	0.1	< 0.3%	Passing further south of Caledonia OWF.

Route length increase is low for all deviated routes, noting that the overall percentage increase in route length would be lower than shown in Table 15.1 when total distance travelled is accounted for.

15.4.3 Main Commercial Route Deviations – Caledonia North

Deviations to routeing resulting from Caledonia North will be no greater than those for the Caledonia OWF given less spatial area is covered. On this basis increases in deviation distances are considered low, noting Table 15.1.

15.4.4 Main Commercial Route Deviations – Caledonia South

Deviations to routeing resulting from Caledonia South will be no greater than those for the Caledonia OWF given less spatial area is covered. On this basis increases in deviation distances are considered low, noting Table 15.1.

15.5 Commercial Traffic Routeing (Cumulative)

An illustration of the anticipated worst-case shift in the mean positions of the main commercial routes that are likely to deviate within the study area following the development of the Proposed Development (Offshore) and Tier 1 cumulative developments is presented in Figure 15.2. Again, these deviations are based on Anatec's assessment of the WCS and follow the same methodology outlined for deviations due to the Proposed Development (Offshore) in isolation (see Section 15.4.1).

No main route mean route positions passed within 1nm of both Caledonia OWF and another Tier 1 or Tier 2 screened in cumulative development. However, three routes were observed to require some deviation on a cumulative basis and also pass between Caledonia OWF and Stromar OWF. These routes are shown in Figure 15.2.

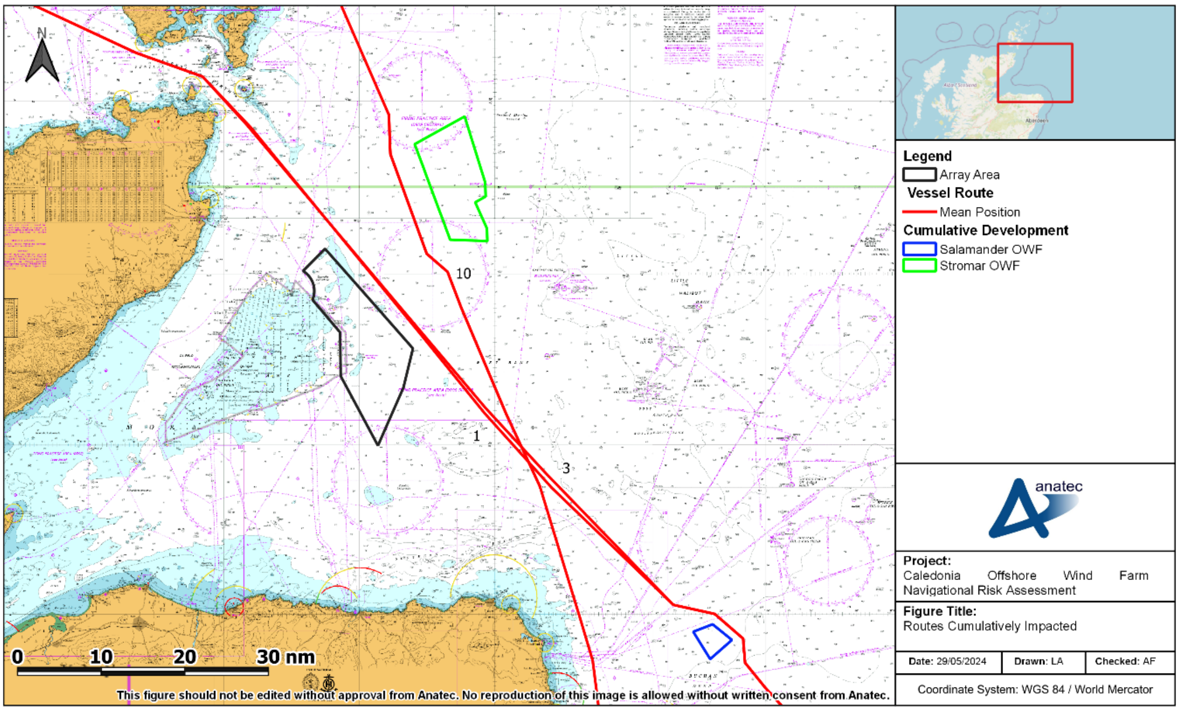

Figure 15.2 Routes Cumulatively Impacted

A summary of each of the likely cumulative deviations of the three routes identified is as follows:

- Route 1: anticipated to pass east of Salamander OWF, leading to a distance increase of 1.6nm.
- Route 3: anticipated to pass east of Salamander OWF, leading to a distance increase of 1.5nm.
- Route 10: anticipated to pass further west of Stromar OWF, leading to a distance increase of 0.6nm.

As discussed above, these deviations would occur irrespective of the presence of Caledonia OWF, and are low in terms of an overall change in distance. This broadly aligns with the outputs of the Hazard Workshop process, see Section 4. General stakeholder consensus was that while minor deviations would occur, there is sufficient sea room between Caledonia OWF and other nearby cumulative developments to the east to safely accommodate the expected number of users.

15.6 Commercial Traffic Routeing (Adverse Weather)

As detailed in Section 12, assessment of long term AIS data and consultation has identified adverse weather routeing by Serco NorthLink ferries intersecting the Array Area. This section assesses the potential impact of the Caledonia OWF on this adverse weather routeing. It is noted that the assessment within the NRA considers navigational safety hazards. The commercial and socio-economic impact is considered separately in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation.

Consultation input from Serco NorthLink indicated that any individual instance of adverse weather routeing is based upon the judgement of the vessel master who will consider a number of factors when planning a passage. It is therefore not possible to confirm for historic transits whether the presence of the Caledonia OWF, Caledonia South or Caledonia North would have led to delays, deviations or cancellations for any given historical transit. Delays, deviations, and cancellations already occur, however the presence of Caledonia OWF, Caledonia South or Caledonia North may mean more sailings are impacted in adverse weather.

As detailed in Section 12, in adverse weather conditions Serco NorthLink ferries may either pass further inshore than the typical routeing but offshore of Moray East, or inshore of Moray East, Moray West, and Beatrice. This is illustrated in Figure 15.3 which shows:

- Typical Serco NorthLink routeing (marked with an “A” in Figure 15.3);
- Adverse Weather routeing passing offshore of Moray East (marked with a “B” in Figure 15.3); and
- Area inshore of Moray East, Moray West, and Beatrice (marked with a “C” in Figure 15.3).

Use of the latter (C) leads to a very large deviation, and therefore this option is used very infrequently. However, the presence of Caledonia OWF, Caledonia South or Caledonia North could lead to an increased need to use that route, given the presence of wind turbines in the area where the more frequent adverse weather routeing occurs (B).

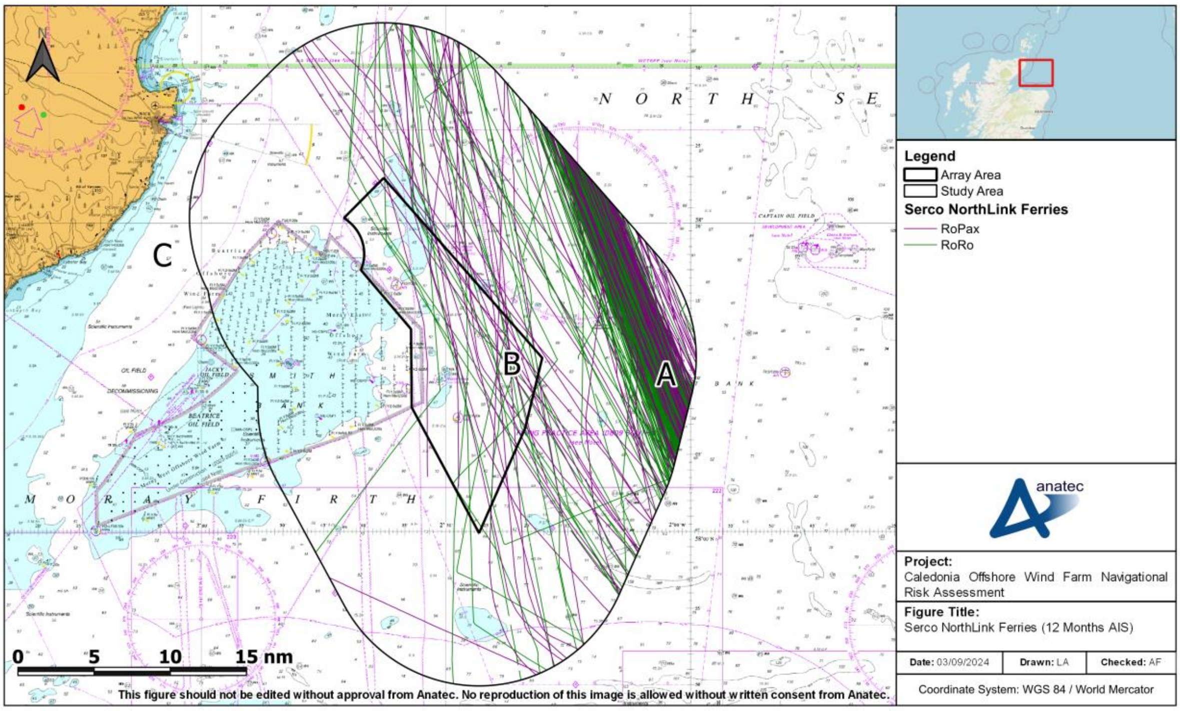

Figure 15.3 Serco NorthLink Adverse Weather Routeing

On the basis of the findings of the AIS analysis and input from Serco NorthLink, the Applicant has implemented a proposed mitigation in the form of a Structure Exclusion Zone (SEZ) to reduce the impact on adverse weather routeing. Further details are provided in Section 17.4 and Section 18.

15.7 Post Wind Farm Fishing Vessel Activity

To maintain a WCS for modelling purposes, it has been conservatively assumed that fishing vessel activity will not change. However, based on consultation input (Section 4), it is likely that fishing vessel transits will change in a post wind scenario, in particular:

- Fishing vessels on a NW/SE transit through the Caledonia OWF (generally from Peterhead) are likely to deviate further offshore rather than transit through given that this would represent a small deviation; and
- Fishing vessels are unlikely to actively fish in or near floating WTGs, fishing within fixed foundations may continue as evidenced from Moray East OWF, however, will likely depend on current conditions, size of vessel, gear type, and the layout.

On this basis, the modelling is considered as being extremely conservative.

16 Collision and Allision Risk Modelling

16.1 Overview

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

16.1.1 Scenarios Under Consideration

For each element of the quantitative assessment, both a pre and post wind farm scenario with base and future case traffic levels have been considered. As a result, 12 distinct scenarios have been modelled:

- Pre wind farm with base case traffic levels;
- Pre wind farm future case with a 10% increase on base case traffic levels;
- Pre wind farm future case with a 20% increase on base case traffic levels;
- Post Caledonia OWF with base case traffic levels;
- Post Caledonia OWF future case with a 10% increase on base case traffic levels;
- Post Caledonia OWF future case with a 20% increase on base case traffic levels;
- Post Caledonia North Site with base case traffic levels;
- Post Caledonia North Site future case with a 10% increase on base case traffic levels;
- Post Caledonia North Site future case with a 20% increase on base case traffic levels;
- Post Caledonia South Site with base case traffic levels;
- Post Caledonia South Site future case with a 10% increase on base case traffic levels;
- Post Caledonia South Site future case with a 20% increase on base case traffic levels;

The results of the base case scenarios are detailed in full in the following subsections, with the equivalent results for each future case scenario provided in Sections 16.3.6, 16.4.6, and 16.5.6.

16.1.2 Hazards Under Consideration

Hazards considered in the quantitative assessment are as follows:

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

The pre wind farm assessment has been informed by the vessel traffic survey data (see Section 10, Appendix E, and other baseline data sources such as Anatec's ShipRoutes database). Conservative assumptions have been made with regard to route deviations and future shipping growth over the lifetime of the Proposed Development (Offshore) (see Section 15.4 for rerouteing assumptions).

16.2 Pre Wind Farm Modelling

16.2.1 Vessel to Vessel Encounters

An assessment of current vessel to vessel encounters has been undertaken by replaying at high speed the vessel traffic data collected as part of the vessel traffic surveys (see Section 10). The model defines an encounter as two vessels passing within 1nm of each other within the same minute. This helps to illustrate where existing shipping congestion is highest and therefore where offshore developments, such as an OWF, could potentially increase congestion and therefore also increase the risk of encounters and collisions. No account of whether encounters are head on or stern to head are given; only close proximity is identified for.

Figure 16.1 presents a heat map based upon the geographical distribution of vessel encounter tracks within a density grid. Following this, Figure 16.2 illustrates the daily number of encounters recorded within both the study area and Caledonia OWF throughout the survey periods.

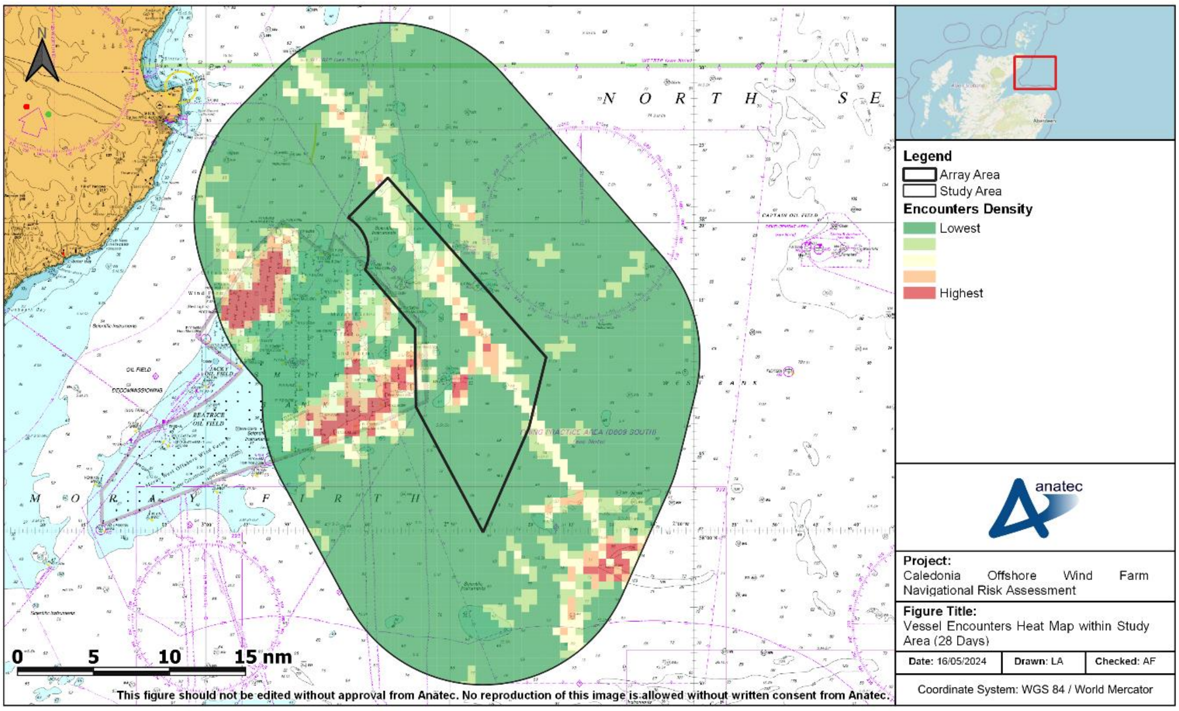

Figure 16.1 Vessel Encounters Heat Map within Study Area (28 Days)

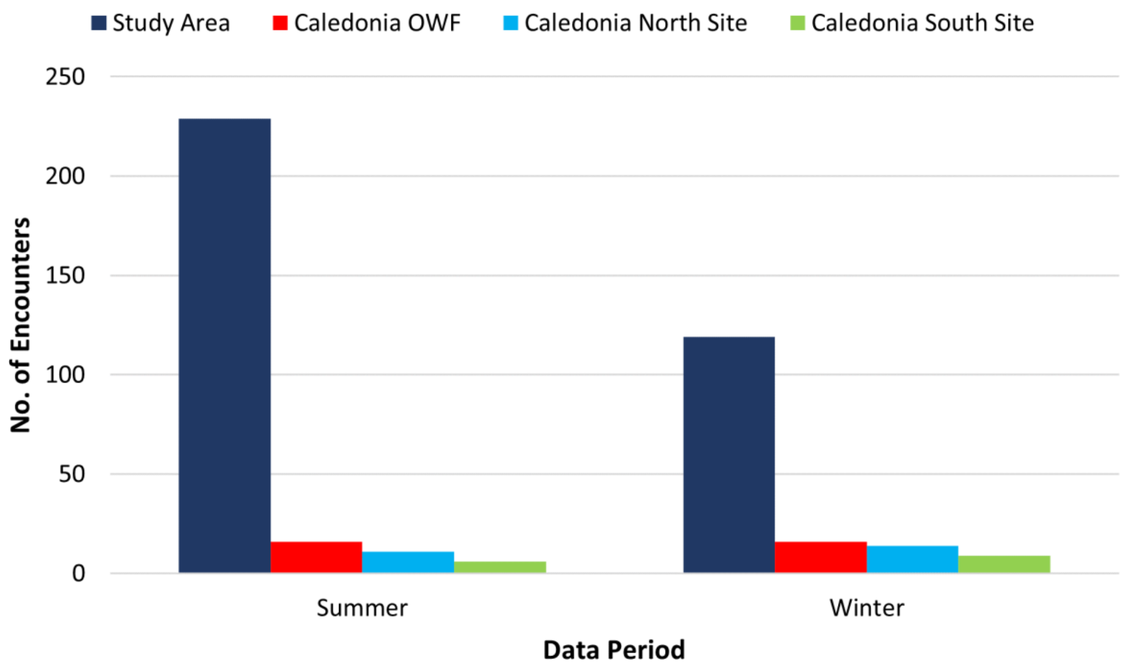

Figure 16.2 Vessel Encounters During Vessel Traffic Surveys (28 Days)

There was an average of 12 encounters per day within the study area during the survey periods. The majority of encounters were observed to be between wind farm vessels at approximately 64%. It should be considered that such encounters are likely to have been part of planned operations by the wind farm operators.

The largest proportion of encounters recorded within the study area occurred outwith Caledonia OWF (91%). The largest number of encounters recorded within the study area on a given day was 30, which occurred on the 27th July 2023, and was primarily due to the presence of wind farm and fishing vessels to the west and south of Caledonia OWF respectively. The Caledonia North Site recorded more encounters than the Caledonia South Site, at 7% and 4% of all encounters respectively. Within the study area as a whole, the largest number of encounters occurred during the summer survey period, whereas within Caledonia OWF itself, there was a greater number of encounters recorded during the winter survey period.

16.2.2 Vessel to Vessel Collisions

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

A heat map based upon the geographical distribution of collision risk within a density grid for the pre wind farm base case is presented in Figure 16.3.

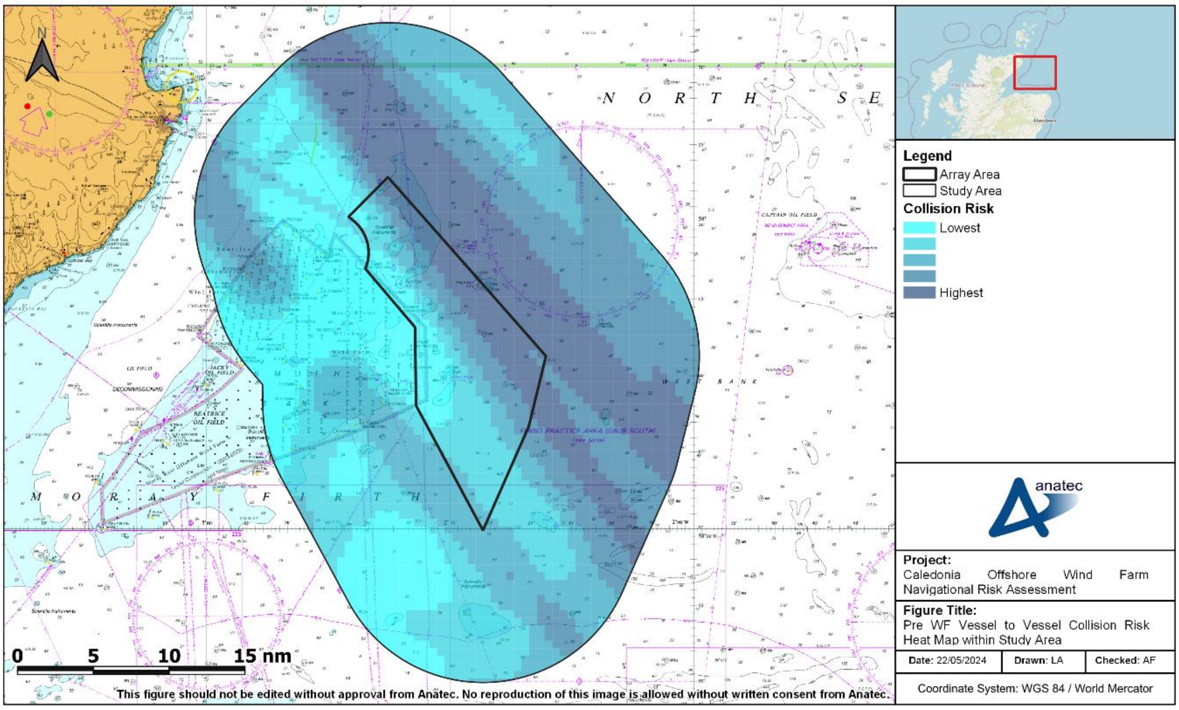

Figure 16.3 Pre Wind Farm Vessel to Vessel Collision Risk Heat Map within Study Area

Assuming base case vessel traffic levels, the annual collision frequency pre wind farm was estimated to be 1.92×10^{-3}, corresponding to a return period of approximately one in 520 years. It is noted that the model is calibrated based upon major incident data at sea which allows for benchmarking but does not cover all incidents. Other incident data, which includes minor incidents, is presented in Section 9.

16.3 Caledonia OWF Post Wind Farm Modelling

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

16.3.1 Simulated Automatic Identification System Data

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

A figure of 28 days of simulated AIS (matching the total duration of the vessel traffic surveys) within the study area, based on the deviated main commercial routes, is presented in Figure 16.4.

It is noted that the simulated AIS represents a WCS based on commercial routes passing at a minimum mean distance of 1 nm from Caledonia OWF.

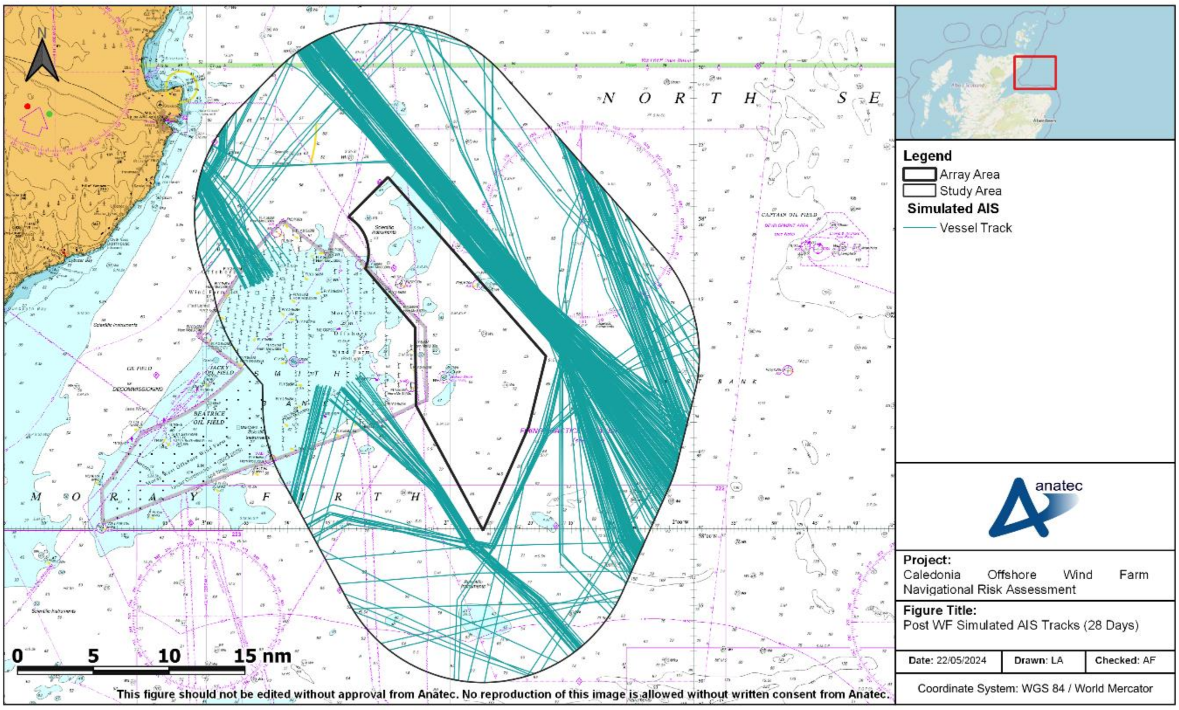

Figure 16.4 Post Wind Farm Simulated AIS Tracks (28 Days)

16.3.2 Vessel to Vessel Collision Risk

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

A heat map based on the geographical distribution of collision risk within a density grid for post wind farm base case is presented in Figure 16.5.

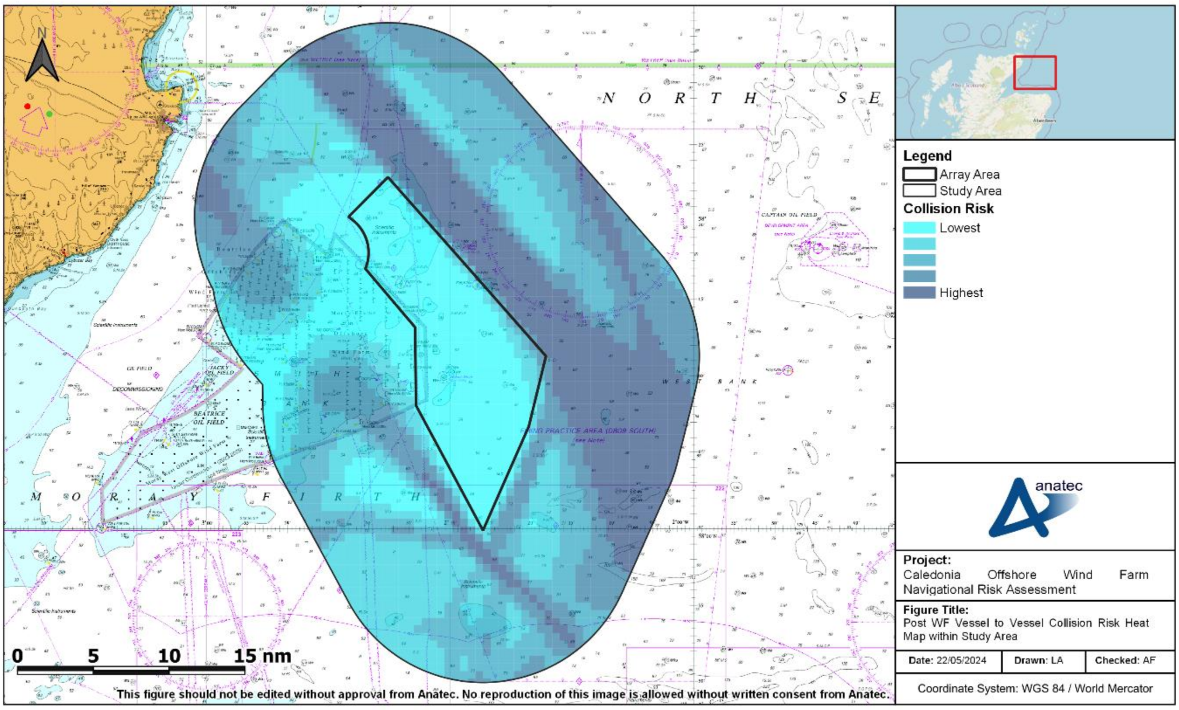

Figure 16.5 Post Wind Farm Vessel to Vessel Collision Risk Heat Map within Study Area

Assuming base case traffic levels, the annual collision frequency post wind farm was estimated to be 3.42×10^{-3}, corresponding to a return period of approximately one in 292 years. This represents a 78% increase in collision frequency compared to the pre wind farm base case result. As per Section 15.4.1, conservative assumptions have been made within the WCS modelled, in particular it is likely that vessels will increase passing distance over that modelled from the Caledonia OWF to utilise the sea room available offshore to the east. This aligns with general consensus of the hazard workshop, which indicated that there is sufficient searoom to the east to safely accommodate the number of expected users.

Based on modelling results, the majority of collision risk is due to vessels deviating to the east of Caledonia OWF.

16.3.3 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 Proposed Development (Offshore), and assumptions that relevant embedded mitigation measures are in place (see Section 17), 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 Proposed Development (Offshore) 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 AtoNs located in the region and those present at the Proposed Development (Offshore) (noting this is observed at other UK wind farms including those with larger minimum spacing than for the Proposed Development (Offshore)). During the construction and decommissioning phases this will primarily consist of the buoyed construction area whilst during the operations and maintenance phase this will primarily consist of the lighting and marking of the wind farm structures.

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

A plot of the annual powered allision frequency per structure for the base case is presented in Figure 16.6, with the chart background removed to increase the visibility of those structures with lower allision frequencies.

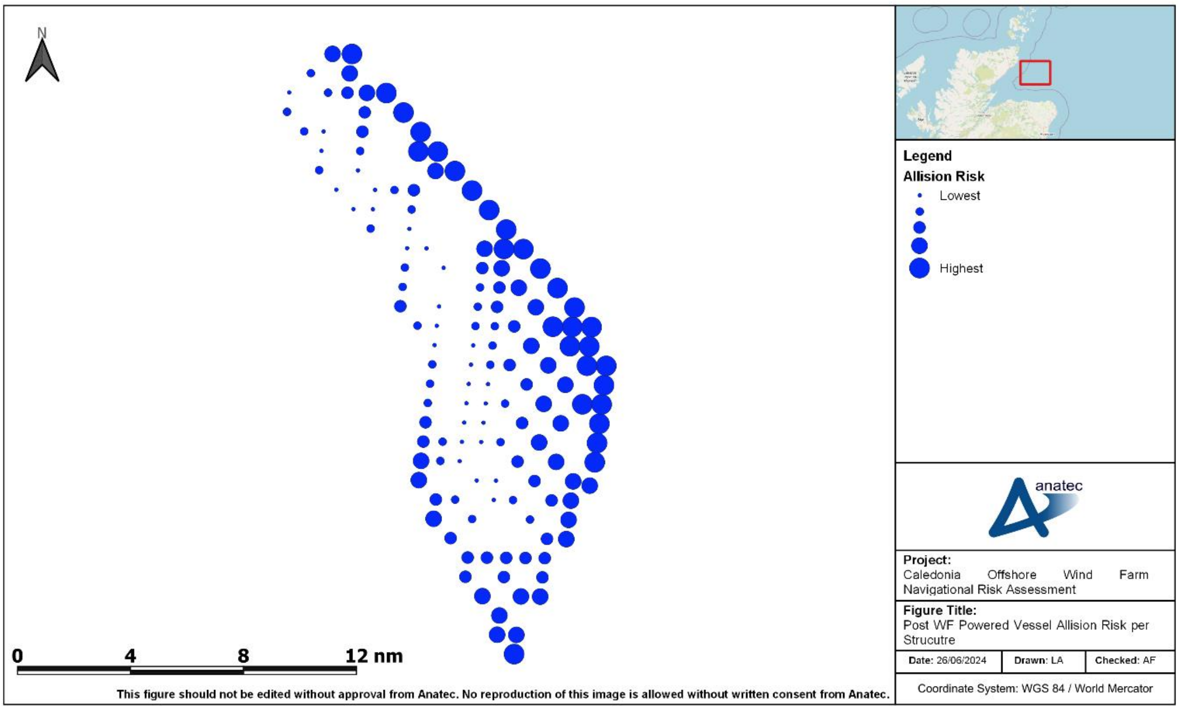

Figure 16.6 Post Wind Farm Vessel Allision Risk per Structure

Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 2.9×10^{-3}, corresponding to a return period of approximately one in 341 years. As per Section 15.4.1, conservative assumptions have been made within the WCS modelled, in particular it is likely that vessels will increase passing distance over that modelled from the Caledonia OWF to utilise the sea room available offshore the east, resulting in lower allision risk.

The greatest powered vessel to structure allision risk was associated with structures along the eastern periphery of Caledonia OWF, where a high volume of traffic from multiple main commercial routes associated with routeing to the West of Scotland, Iceland, and North

America pass. The greatest individual allision risk was associated with the structure on the eastern corner of Caledonia OWF (approximately 4.88×10^{-4} or one in 2,048 years).

16.3.4 Drifting Vessel to Structure Allision

Using the post wind farm routeing as input, together with the worst-case indicative array layout and local metocean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within Caledonia OWF. 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 Caledonia OWF (up to 10nm from the Array 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 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 Caledonia OWF was estimated. The probability of a vessel drifting towards a wind farm structure and the drift speed are dependent on the prevailing wind, wave, and tidal conditions at the time of the incident. Therefore, three drift scenarios were modelled, each using the metocean data provided in Section 8:

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

After modelling the three drifting scenarios, it was established that the flood tide dominated scenario produced the worst-case results. A plot of the annual drifting allision frequency per structure for the base case is presented in Figure 16.7 with the chart background removed to increase the visibility of those structures with a low allision frequency.

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

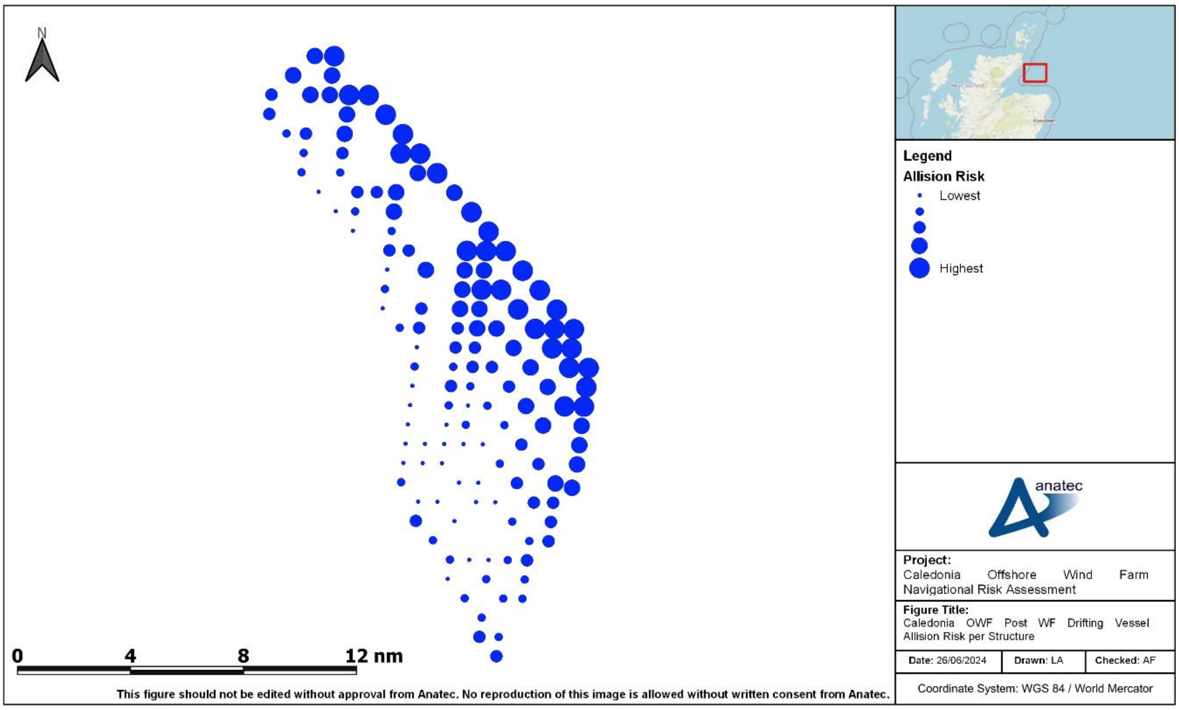

Figure 16.7 Caledonia OWF Post Wind Farm Drifting Vessel Allision Risk per Structure

Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 2.47×10^{-4}, corresponding to a return period of approximately one in 4,054 years.

The greatest drifting vessel to structure allision risk was associated with structures at the eastern extent of Caledonia OWF where a high volume of traffic from multiple main commercial routes associated with routeing to the West of Scotland, Iceland, and North America pass. The greatest individual allision risk was associated with the WTG just above the eastern corner (approximately 4.89×10^{-5} or one in 20,462 years).

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

16.3.5 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 wind farm structures within Caledonia OWF.

A fishing vessel allision is classified separately from other allisions since fishing vessels may be either in transit or actively fishing within Caledonia OWF (unlike the transiting commercial traffic characterised by the main commercial routes). Additionally, fishing vessels could be observed internally within Caledonia OWF (i.e., between structures) as well as externally. Anatec's model uses vessel numbers, sizes (length and beam), array layout and structure dimensions. The likelihood of a major allision incident has been calibrated against historical maritime incident data and historical AIS vessel traffic data within operational wind farm arrays. Given that not all fishing vessels broadcast on AIS, the vessel density observed is scaled up to account for non-AIS fishing vessels, with the scaling factor dependent on the distance of the array offshore.

The model conservatively assumes no change in baseline fishing activity i.e., no account is made of vessels passing over or in close proximity to structure locations choosing to increase passing distance post wind farm. Further details of this conservatism are provided in Section 15.6.

A plot of the annual fishing vessel allision frequency per structure for the base case is presented in Figure 16.9.

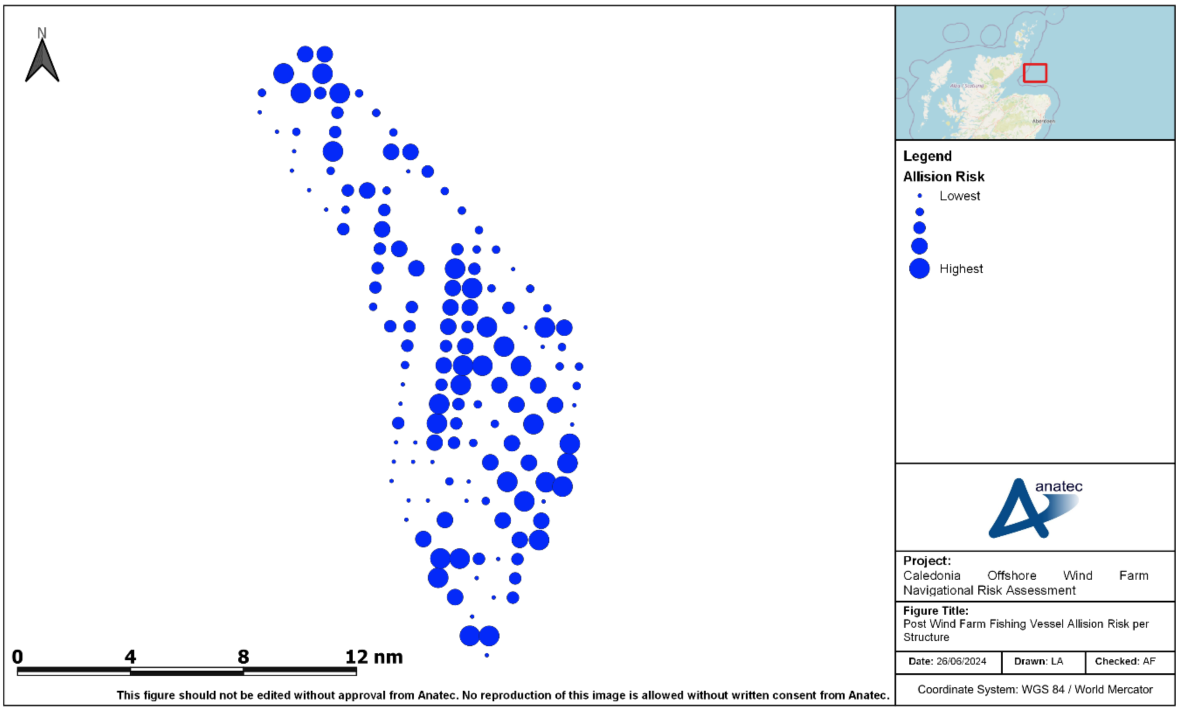

Figure 16.8 Caledonia OWF Post Wind Farm Fishing Vessel Allision Risk per Structure

Assuming base case traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 2.89×10^{-1} corresponding to a return period of approximately one in 3.5 years. As detailed above, the model conservatively assumes that there will be no change in baseline fishing vessel activity (Section 15.6). In reality, it is likely that fishing vessels will change behaviour to account for the presence of the Caledonia OWF. This aligns with consultation input from the hazard workshop where it was indicated that:

- It is likely that fishing vessels from Peterhead would choose to transit north of the Array Area given it was a small deviation (rather than transiting through as the model has assumed); and

- Fishing vessels may deviate around the floating structures, but may undertake fishing amongst the fixed structures.

On this basis, it is considered likely that the actual allision return period will be notably lower than the quantitative modelled output.

The fishing vessel to structure allision risk was distributed throughout Caledonia OWF, reflective of the fishing activity occurring. The greatest individual allision risk was associated with a WTG near the centre of Caledonia OWF (approximately 1.33×10^{-2} or one in 75 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).

16.3.6 Risk Result 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 have also been modelled for future case traffic levels (both 10% and 20% increases). Table 16.1 summarises the results of all six scenarios.

Table 16.1 Caledonia OWF Risk Result Summary

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.92×10^{-3} (1 in 520 years)	3.42×10^{-3} (1 in 292 years)	1.50×10^{-3} (1 in 667 years)
	Future case (10%)	2.42×10^{-3} (1 in 413 years)	4.29×10^{-3} (1 in 232 years)	1.87×10^{-3} (1 in 533 years)
	Future case (20%)	2.86×10^{-3} (1 in 350 years)	5.07×10^{-3} (1 in 197 years)	2.21×10^{-3} (1 in 451 years)
Powered vessel to structure allision	Base case	-	2.93×10^{-3} (1 in 341 years)	2.93×10^{-3} (1 in 341 years)
	Future case (10%)	-	3.25×10^{-3} (1 in 307 years)	3.25×10^{-3} (1 in 307 years)
	Future case (20%)	-	3.55×10^{-3} (1 in 282 years)	3.55×10^{-3} (1 in 282 years)
Drifting vessel to structure allision	Base case	-	2.47×10^{-4} (1 in 4,054 years)	2.47×10^{-4} (1 in 4,054 years)
	Future case (10%)	-	2.71×10^{-4} (1 in 3,685 years)	2.71×10^{-4} (1 in 3,685 years)
	Future case (20%)	-	2.96×10^{-4} (1 in 3,377 years)	2.96×10^{-4} (1 in 3,377 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Fishing vessel to structure allision	Base case	-	2.89×10^{-1} (1 in 3.5 years)	2.89×10^{-4} (1 in 3.5 years)
	Future case (10%)	-	3.17×10^{-1} (1 in 3.2 years)	3.17×10^{-1} (1 in 3.2 years)
	Future case (20%)	-	3.45×10^{-1} (1 in 2.9 years)	3.45×10^{-1} (1 in 2.9 years)
Total	**Base case**	**1.92×10^{-3} (1 in 520 years)**	**2.95×10^{-1} (1 in 3.4 years)**	**2.94×10^{-1} (1 in 3.4 years)**
	Future case (10%)	**2.42×10^{-3} (1 in 413 years)**	**3.25×10^{-1} (1 in 3.1 years)**	**3.22×10^{-1} (1 in 3.1 years)**
	Future case (20%)	**2.86×10^{-3} (1 in 350 years)**	**3.54×10^{-1} (1 in 2.8 years)**	**3.51×10^{-1} (1 in 2.8 years)**

16.4 Caledonia North Site Post Wind Farm Modelling

16.4.1 Simulated Automatic Identification System Data

As described in relation to Caledonia OWF in Section 16.3.1, Anatec's AIS Simulator software was used to gain an insight into the potential re-routed commercial traffic following the installation of the wind farm structures within the Caledonia North Site.

A figure of 28 days of simulated AIS (matching the total duration of the vessel traffic surveys) within the study area, based on the deviated main commercial routes, is presented in Figure 16.9.

It is noted that the simulated AIS represents a WCS based on commercial routes passing at a minimum mean distance of 1nm from the Caledonia North Site.

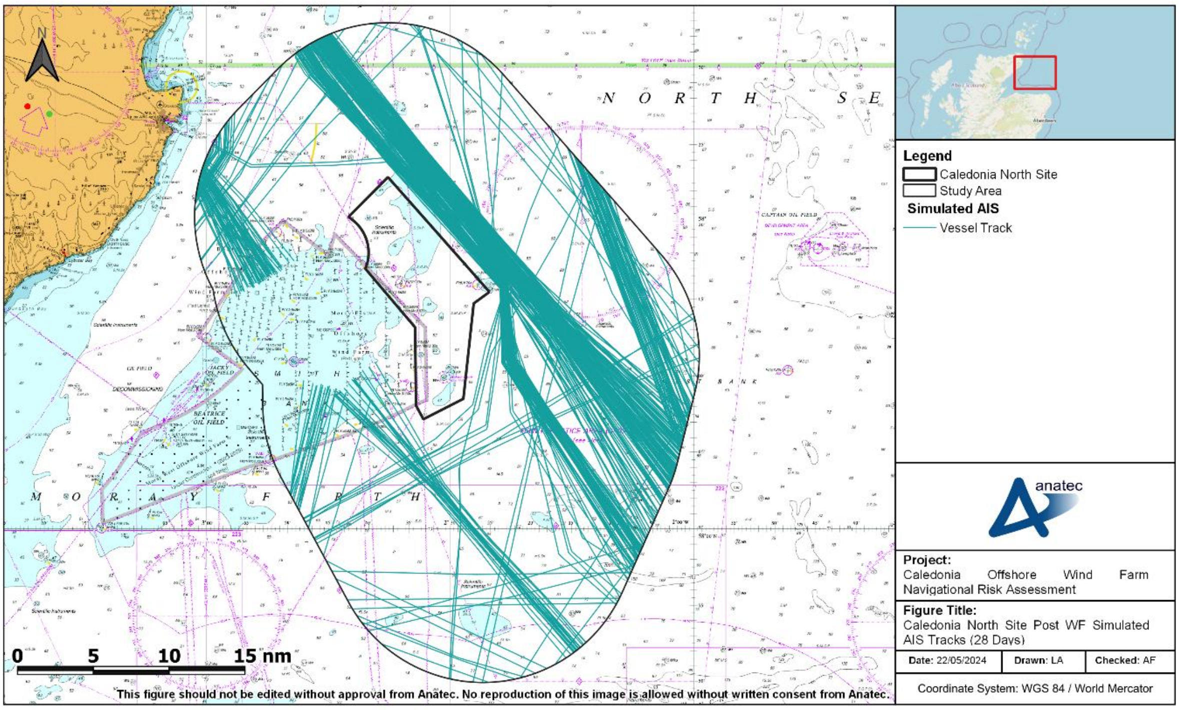

Figure 16.9 Caledonia North Site Post Wind Farm Simulated AIS Tracks (28 Days)

16.4.2 Vessel to Vessel Collision Risk

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

A heat map based on the geographical distribution of collision risk within a density grid for the Caledonia North Site post wind farm base case is presented in Figure 16.10.

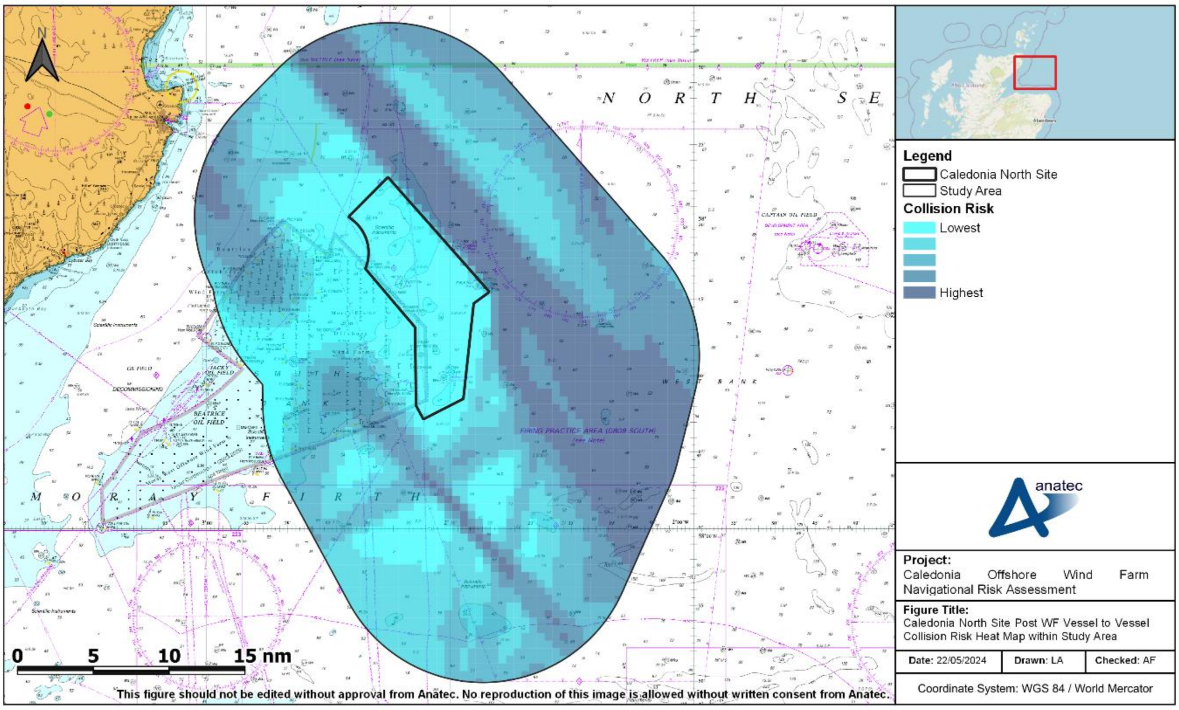

Figure 16.10 Caledonia North Site Post Wind Farm Vessel to Vessel Collision Risk Heat Map within Study Area

Assuming base case traffic levels, the annual collision frequency post wind farm was estimated to be 3.01×10^{-3}, corresponding to a return period of approximately one in 332 years. This represents a 57% increase in collision frequency compared to the pre wind farm base case result. As per Section 15.4.1, conservative assumptions have been made within the WCS modelled, in particular it is likely that vessels will increase passing distance over that modelled from the Caledonia OWF to utilise the sea room available offshore the east. This aligns with general consensus of the hazard workshop, which indicated that there is sufficient searoom to the east to safely accommodate the number of expected users.

Based on modelling results, the majority of collision risk is associated with vessels passing to the east of the Caledonia North Site.

16.4.3 Powered Vessel to Structure Allision

Following the methodology and assumptions noted in Section 16.3.3, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within the Caledonia North Site whilst under power. A plot of the annual powered allision frequency per structure for the Caledonia North Site base case is presented in Figure 16.11, with the chart background removed to increase the visibility of those structures with lower allision frequencies.

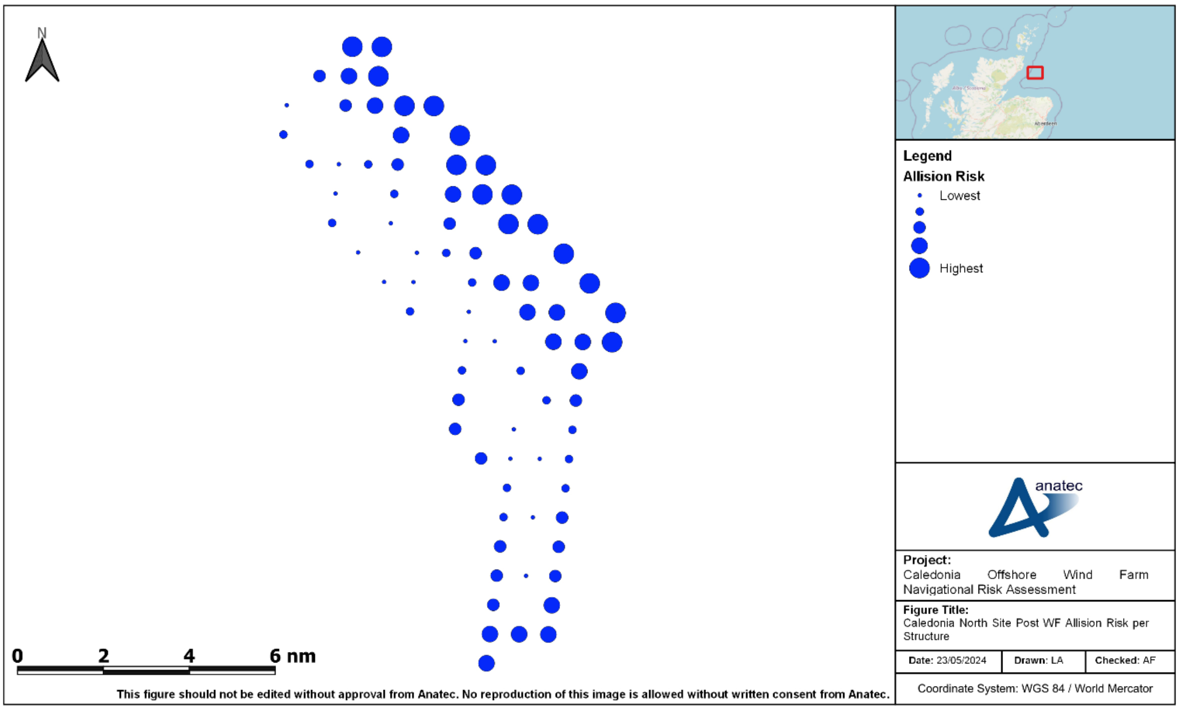

Figure 16.11 Caledonia North Site Post Wind Farm Allision Risk per Structure

Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 5.15×10^{-4}, corresponding to a return period of approximately one in 1,943 years. This result was observed to be lower than that estimated for Caledonia OWF and the Caledonia South Site. The key factors behind the reduction was observed to be the smaller size of the fixed foundations and the assumed behaviour of vessels within the WCS on the eastern periphery of Caledonia OWF and the Caledonia South Site. Given the available sea room, it is not considered that there is a large difference in powered allision risk between the three scenarios on a qualitative basis. This is discussed further in the respective sections for Caledonia OWF and the Caledonia South Site.

The greatest powered vessel to structure allision risk was associated with structures at the eastern extent of the Caledonia North Site where a high volume of traffic from multiple main commercial routes associated with routeing to the West of Scotland, Iceland, and North America pass. The greatest individual allision risk was associated with the most eastern structure of the Caledonia North Site (approximately 8.42×10^{-5} or one in 11,882 years).

16.4.4 Drifting Vessel to Structure Allision

Applying the methodology stated in Section 16.3.4, after modelling the three drifting scenarios for the Caledonia North Site, it was established that the flood dominated scenario produced the worst-case results. A plot of the annual drifting allision frequency per structure for the base case is presented in Figure 16.12, with the chart background removed to increase the visibility of those structures with a low allision frequency.

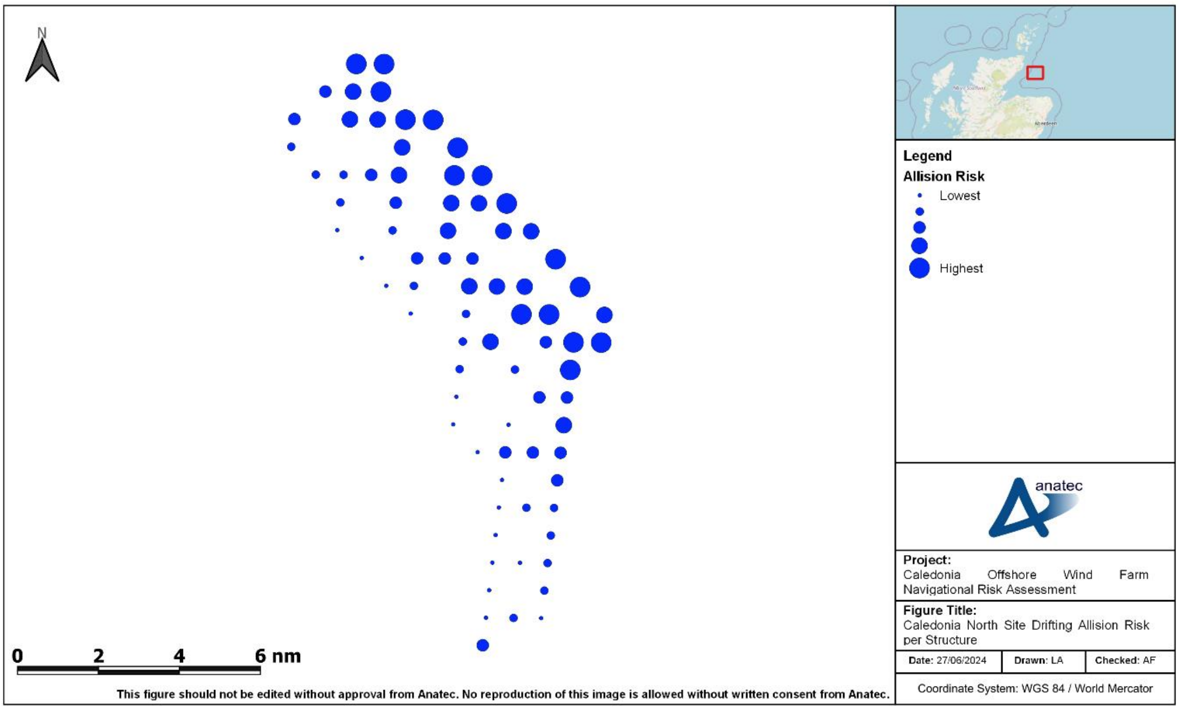

Figure 16.12 Caledonia North Site Drifting Vessel Allision Risk per Structure

Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 9.18×10^{-5}, corresponding to a return period of approximately one in 10,897 years.

The greatest drifting vessel to structure allision risk was associated with structures at the eastern extent of the Caledonia North Site where a high volume of traffic from multiple main commercial routes associated with routeing to the West of Scotland, Iceland, and North America pass. The greatest individual allision risk was associated with a WTG along the northeastern periphery of the Caledonia North Site (approximately $3.24\text{x}10^{-5}$ or one in 30,869 years).

16.4.5 Fishing Vessel to Structure Allision

As described in relation to Caledonia OWF, Anatec's COLLRISK model was run to estimate the likelihood of a fishing vessel alliding with one of the wind farm structures within the Caledonia North Site.

The model conservatively assumes no change in baseline fishing activity i.e., no account is made of vessels passing over or in close proximity to structure locations choosing to increase passing distance post wind farm. Further details of this conservatism are provided in Section 15.6.

A plot of the annual fishing vessel allision frequency per structure within the Caledonia North Site for the base case is presented in Figure 16.13.

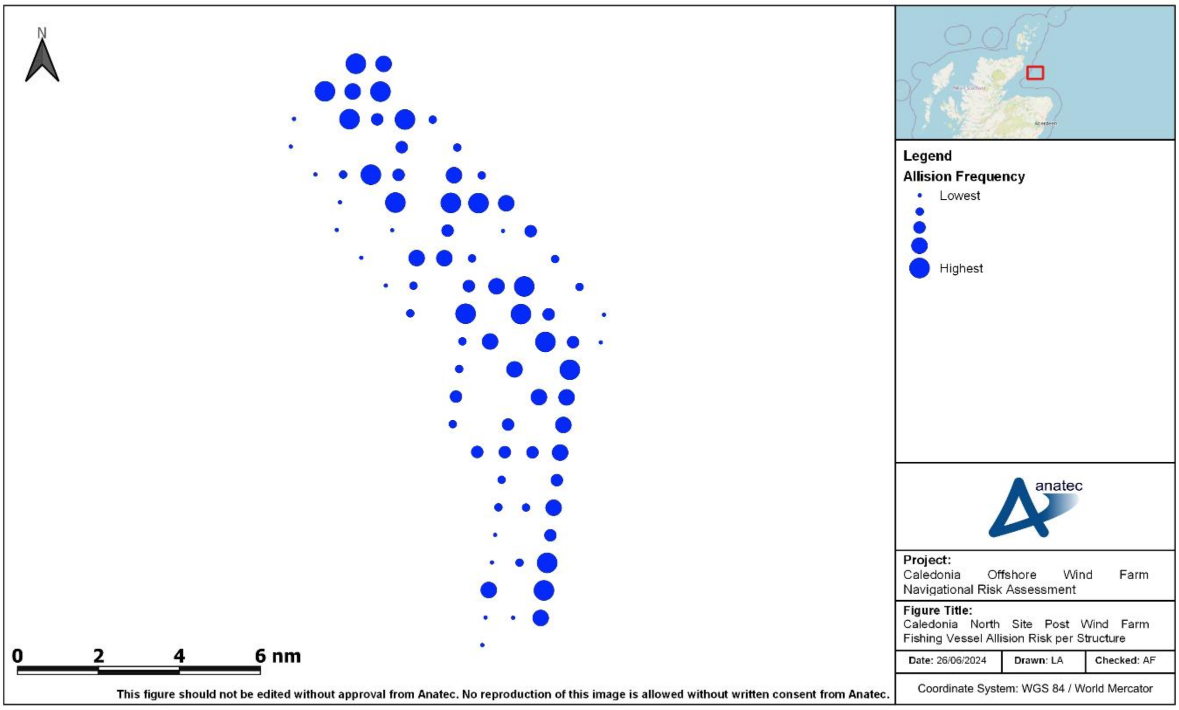

Figure 16.13 Caledonia North Site Post Wind Farm Fishing Vessel Allision Risk per Structure

Assuming base case traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 1.38×10^{-1}, corresponding to a return period of approximately one in 7.2 years.

However, for the reasons detailed in Section 16.3.5, it is considered likely that the actual allision return period will be notably lower than the quantitative modelled output.

The fishing vessel to structure allision risk was distributed throughout the Caledonia North Site, reflective of the fishing activity occurring. The greatest individual allision risk was associated with a WTG towards the south of the Caledonia North Site (approximately $1.59\text{x}10^{-2}$ or one in 63 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).

16.4.6 Risk Result Summary

Similar to Caledonia OWF in Section 16.3.6, in order to incorporate the potential for future traffic growth, pre and post wind farm scenarios have also been modelled for future case traffic levels (both 10% and 20% increases) in relation to the Caledonia North Site. Table 16.2 summarises the results of all six scenarios.

Table 16.2 Caledonia North Site Risk Result Summary

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.92×10^{-3} (1 in 520 years)	3.01×10^{-3} (1 in 332 years)	1.09×10^{-3} (1 in 919 years)
	Future case (10%)	2.42×10^{-3} (1 in 413 years)	3.77×10^{-3} (1 in 265 years)	1.35×10^{-3} (1 in 740 years)
	Future case (20%)	2.86×10^{-3} (1 in 350 years)	4.45×10^{-3} (1 in 224 years)	1.60×10^{-3} (1 in 625 years)
Powered vessel to structure allision	Base case	-	5.15×10^{-4} (1 in 1,943 years)	5.15×10^{-4} (1 in 1,943 years)
	Future case (10%)	-	5.73×10^{-4} (1 in 1,744 years)	5.73×10^{-4} (1 in 1,744 years)
	Future case (20%)	-	6.23×10^{-4} (1 in 1,603 years)	6.23×10^{-4} (1 in 1,603 years)
Drifting vessel to structure allision	Base case	-	9.18×10^{-5} (1 in 10,897 years)	9.18×10^{-5} (1 in 10,897 years)
	Future case (10%)	-	1.01×10^{-4} (1 in 9,906 years)	1.01×10^{-4} (1 in 9,906 years)
	Future case (20%)	-	1.10×10^{-4} (1 in 9,080)	1.10×10^{-4} (1 in 9,080)
Fishing vessel to structure allision	Base case	-	1.38×10^{-1} (1 in 7.2 years)	1.38×10^{-1} (1 in 7.2 years)
	Future case (10%)	-	1.52×10^{-1} (1 in 6.6 years)	1.52×10^{-1} (1 in 6.6 years)
	Future case (20%)	-	1.65×10^{-1} (1 in 6.1 years)	1.65×10^{-1} (1 in 6.1 years)
Total	**Base case**	**1.92×10^{-3} (1 in 520 years)**	**1.42×10^{-1} (1 in 7.1 years)**	**1.40×10^{-1} (1 in 7.1 years)**
	Future case (10%)	**2.42×10^{-3} (1 in 413 years)**	**1.56×10^{-1} (1 in 6.4 years)**	**1.54×10^{-1} (1 in 6.5 years)**
	Future case (20%)	**2.86×10^{-3} (1 in 350 years)**	**1.70×10^{-1} (1 in 5.9 years)**	**1.68×10^{-1} (1 in 6 years)**

16.5 Caledonia South Site Post Wind Farm Modelling

16.5.1 Simulated Automatic Identification System Data

As described in relation to Caledonia OWF and the Caledonia North Site in Section 16.3.1 and Section 16.4.1 respectively, Anatec's AIS Simulator software was used to gain an insight into the potential re-routed commercial traffic following the installation of the wind farm structures within the Caledonia South Site.

A figure of 28 days of simulated AIS (matching the total duration of the vessel traffic surveys) within the study area, based on the deviated main commercial routes, is presented in Figure 16.14.

It is noted that the simulated AIS represents a WCS based on commercial routes passing at a minimum mean distance of 1nm from Caledonia South Site.

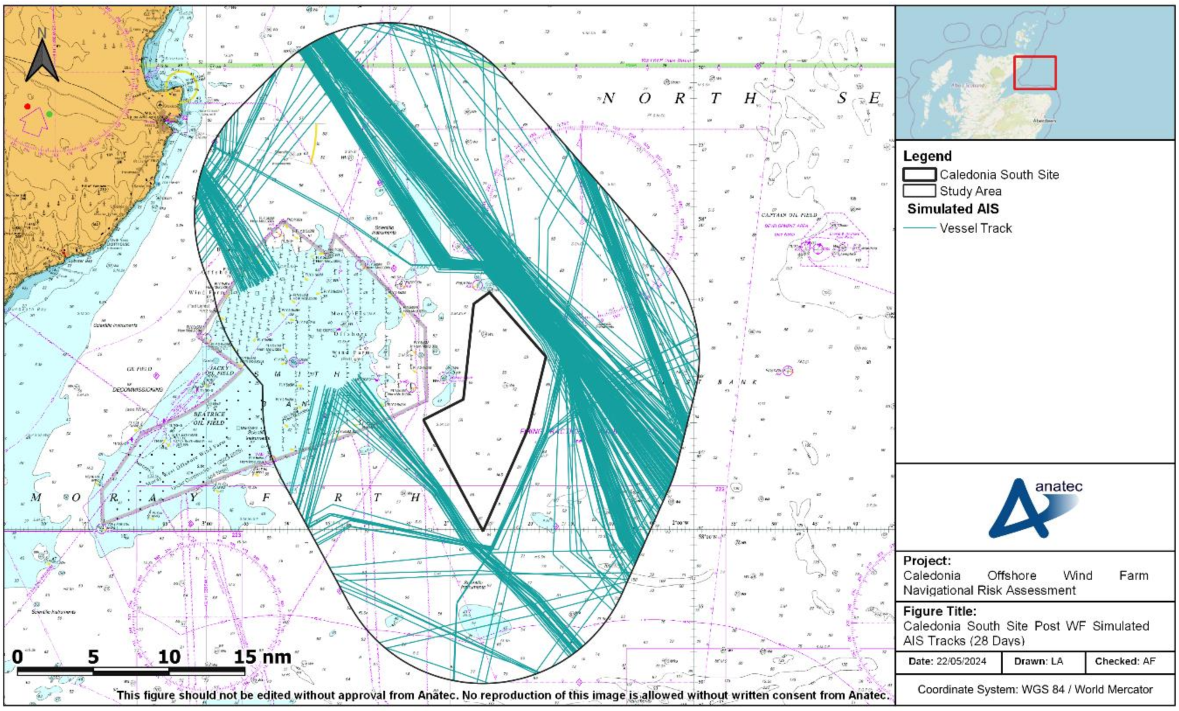

Figure 16.14 Caledonia South Site Post Wind Farm Simulated AIS Tracks (28 Days)

16.5.2 Vessel to Vessel Collision Risk

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

A heat map based on the geographical distribution of collision risk within a density grid for the Caledonia South Site post wind farm base case is presented in Figure 16.15.

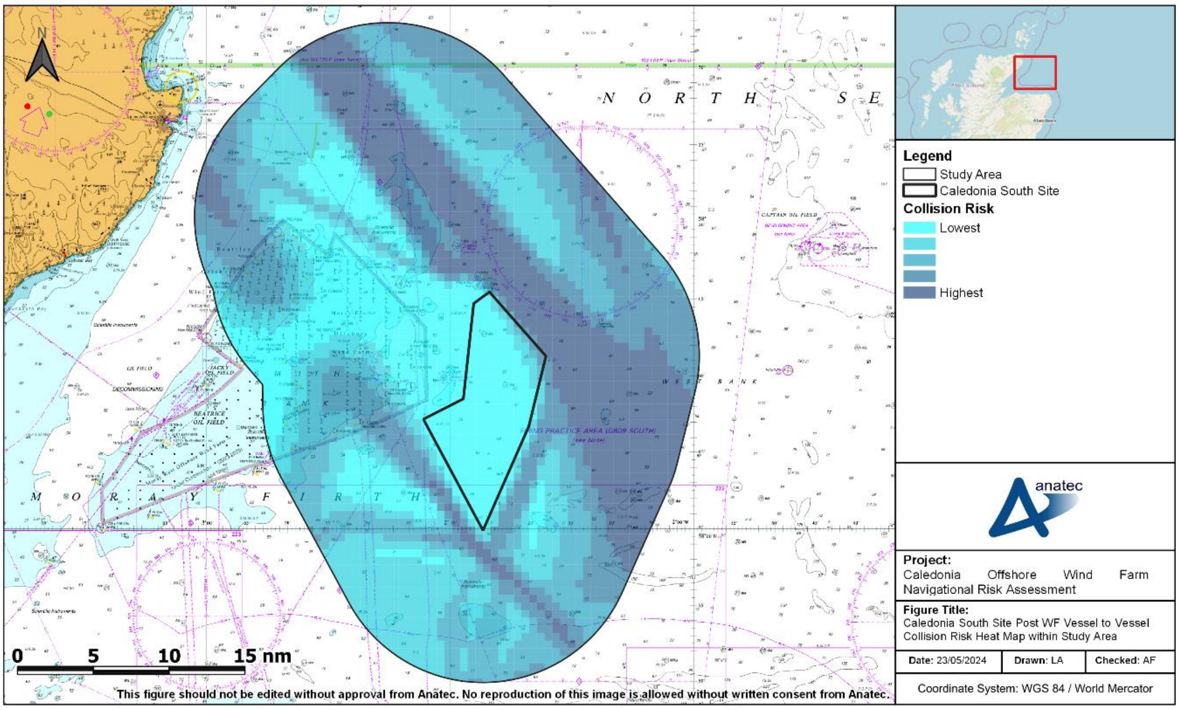

Figure 16.15 Caledonia South Site Post Wind Farm Vessel to Vessel Collision Risk Heat Map within Study Area

Assuming base case traffic levels, the annual collision frequency post wind farm was estimated to be 3.13×10^{-3}, corresponding to a return period of approximately one in 319 years. This represents a 63% increase in collision frequency compared to the pre wind farm base case result. As per Section 15.4.1, conservative assumptions have been made within the WCS modelled, in particular it is likely that vessels will increase passing distance over that modelled from the Caledonia OWF to utilise the sea room available offshore the east. This aligns with general consensus of the hazard workshop, which indicated that there is sufficient searoom to the east to safely accommodate the number of expected users.

Based on modelling results, the majority of collision risk is associated with vessels passing to the east of the Caledonia South Site.

16.5.3 Powered Vessel to Structure Allision

Following the methodology and assumptions noted in Section 16.3.3, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within the Caledonia South Site whilst under power. A plot of the annual powered allision frequency per structure for the Caledonia South Site base case is presented in Figure 16.16, with the chart background removed to increase the visibility of those structures with lower allision frequencies.

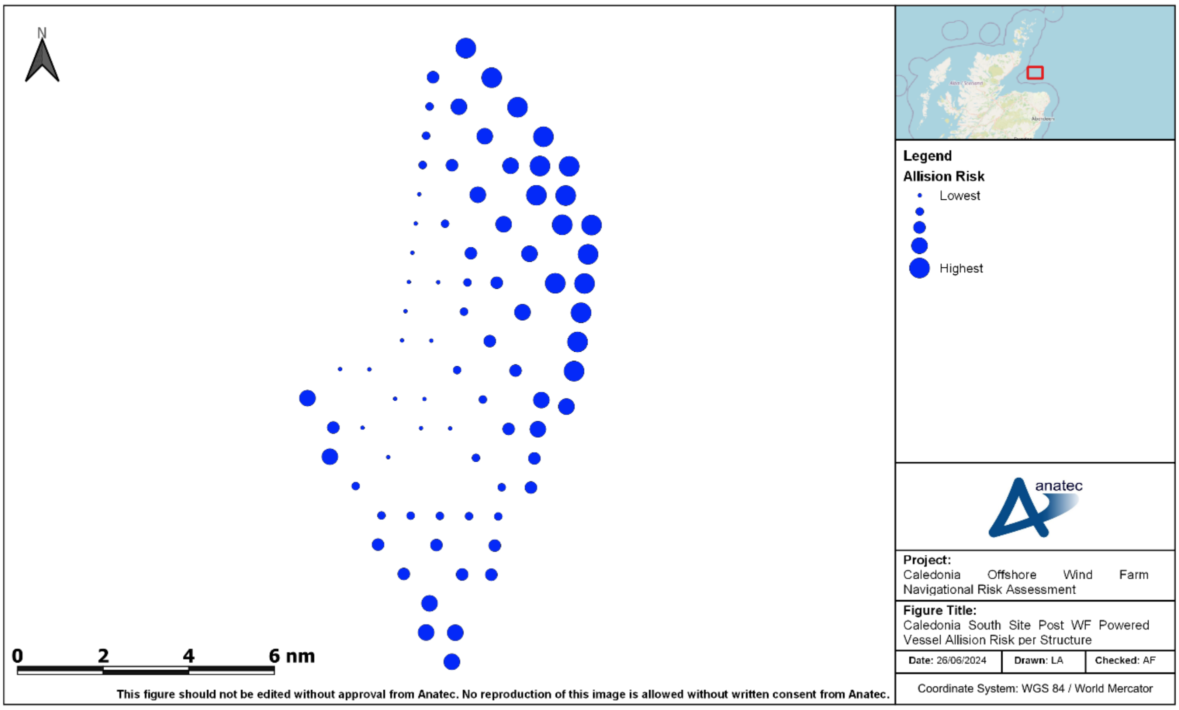

Figure 16.16 Caledonia South Site Post Wind Farm Allision Risk per Structure

Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 2.43×10^{-3}, corresponding to a return period of approximately one in 412 years. As per Section 15.4.1, conservative assumptions have been made within the WCS modelled, in particular it is likely that vessels will increase passing distance over that modelled from the Caledonia OWF to utilise the sea room available offshore the east, resulting in lower allision risk.

The greatest powered vessel to structure allision risk was associated with structures at the eastern extent of the Caledonia South Site where a high volume of traffic from multiple main commercial routes associated with routeing to the West of Scotland, Iceland, and North America pass. The greatest individual allision risk was associated with the structure on the northeastern corner of the Caledonia South Site (approximately 4.88×10^{-4} or one in 2,048 years).

16.5.4 Drifting Vessel to Structure Allision

Applying the methodology stated in Section 16.3.4, after modelling the three drifting scenarios for the Caledonia South Site, it was established that the flood dominated scenario produced the worst-case results. A plot of the annual drifting allision frequency per structure for the base case is presented in Figure 16.17, with the chart background removed to increase the visibility of those structures with a low allision frequency.

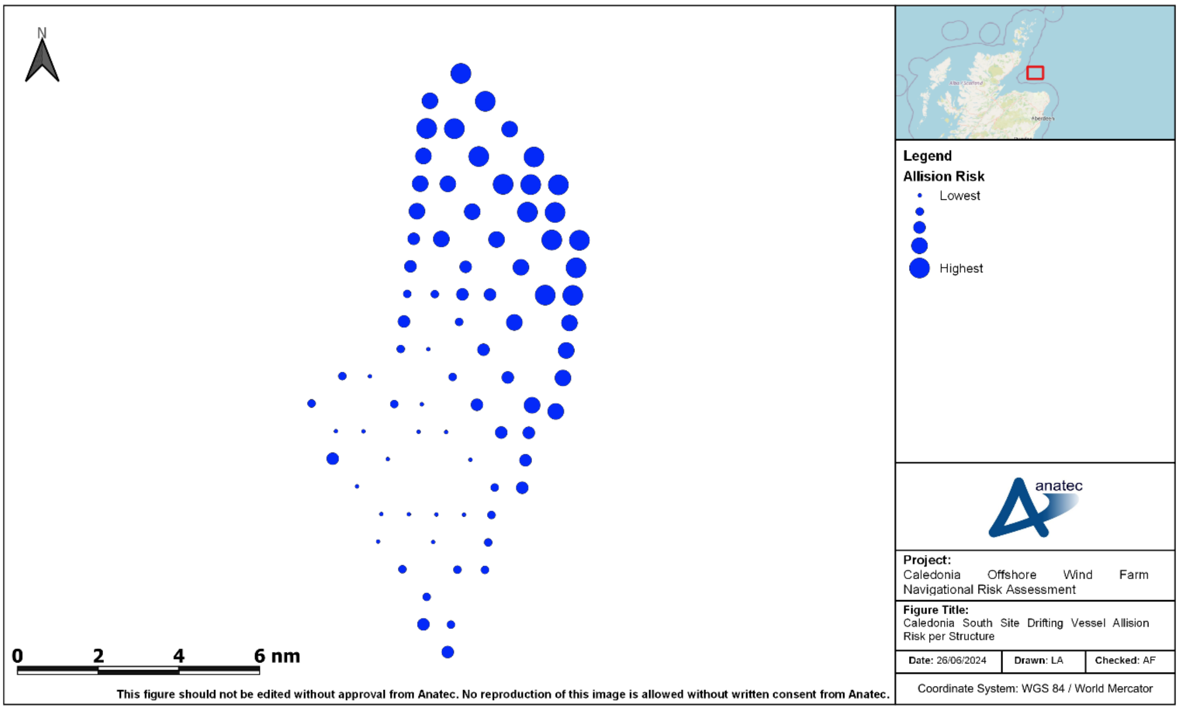

Figure 16.17 Caledonia South Site Drifting Vessel Allision Risk per Structure

Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 1.42×10^{-4}, corresponding to a return period of approximately one in 7,018 years.

The greatest drifting vessel to structure allision risk was associated with structures at the eastern extent of the Caledonia South Site where a high volume of traffic from multiple main commercial routes associated with routeing to the West of Scotland, Iceland, and North America pass. The greatest individual allision risk was associated with the WTG above the eastern corner of the Caledonia South Site (approximately $4.88\text{x}10^{-5}$ or one in 20,461 years).

16.5.5 Fishing Vessel to Structure Allision

As described in relation to Caledonia OWF, Anatec's COLLRISK model was run to estimate the likelihood of a fishing vessel alliding with one of the wind farm structures within the Caledonia South Site.

The model conservatively assumes no change in baseline fishing activity i.e., no account is made of vessels passing over or in close proximity to structure locations choosing to increase passing distance post wind farm. Further details of this conservatism are provided in Section 15.6.

A plot of the annual fishing vessel allision frequency per structure within the Caledonia South Site for the base case is presented in Figure 16.18.

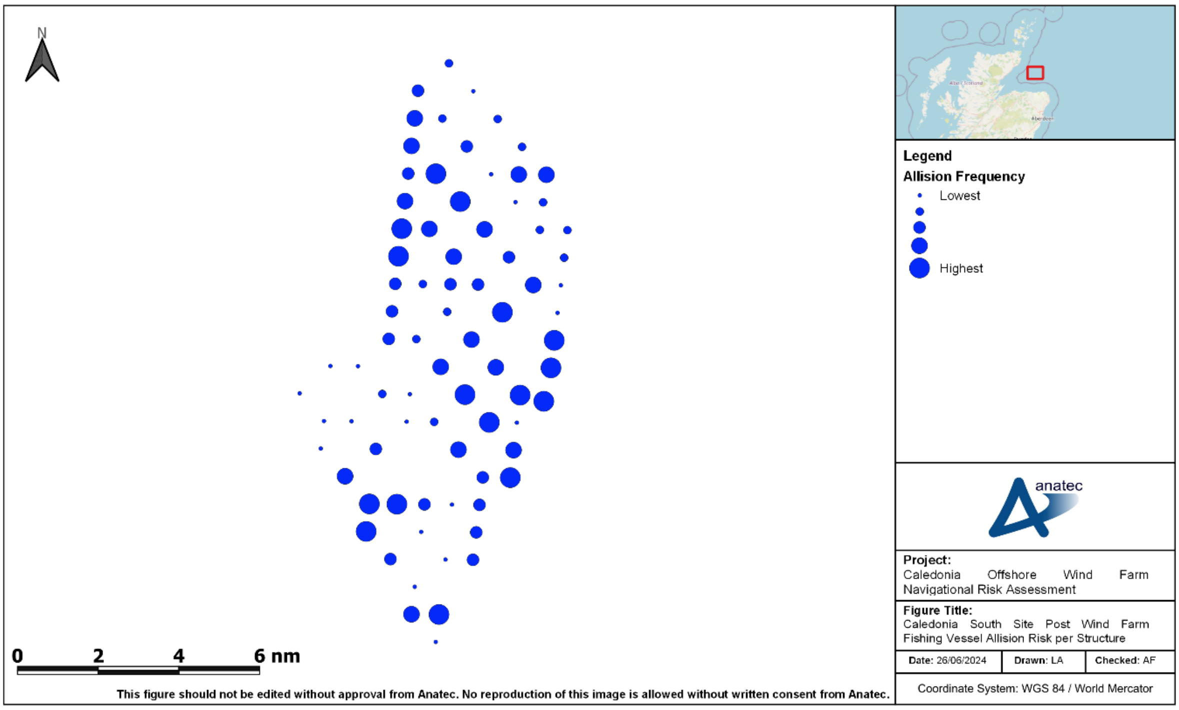

Figure 16.18 Caledonia South Site Post Wind Farm Fishing Vessel Allision Risk per Structure

Assuming base case traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 1.85×10^{-1}, corresponding to a return period of approximately one in 5.4 years.

However, for the reasons detailed in Section 16.3.5, it is considered likely that the actual allision return period will be notably lower than the quantitative modelled output.

The fishing vessel to structure allision risk was distributed throughout the Caledonia South Site, reflective of the fishing activity occurring. The greatest individual allision risk was associated with a WTG at the northwest periphery of the Caledonia South Site (approximately 1.09×10^{-2} or one in 91 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).

16.5.6 Risk Result Summary

Similar to Caledonia OWF in Section 16.3.6 and the Caledonia North Site in Section 16.4.6, in order to incorporate the potential for future traffic growth, pre and post wind farm scenarios have also been modelled for future case traffic levels (both 10% and 20% increases) in relation to the Caledonia South Site. Table 16.3 summarises the results of all six scenarios.

Table 16.3 Caledonia South Site Risk Result Summary

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.92×10^{-3} (1 in 520 years)	3.13×10^{-3} (1 in 319 years)	1.21×10^{-3} (1 in 827 years)
	Future case (10%)	2.42×10^{-3} (1 in 413 years)	3.93×10^{-3} (1 in 254 years)	1.51×10^{-3} (1 in 663 years)
	Future case (20%)	2.86×10^{-3} (1 in 350 years)	4.64×10^{-3} (1 in 215 years)	1.78×10^{-3} (1 in 561 years)
Powered vessel to structure allision	Base case	-	2.43×10^{-3} (1 in 412 years)	2.43×10^{-3} (1 in 412 years)
	Future case (10%)	-	2.70×10^{-3} (1 in 370 years)	2.70×10^{-3} (1 in 370 years)
	Future case (20%)	-	2.94×10^{-3} (1 in 340 years)	2.94×10^{-3} (1 in 340 years)
Drifting vessel to structure allision	Base case	-	1.42×10^{-4} (1 in 7,018 years)	1.42×10^{-4} (1 in 7,018 years)
	Future case (10%)	-	1.57×10^{-4} (1 in 6,380 years)	1.57×10^{-4} (1 in 6,380 years)
	Future case (20%)	-	1.71×10^{-4} (1 in 5,848 years)	1.71×10^{-4} (1 in 5,848 years)
Fishing vessel to structure allision	Base case	-	1.85×10^{-1} (1 in 5.4 years)	1.85×10^{-1} (1 in 5.4 years)
	Future case (10%)	-	2.03×10^{-1} (1 in 4.9 years)	2.03×10^{-1} (1 in 4.9 years)
	Future case (20%)	-	2.21×10^{-1} (1 in 4.5 years)	2.21×10^{-1} (1 in 4.5 years)
Total	**Base case**	**1.92×10^{-3} (1 in 520 years)**	**1.91×10^{-1} (1 in 5.2 years)**	**1.90×10^{-1} (1 in 5.3 years)**
	Future case (10%)	**2.42×10^{-3} (1 in 413 years)**	**2.10×10^{-1} (1 in 4.8 years)**	**2.10×10^{-1} (1 in 4.8 years)**
	Future case (20%)	**2.86×10^{-3} (1 in 350 years)**	**2.29×10^{-1} (1 in 4.4 years)**	**2.26×10^{-1} (1 in 4.4 years)**

17 Mitigation Measures

17.1 Embedded Mitigation Measures

As part of the design process for the Proposed Development (Offshore), a number of embedded mitigation measures have been adopted to reduce the risk of hazards identified, including those relevant to shipping and navigation.

These measures typically include those that have been identified as good or standard practice and include actions that will be undertaken to meet existing legislation requirements. As there is a commitment to implementing these measures, and also to various standard sectoral practices and procedures, they are considered inherently part of the design of the Proposed Development (Offshore).

For the purposes of the NRA, the implementation of a Structure Exclusion Zone (SEZ) on the eastern boundary has also been included as a mitigation. Further details are provided in Section 17.4.

The embedded mitigation measures within the design relevant to shipping and navigation are outlined in Table 17.1.

Table 17.1 Embedded Mitigation Measures Relevant to Shipping and Navigation

Embedded Mitigation Measure	Details
Development of and adherence to a Cable Plan (CaP)	The CaP will confirm planned cable routeing, burial and any additional protection and will set out methods for post-installation cable monitoring.
Development of and adherence to a Development Specification and Layout Plan (DSLP)	The DSLP will confirm the layout and design parameters of the Proposed Development (Offshore). Layout to be agreed via the DSLP process which will include MCA and NLB consultation. Minimum spacing of 944m between WTGs
Development of and adherence to a Marine Pollution Contingency Plan (MPCP)	The MPCP will identify potential sources of pollution and associated spill response and reporting procedures.
Development of and adherence to a Fisheries Management and Mitigation Strategy (FMMS)	The FMMS will set out the means of ongoing fisheries liaison through construction and O&M phases of the Proposed Development (Offshore) and detail any mitigation measures to be put in place to limit effects on commercial fisheries activity.

Embedded Mitigation Measure	Details
Development of and adherence to a Navigational Safety Plan (NSP)	The NSP will describe measures put in place by the Proposed Development (Offshore), related to navigational safety, including information on Safety Zones, charting, construction buoyage, temporary lighting and marking, and means of notification of project activity to other sea users (e.g., via Notice to Mariners).
Project Environmental Monitoring Plan (PEMP)	The PEMP will set out commitments to environmental monitoring in pre-, during and post-construction phases.
VMP	The VMP will confirm the types and numbers of vessels that will be engaged on the Proposed Development (Offshore), and consider vessel coordination including indicative transit route planning.
LMP	The LMP will confirm compliance with legal requirements with regards to shipping, navigation and aviation marking and lighting.
ERCoP	The ERCoP will be prepared in line with MCA guidance and confirms what measures the Proposed Development (Offshore) has in place to support any emergency response.
Promulgation of information	Advance warning and accurate location details of construction, maintenance and decommissioning operations, associated Safety Zones and advisory passing distances will be given via Notices to Mariners and Kingfisher Bulletins.
Application for safety zones	Application for and use of Safety Zones of up to 500m during construction, maintenance and decommissioning phases.
Minimum Blade Clearance	Blade clearance of at least 35m above MSL in excess of minimum requirements (22m above MHWS).
Marine coordination	Marine coordination and communication to manage project vessel movements.
CBRA	Where practicable, cable burial will be the preferred means of cable protection. Cable burial will be informed by the CBRA and detailed within the CaP. Suitable implementation and monitoring of cable protection (via burial, or external protection where adequate burial depth as identified via risk assessment is not feasible).
Compliance with MGN 654	Compliance with MCA MGN 654 (MCA, 2021) and its annexes where applicable. Also MGN 654 Search and Rescue annex 5 (MCA, 2024).
Marking on charts	Appropriate marking of the Proposed Development (Offshore) on Admiralty and aeronautical charts. This will include provision of the

<table>
<tr><th>Embedded Mitigation Measure</th><th>Details</th></tr>
<tr><td></td><td>positions and heights of structures to the UKHO, Civil Aviation Authority (CAA), MoD and Defence Geographic Centre (DGC).</td></tr>
<tr><td>Buoyed construction area</td><td>The construction area will be buoyed, as described in the LMP. Buoyage will be defined in consultation with the NLB.</td></tr>
<tr><td>Lighting and marking</td><td>Marine navigation marking and lighting of the Proposed Development (Offshore), as described in the LMP, will be defined in agreement with NLB and in line with IALA G1162 (IALA, 2021b).</td></tr>
<tr><td>Floating WTG regulations</td><td>Compliance with regulatory expectations on moorings for floating wind and marine devices (Health and Safety Executive (HSE) and MCA, 2017).</td></tr>
<tr><td>Guard Vessel(s)</td><td>Guard vessel(s) as required by risk assessment.</td></tr>
<tr><td>Project Vessel AIS Transmission</td><td>Project vessel AIS transmission regardless of size.</td></tr>
<tr><td>Project vessel compliance with international marine regulations</td><td>Compliance of all project vessels with international marine regulations as adopted by the Flag State, notably the COLREGs (IMO, 1974) and the International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974).</td></tr>
<tr><td>Structure Exclusion Zone (SEZ)</td><td>No surface piercing infrastructure will be installed within the area bounded by the following coordinates:
<table><tr><th>Latitude</th><th>Longitude</th></tr><tr><td>58° 15' 26.66" N</td><td>002° 25' 05.54" W</td></tr><tr><td>58° 07' 45.98" N</td><td>002° 19' 46.87" W</td></tr><tr><td>58° 11' 17.07" N</td><td>002° 18' 09.49" W</td></tr></table>
Further details are provided in Section 17.4.</td></tr>
</table>

17.2 Marine Aids to Navigation

Throughout all phases, AtoNs will be provided in accordance with NLB and MCA requirements, with consideration being given to IALA Guidance G1162 (IALA, 2021 (a)), IALA Recommendation O-139 (IALA, 2021 (b)), and MGN 654 (MCA, 2021).

17.2.1 Operation and Maintenance Phase

Marking during the O&M phase will be agreed in consultation with NLB once the final array layout has been selected post consent; however, the following subsections summarise likely requirements.

17.2.1.1 Marking of Individual Array Structures

As per IALA Guideline G1162, each surface structure within Caledonia OWF will be painted yellow from the level of Highest Astronomical Tide (HAT) to at least 15m above HAT. Each structure will also be clearly marked with a unique alphanumeric identifier which will be clearly visible from all directions. The MCA will advise post consent on the specific requirements for the identifiers, but a logical pattern with potential for additional visual marks may be considered by statutory stakeholders. Each identifier will be illuminated by a low-intensity light such that the sign is available from a vessel thus enabling the structure to be identified at a suitable distance to avoid an allision incident.

The identifiers will be situated such that under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer (with the naked eye), stationed 3m above sea level and at a distance of at least 150m from the WTG. The light will be either hooded or baffled so as to avoid unnecessary light pollution or confusion with navigational marks.

17.2.1.2 Marking of Array Area as a Whole

The marking of Caledonia OWF as a whole will be agreed with NLB once the final array layout has been selected and will be in line with IALA Recommendation O-139 and G1162. As per the IALA guidance, and in consultation with NLB, it will be ensured that:

- All corner structures will be marked as a Significant Peripheral Structure (SPS) and where necessary, to satisfy the spacing requirements between SPSs, additional periphery structures may also be marked as SPSs;
- Structures designated as an SPS will exhibit a flashing yellow five second (flash yellow every five seconds) light of at least 5nm nominal range and omnidirectional fog signals as appropriate and where prescribed by NLB, and will be sounded at least when the visibility is 2nm or less;
- Further periphery structures may be marked as Intermediate Peripheral Structures (IPS) including a flashing yellow light with a distinctly different flash character from those displayed on the SPSs and at least 2nm nominal range;
- All lights will be visible to shipping through 360˚ and if more than one lantern is required on a structure to meet the all-round visibility requirement, then all the lanterns on that structure will be synchronised;
- All lights will be exhibited at the same height at least 6m above HAT and below the arc of the lowest WTG blades;

- Remote monitoring sensors using Supervisory Control and Data Acquisition (SCADA) will be included as part of the lighting and marking scope to ensure a high level of availability for all AtoNs;
- Aviation lighting will be as per CAA requirements; however, will likely be synchronised Morse "W" at the request of NLB; and
- All lighting will be considered cumulatively with existing AtoNs to avoid the potential for light confusion to passing traffic.

Consideration will also be given to the use of marking via AIS, or other electronic means (such as Radar Beacons (Racon)) to assist safe navigation particularly in reduced visibility.

17.3 Design Specifications Noted in MGN 654

The individual WTGs and other structures will have functions and procedures in place for generator shut down in emergency situations, as per MGN 654 (MCA, 2021).

17.4 Structure Exclusion Zone

As discussed in Section 15.6, AIS analysis and consultation have identified that Serco NorthLink ferries utilise the general sea space within which the Array Area is located during certain periods of adverse weather.

Based on the input received from Serco NorthLink, the Applicant considered how to optimally increase the optionality for NorthLink ferries in such adverse weather conditions. In order to increase the sea room available in the area where NorthLink adverse weather routeing generally occurs, the possibility of a SEZ was considered and discussed with Serco NorthLink in consultation (Section 4). The SEZ would represent a section of the Array Area where no surface piercing infrastructure would be installed, therefore providing increased sea room for use in all conditions including adverse weather.

The resultant SEZ is shown in Figure 17.1.

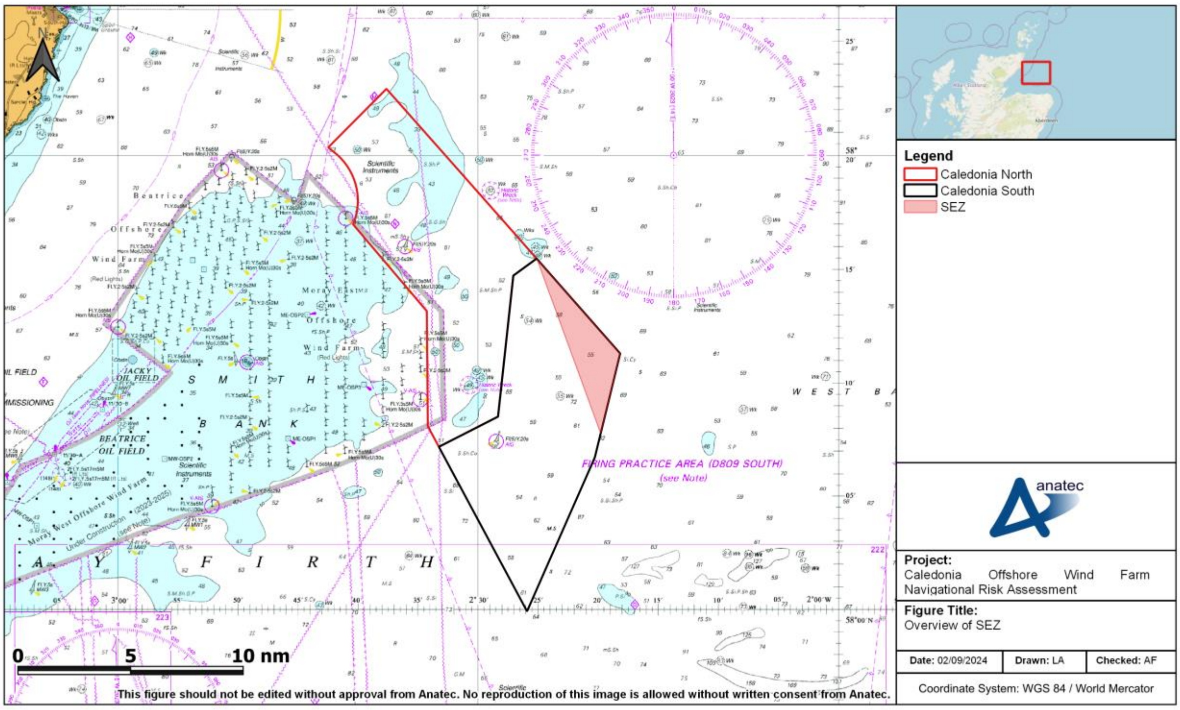

Figure 17.1 Overview of SEZ

The SEZ was proposed to Serco NorthLink via a meeting on the 12th August 2024. Feedback received was that the SEZ and associated increase in searoom would be a positive for NorthLink adverse weather routeing, and also shipping and navigation in general. It Is considered that the SEZ would:

- Facilitate Serco NorthLink adverse weather routeing and reduce impact in the area where it usually occurs (B in Figure 15.3);
- Decrease the frequency at which Serco NorthLink ferries would need to use the inshore routeing option (C in Figure 15.3); and
- Decrease the likelihood that Serco NorthLink ferries may need to cancel a sailing.

The Risk Assessment in Section 18 assumes the SEZ will be in place.

18 Risk Assessment – Caledonia OWF In Isolation

This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the Proposed Development (Offshore), based on baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments. The hazards assessed are as follows:

- Vessel displacement (including during adverse weather);
- Increased third-party collision risk;
- Third-party with project vessel collision risk;
- Creation of vessel to structure allision risk;
- Changes in under keel clearance;
- Increased interaction with subsea cables and mooring lines;
- Loss of station;
- Reduced access to local ports and harbours; and
- Reduction of SAR capability.

For each hazard, embedded mitigation measures which have been identified as relevant to reducing risk are listed, with full descriptions provided in Section 17.1. This is followed by statements defining the frequency of occurrence, severity of consequence, and subsequent significance of risk based on the methodology defined in Section 3.

The risk control log (see Section 24) summarises the risk assessment and a concluding risk statement is provided (see Section 26.5).

Risk assessments for Caledonia North and Caledonia South are provided separately in Sections 19 and 20 respectively.

18.1 Construction Phase

18.1.1 Vessel Displacement

Construction activities associated with the Proposed Development (Offshore) may displace existing vessel routes or activity, which may be more prevalent during periods of adverse weather.

These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

18.1.1.1 Vessel Displacement

18.1.1.1.1 Qualification of Risk

Vessel traffic data collected during the winter and summer 2023 surveys have been used to establish the vessel traffic baseline, alongside 12 months of AIS collected via coastal receivers between November 2022 and October 2023. These vessel traffic datasets have been validated by Anatec's ShipRoutes database, and analysed to identify the volume of traffic passing within or in proximity to the Caledonia OWF. Additionally, main routes were recognised from these datasets using the principles set out in MGN 654 (MCA, 2021) (see Section 11.2).

Although there will be no restrictions on entry into the buoyed construction area, other than through active safety zones, based on experience at previously under construction OWFs and consultation it is anticipated that the majority of commercial vessels will choose not to navigate within the buoyed construction area, therefore some main route deviations will be required. It is noted that Tidal Transit, who provide offshore transport services, responded to the regular operators outreach (see Appendix D) stating they may choose to transit internally within the Caledonia OWF if it is allowable to save fuel or energy. On this basis, smaller commercial vessel operators may choose to transit through (noting Tidal Transit vessels are small wind farm crew transfer vessels (below 28m in length), and were recorded working between Wick and Beatrice OWF), however it is likely that the majority of commercial vessels will deviate in line with other developments.

The full methodology for classifying main route deviations is provided in Section 15, noting it is in line with MGN 654 (MCA, 2021). A deviation will be required for three of the 10 main routes identified within the study area, with details as follows:

- Route 5 (Pentland Firth to East England) – eight vessels per week, deviation of 0.6nm (1%). Vessels on this route will likely pass further east to increase passing distance from the Caledonia OWF leading to a minor deviation;
- Route 6 (Pentland Firth to East Scotland) – six vessels per week, deviation of 0.7nm (1%). Vessels on this route will also likely pass further east to increase passing distance from the Caledonia OWF leading to a minor deviation; and
- Route 7 (Fraserburgh – Moray East OWF) – six vessels per week, deviation of 0.1nm (<0.3%). Vessels on this route will likely pass further south to increase passing distance from the Caledonia OWF leading to a minor deviation.

These all represent relatively low magnitude of deviations, which aligns with feedback received during consultation including at the Hazard Workshop (see Section 4.3).

Regular routeing involving RoRo vessels was identified within the vessel traffic datasets and was attributed to Smyril Line and Serco NorthLink Ferries, both of which were observed to transit within the study area every one to two days. Smyril Line vessels were noted to intersect the Proposed Development (Offshore); however, during consultation, Smyril Line stated that there would not be any issues or concern with deviating to the east of the Proposed Development (Offshore).

Regular routeing of RoPax vessels operated by Serco NorthLink Ferries was also noted within the vessel traffic data. Route deviation was also deemed unnecessary for these regular journeys due to the distance from the Caledonia OWF. Serco NorthLink confirmed during consultation that they had no concerns with impacts on their regular routeing.

It is noted that certain transits from NorthLink Ferries were observed to intersect the Caledonia OWF. Consultation with NorthLink confirmed these transits were during adverse weather. Vessel displacement during adverse weather is considered in the relevant hazard below.

Based on experience at previously under construction OWFs, it is anticipated that fishing vessels and recreational vessels may also choose not to routinely navigate internally within the buoyed construction area, noting there would be no restriction on transit other than through active safety zones. However, they may be more likely to do so than commercial vessels, in particular in any areas of the Caledonia OWF where active construction is not ongoing, or structures are not yet present. Input received during the Hazard Workshop from commercial fishing representatives was that (as for commercial vessels) only a minor deviation would be required for fishing vessels in transit and as such it is likely that such vessels will choose to deviate. Input from the RYA Scotland indicated that this would likely apply to recreational vessels as well, noting that it is of the skippers preference as to whether or not a transit is made through a wind farm.

For any smaller vessels that do choose to deviate, there is considered to be sufficient sea room outside of the Caledonia OWF for transits from such vessels to be accommodated, noting this aligns with general consensus from the Hazard Workshop. It is noted that displacement of active commercial fishing is assessed separately in Volume 2, Chapter 8: Commercial Fisheries of the EIAR.

Given the east and west routeing of commercial vessels across the Caledonia OECC, installation activities associated with the offshore export cables will likely lead to vessel displacement. However, any associated displacement will be temporary in nature and spatially limited to the area immediately around the installation vessel position. Considering embedded mitigation measures such as promulgation of information, any displacement as a result of cable installation will be minor and manageable with appropriate passage planning.

The main consequences of vessel displacement will be increased journey times and distances for affected third party vessels, under the assumption that the buoyed construction area will be deployed around the maximum extent of the Caledonia OWF. Any notable safety impacts are considered unlikely given the available sea room, noting this aligns with outputs of the Hazard Workshop. Vessels are expected to comply with international and flag state regulations (including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974) and will be able to passage plan in advance given the promulgation of information relating to the Proposed Development (Offshore) and relevant nautical charts.

Relevant embedded mitigation measures include DSLP approval, adherence to an LMP, adherence to an NSP, marking on nautical charts, and promulgation of information.

18.1.1.1.2 Frequency of Occurrence

The frequency of occurrence in relation to displacement of vessel traffic during the construction phase is considered **Frequent**.

18.1.1.1.3 Severity of Consequence

The severity of consequence in relation to displacement of vessel traffic during the construction phase is considered **Negligible**.

18.1.1.1.4 Significance of Effect

Taking the frequency of occurrence as frequent and the severity of consequence as negligible, the overall effect of vessel displacement during construction of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.1.1.2 Vessel Displacement During Adverse Weather

18.1.1.2.1 Qualification of Risk

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

Based on review of the input received, it is unlikely that commercial vessels would choose to make transit through the buoyed construction area during adverse weather conditions. Larger deviations may be required than during more favourable conditions (e.g., vessels may choose to increase passing distance from the buoyed construction area or transit inshore of the Moray Firth OWFs), however there is considered to be sufficient sea room to safely accommodate these chosen transits.

The long term vessel traffic data studied in Appendix E showed the presence of transits within the Caledonia OWF undertaken by Serco NorthLink Ferries, further inshore of their typical routeing. Consultation with Serco NorthLink Ferries confirmed these transits were utilised during adverse weather conditions. The presence of the buoyed construction area may therefore impact Serco NorthLink adverse weather transits, with the potential for delays in sailings, a large deviation inshore of the Moray Firth OWFs, or sailing cancellation. However, as each historical transit is based upon individual Master decisions based upon the conditions and factors on the day, Serco NorthLink have confirmed that the impact cannot be quantified (i.e., it cannot be confirmed whether any given historical transit would have been delayed, deviated or cancelled).

The Applicant engaged with Serco NorthLink Ferries throughout the NRA process, and this engagement culminated in the Applicant proposing a SEZ on the eastern boundary of the

Caledonia OWF within which no surface piercing infrastructure will be placed for the purposes of increasing searoom and optionality for Serco NorthLink Ferries in adverse weather conditions. The SEZ was proposed to Serco NorthLink via a meeting on 12 August 2024. Feedback received was that the SEZ and associated increase in searoom would be a significant positive for NorthLink adverse weather routeing, and also shipping and navigation in general.

There may still be works undertaken within the SEZ (e.g., cable installation), however any such hazard would be temporary in nature and spatially limited to the area around the operation. The placement of the buoyed construction area will be agreed with NLB as part of the LMP process to ensure any hazards to shipping and navigation are managed.

From a navigational safety perspective, worst case consequences are an increase in delays, deviations or cancellation, however based upon Serco NorthLink feedback it is considered that the implementation of the SEZ reduces the risk to ALARP parameters noting frequency of the hazard is reduced. Socioeconomic impacts are assessed in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation of the EIAR.

Full details of the assessment and consultation undertaken in relation to Serco NorthLink are provided in Sections 12 and 4.2, respectively.

18.1.1.2.2 Frequency of Occurrence

The frequency of occurrence relating to vessel displacement during periods of adverse weather during construction is considered to be **Remote**.

18.1.1.2.3 Severity of Consequence

The severity of consequence relating to vessel displacement during periods of adverse weather during construction is considered to be **Serious**.

18.1.1.2.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as serious, the overall effect of adverse weather during construction of the Proposed Development (Offshore) is considered to be tolerable.

Assuming the implementation of the SEZ, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms**.

18.1.2 Increased Third Party Vessel to Vessel Collision Risk

18.1.2.1 Qualification of Risk

As noted in relation to the hazard of vessel displacement, three of 10 main routes will deviate as a result of the construction of the Proposed Development (Offshore). This will likely cause an increase in vessel density in proximity to the Proposed Development (Offshore), leading to a higher chance of vessel to vessel encounters and therefore a greater collision risk.

Based on pre OWF modelling, the baseline collision risk levels within the study area are low, with an estimated vessel to vessel collision frequency of one every 520 years. This level of collision risk is due to the volume of traffic in the area relative to the available sea space, noting the presence of Moray East and Beatrice OWFs, as well as the under-construction Moray West OWF. Additionally, it is noted that no collisions occurring within the study area were recorded within the MAIB over the most recent 20 years of data, nor were any responded to by the RNLI between 2010 and 2022.

Based on post OWF modelling, the collision frequency was estimated at one every 292 years, with the change primarily associated with vessels displaced east of the Caledonia OWF. This represents an increase of 78% on the pre OWF scenario. Although there is an increase in risk, it should be considered that a conservative approach has been undertaken within the modelling process, with an assumption made that vessel routeing will remain in proximity to the north eastern boundary of the Caledonia OWF. In reality it is likely that vessels will deviate to use more of the available sea space offshore of the Caledonia OWF. This aligns with general stakeholder consensus of the Hazard Workshop which indicated that there is sufficient post wind farm sea room available to safely accommodate the likely number of users.

For the Caledonia OECC, any displacement of commercial vessels due to installation activities is not anticipated to affect available sea room to such an extent that the risk of a collision between third party vessels is materially increased. This is due to the temporary nature of the installation process, and spatially limited extent of the operation at any given time.

An additional factor is the potential for installed or partially installed WTGs to obscure vessels from one another, thus hindering ability to comply with COLREGs (IMO, 1972/77). Minimum spacing of 944m between WTGs will likely provide sufficient sea room for visual observations, with full obstruction likely only to occur when vessels are at opposite ends of a WTG row. Collision risk is likely to be low in such cases due to the distance between vessels and the avoidance of the buoyed construction area.

In the event of an encounter between third party vessels, it is likely to be localised and short in duration, with collision avoidance action implemented by the vessels involved, as per compliance with COLREGs (IMO, 1972/77), to ensure that a collision incident does not develop. This is supported by experience at previous under construction OWFs, where no collision incidents involving two third party vessels have been reported as a result of an OWF (see Section 9.6).

Historical collision incident data studied also indicates that the most likely consequences will be low should a collision occur, with contact between the vessels resulting in minor damage and no injuries to persons, with the vessels involved able to resume their respective passages and undertake a full inspection at the next port.

As an unlikely worst-case scenario, a high impact collision event could occur. This may result in vessel foundering and subsequent Potential Loss of Life (PLL), as well as pollution. In such a circumstance, vessels associated with the Proposed Development (Offshore) may attend the incident under SOLAS obligations and in liaison with the MCA, and the procedures within the ERCoP and MPCP would be implemented.

Relevant embedded mitigation measures includes marking on nautical charts, clear buoyage to mark the construction area, promulgation of information, DSLP approval, adherence to an LMP, adherence to an MPCP, and adherence to an ERCoP.

18.1.2.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between third party vessels during the construction phase is **Extremely Unlikely**.

18.1.2.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between third party vessels during the construction phase is considered **Serious**.

18.1.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of third party vessel to vessel collision risk during construction of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms**.

18.1.3 Increased Third Party Vessel to Project Vessel Collision Risk

The presence of vessels associated with construction activities of the Proposed Development (Offshore) may increase encounters and thus collision risk for vessels already operating in the area.

18.1.3.1 Qualification of Risk

During the construction phase of the Proposed Development (Offshore) there may be up to 3,992 vessel movements made by up to 25 project vessels on-site simultaneously. This will include vessels which are Restricted in Ability to Manoeuvre (RAM). It is assumed that construction vessels will be on-site throughout the entire duration of the construction phase.

Encounters and collision risk involving project vessels will be managed through the implementation of marine coordination with full details of this to be provided in the VMP and NSP. Project vessels will also be expected to carry AIS and comply with flag state regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974). COLREGs will remain the navigational priority for project vessels at all times.

Applications for safety zones of 500m around on-going construction activities will be sought during the construction phase and will protect deployed project vessels, especially if they are RAM. Minimum advisory passing distances and guard vessels, as defined by risk assessment, may also be implemented where safety zones do not apply, for example around cable installation vessels. Details of safety zones, minimum safe passing distances, and guard vessels will be promulgated including via Notifications to Mariners and Kingfisher Bulletins.

Appropriate marine lighting and marking during construction including the buoyed construction area will be agreed with the NLB. These navigational aids will further maximise mariner awareness when in proximity to ongoing construction works in the Caledonia OWF.

Third-party vessels may experience decreased capability to visually identify project vessels entering and exiting the Caledonia OWF during reduced visibility; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and the mandatory carriage of AIS by project vessels regardless of size. It is noted that the likelihood of a collision is likely to be greater in reduced visibility when the identification of project vessels entering and exiting the Caledonia OWF may be impeded.

Based on historical incident data, there has been one instance of a third-party vessel colliding with a project vessel in the UK (see Section 9.6 for further details). In this case, moderate vessel damage was reported with no harm to persons. It is noted that the incident occurred in 2011, 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.

If an encounter between a project vessel and third party vessel occurs, it is likely to be localised and short in duration. Assuming the implementation of collision avoidance action as required by the COLREGs, the most likely outcome will be any vessels involved being able to resume their respective passages or activities with no long-term consequences.

In the event of a collision, the likely consequences will be minor contact between the vessels resulting in minor damage and no injuries to persons. As an unlikely worst-case scenario, foundering could occur resulting in PLL and pollution. Other project vessels may be able to assist in the event of a collision under SOLAS obligation and the adherence to the ERCoP, noting this would be done in liaison with the MCA. If pollution were to occur in proximity to the Proposed Development (Offshore) or involving a project vessel, the MPCP will be implemented to minimise the risks.

Relevant embedded mitigation measures include application for safety zones, a buoyed construction area, guard vessels as required by risk assessment, DSLP approval, adherence to an LMP, VMP, and NSP, MPCP, ERCoP, promulgation of information, marine coordination, and marking on nautical charts.

18.1.3.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between project vessels and third party vessels during the construction phase is considered to be **Extremely Unlikely.**

18.1.3.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between project vessels and third party vessels during the construction phase is considered to be **Serious**.

18.1.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of encounters and collision risk between project vessels and third party vessels during construction of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.1.4 Vessel to Structure Allision Risk

Presence of structures (including partially constructed) within the buoyed construction area will lead to creation of powered, drifting and internal allision risk for vessels.

The spatial extent of the hazard is small given that a vessel must be in close proximity to an OWF structure for an allision incident to occur. Each allision element is considered in turn in terms of frequency of occurrence and severity of consequence, with the resulting significance of the residual risk across the various elements summarised at the end of the assessment. The forms of allision considered include:

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

18.1.4.1 Powered Allision Risk

18.1.4.1.1 Qualification and Quantification of Risk

Based on quantitative assessment undertaken in Section 16.3, the base case annual powered vessel to structure allision frequency was estimated to be 2.9×10^{-3}, corresponding to a return period of one every 341 years. This is reflective of the volume of traffic within the available sea room, noting that it has been conservatively assumed that vessels will not use the full available sea room offshore of the Caledonia OWF. In reality, it is likely that vessels will increase passing distance from the Caledonia OWF, noting this aligns with feedback received at the Hazard Workshop, where general consensus was that there was sufficient sea room to accommodate likely users.

Based on historical incident data, there have been two reported instances of a third-party vessel alliding with an operational OWF structure in the UK (in the Irish Sea and Southern North Sea). Both of these incidents involved a fishing vessel. These allisions resulted in minor to moderate damage to the vessels with minor injury to crew members.

Temporary marine lighting and marking will be implemented including the buoyed construction area in agreement with the NLB. Promulgation of information and marking on charts will ensure vessels can passage plan in advance to minimise risk. Safety zones of 50m in radius around structures will also be applied for during the construction phase up until the point of commissioning of the Proposed Development (Offshore) (rising to 500m where active construction is ongoing).

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 hazard given the potential for a non-steel construction and possible internal navigation within the Caledonia OWF. 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 founder resulting in PLL and pollution. Project vessels may assist in the event of an allision under SOLAS obligation and the adherence to the ERCoP, in line with the MCA. If pollution were to occur, then the MPCP will be implemented to minimise the environmental risk.

Relevant embedded mitigation measures include DSLP approval, adherence to a MPCP, adherence to an LMP, adherence to an NSP, promulgation of information, application for safety zones, adherence to an ERCoP, guard vessels where required by risk assessment, and appropriate marking via construction buoyage as well as on nautical charts.

18.1.4.1.2 Frequency of Occurrence

The frequency of occurrence in relation to powered vessel to structure allision risk during the construction phase is considered to be **Extremely Unlikely**.

18.1.4.1.3 Severity of Consequence

The severity of consequence in relation to powered vessel to structure allision risk during the construction phase is considered to be **Moderate**.

18.1.4.1.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during construction of the Proposed Development (Offshore) is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

18.1.4.2 Drifting Allision Risk

18.1.4.2.1 Qualification and Quantification of Risk

Based on quantitative assessment undertaken in Section 16.3, the base case annual drifting vessel to structure allision frequency was estimated to be 2.5×10^{-4}, corresponding to a return period of one every 4,045 years.

Based on historical incident data, there have been no instances of a third-party vessel alliding with an under-construction OWF structure whilst Not Under Command (NUC). However, there is considered to be potential for a vessel to be adrift; this is reflected in the MAIB incident data reviewed in proximity to the Proposed Development (Offshore) which indicates that machinery failure is the most common incident type (approximately 50%) in the 2012-2021 dataset, noting that only two were recorded. A vessel adrift may only develop into an allision situation if in proximity to a OWF structure. This is only the case where the adrift vessel is located internally or in close proximity to the Caledonia OWF and the direction of the wind and/or tide directs the vessel towards a structure. Promulgation of information and marking on charts will help mitigate the risks of a drifting allision.

In circumstances where a vessel drifts towards a structure in the Caledonia OWF, there are actions which the vessel may take to prevent the drift incident developing into an allision situation. Powered vessels may be able to regain power prior to reaching the Caledonia OWF (i.e., by rectifying any fault). Failing this, the vessel’s emergency response procedures would be implemented which may include an emergency anchoring event following a check of the relevant nautical charts to ensure the deployment of the anchor will not lead to other risks (such as anchor snagging on a subsea cable), or the use of thrusters (depending on availability and power supply).

Where the deployment of the anchor is not possible (e.g., for small craft), any project vessels on-site may be able to render assistance in liaison with the MCA and in line with SOLAS obligations (IMO, 1974). This response will be managed via the coastguard and marine coordination, and depends on the type and capability of vessels on site. This would be particularly relevant for sailing vessels relying on metocean conditions for propulsion, noting if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance.

Should an allision occur, the consequences will be similar to those noted for the case of a powered allision including the unlikely worst-case of foundering, PLL, and pollution; in the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the MPCP will minimise the environmental risk. Project vessels may assist in the event of an allision under SOLAS obligation and the adherence to the ERCoP, in line with the MCA. Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel, thus reducing the energy of the impact, including in the case of a recreational vessel under sail.

Relevant embedded mitigation measures include adherence to an ERCoP, adherence to an MPCP, marking on nautical charts, and project vessel compliance with SOLAS (IMO, 1974).

18.1.4.2.2 Frequency of Occurrence

The frequency of occurrence in relation to drifting vessel to structure allision risk during the construction phase is considered to be **Extremely Unlikely**.

18.1.4.2.3 Severity of Consequence

The severity of consequence in relation to drifting vessel to structure allision risk during the construction phase is considered to be **Moderate**.

18.1.4.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during construction of the Proposed Development (Offshore) is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

18.1.4.3 Internal Allision Risk

18.1.4.3.1 Qualification and Quantification of Risk

As noted previously, based on experience at previously under-construction OWFs, it is anticipated that commercial vessels will be unlikely to navigate internally within the Caledonia OWF. Fishing and recreational vessels may be more likely to transit through noting they may choose not to depending on various conditions. They may be less likely to navigate within a site which hosts floating wind farm structures due to the presence of mooring lines and dynamic cables.

The base case fishing vessel to structure allision frequency is estimated to be 2.9×10^{-1}, corresponding to a return period of approximately one in 3.5 years. This return period is reflective of the volume of fishing vessel traffic in the study area, both in transit and engaged in active fishing. Conservative modelling has been undertaken with the assumption that fishing levels in proximity to the WTGs will not change. In reality fishing vessels will account for the presence of the WTGs, and may choose to transit or fish elsewhere, noting this aligns with feedback received during the Hazard Workshop.

The worst-case consequences reported for vessels involved in an allision incident involving a UK OWF has been flooding, with no life-threatening injuries to persons reported (the model is calibrated against known reported incidents). If an allision incident were to occur, project vessels may assist under obligation of SOLAS (IMO, 1974) and adherence to the ERCoP. Additionally, if pollution occurs as a result of an allision incident, the MPCP would be implemented where appropriate.

If a vessel chooses to transit within the Caledonia OWF, the minimum spacing of 944m between wind farm structures is considered sufficient for safe internal navigation. Furthermore, application for safety zones around construction activities, as well as the buoyed construction area and temporary lighting and marking provides mitigation against internal allision risk. Any vessel planning to transit through the Caledonia OWF is expected to passage plan in advance in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information including through ongoing liaison with fishing fleets via an appointed Fisheries

Liaison Officer (FLO) to ensure that such vessels have good awareness of the Proposed Development (Offshore).

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, 2022) 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.

Relevant embedded mitigation measures include application for safety zones, buoyed construction area, DSLP approval, adherence to an LMP, marking on nautical charts, promulgation of information, adherence to an ERCoP, adherence to an MPCP, appointment of a FLO and adherence to an FMMS.

18.1.4.3.2 Frequency of Occurrence

The frequency of occurrence of internal vessel to structure allision risk during the construction phase is considered to be **Remote**.

18.1.4.3.3 Severity of Consequence

The severity of consequence of internal vessel to structure allision risk during the construction phase is considered to be **Moderate**.

18.1.4.3.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during construction of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and ALARP and Not Significant in EIA terms.**

18.1.5 Reduced Access to Local Ports

18.1.5.1 Qualification of Risk

Up to 3,992 vessel movements made by construction vessels (excluding site preparation activities) may be made throughout the construction phase and will include vessels which are RAM. Project vessels will be managed by marine coordination, including the use of traffic management procedures such as the designation of entry and exit points to and from the buoyed construction area, and designated routes to and from construction ports. Project vessels will also carry AIS and be compliant with flag state regulations including the COLREGs (IMO 1972/77).

The closest port or harbour to the Caledonia OWF is Wick Harbour, located approximately 13.2nm to the northwest. Banff Harbour is located approximately 20nm to the south. Given the relative distance to ports in the area and the anticipated deviations for the main commercial routes, it is not anticipated that there will be any substantial effect on vessel approaches to and from the local ports beyond the deviations already outlined for impacts on vessel displacement.

For offshore cable installation activity, there is a greater likelihood of impact on port access given the proximity to Whitehills Harbour and Marina which is located in proximity to the Landfall Site. Additionally, the Landfall Site lies in proximity to approaches to Banff and Macduff harbours, which are located at their closest approximately 2.3nm southeast of the Caledonia OECC.

Where cable installation is ongoing, vessel displacement is possible. Recreational vessels may be particularly sensitive given that the RYA Scotland has indicated that Whitehills Marina is a key stopping point for vessels travelling north as well as along the northeast coast. No concerns were raised during consultation over access to ports during the construction phase in relation to the Caledonia OWF nor the offshore export cables. Additionally, offshore export cable installation activities will likely be short-term in duration and localised at any given time, thus any reduced access will likely be minor and temporary. Regardless, liaison in advance of and during installation is considered necessary with the Whitehills, Banff, and Macduff harbour authorities based on proximity to the Caledonia OECC. It is noted that no known issues have been raised regarding the installation or operation of Moray East OWF offshore export cables, the landfall of which is situated approximately 1nm east of the Caledonia OECC.

The most likely consequences are increased journey times and distances, as per the vessel displacement hazard. There is only one pilot boarding station nearby, at Macduff and outside of the Caledonia OECC, where the service is not compulsory. However, the charted anchorage is adjacent to the Caledonia OECC, and therefore liaison may be needed with local harbour authorities depending on the final cable routeing.

Relevant embedded mitigation measures includes clear buoyage of the construction area, adherence to an LMP, adherence to a VMP, marine coordination of project vessels, marking on nautical charts, and promulgation of information.

18.1.5.2 Frequency of Occurrence

The frequency of the risk of reduced access to local ports during the construction phase is considered to be **Reasonably Probable**.

18.1.5.3 Severity of Consequence

The severity of consequence of the risk of reduced access to local ports during the construction phase is considered to be **Minor**.

18.1.5.4 Significance of Effect

Taking the frequency of occurrence as reasonably probable and the severity of consequence as minor, the overall effect of reduced port access during construction of the Proposed Development (Offshore) is considered to be tolerable.

Assuming liaison with the Whitehills, Banff, and Macduff harbour authorities in advance of and during installation, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.1.6 Reduction of Under Keel Clearance

The presence of subsea cables and mooring lines may reduce under keel clearance during the construction phase of the Proposed Development (Offshore).

18.1.6.1 Qualification of Risk

There may be up to six mooring lines per floating WTG used to secure the substructures to the seabed, and use of subsea cabling. During the construction phase, such components may be wet stored within the Caledonia OWF or Caledonia OECC prior to attachment to the substructures noting at this stage it is likely that only the offshore export cables may be wet stored.

Taking into consideration the baseline and anticipated post wind farm vessel routeing, it is considered highly unlikely that a commercial vessel would pass within the buoyed construction area. Though fishing and recreational vessels are more likely to transit in proximity to the buoyed construction area compared to commercial vessels, these vessels are smaller and tend to have lower draughts.

The buoyed construction area will be appropriately marked on nautical charts and other electronic charts as appropriate to increase awareness. It was raised at the Hazard Workshop that making the locations of mooring lines and dynamic cables available to fishing vessels was a key mitigation. Locations of relevant infrastructure will be provided in the weekly notices distributed during the construction phase as per the FMMS.

There is limited experience of deployment of floating offshore wind projects in UK waters; however, to date there have been no reported under keel interactions between passing vessels and the components associated with such projects.

In line with MGN 654 (MCA, 2021), water depths will not be reduced by more than 5% without prior agreement with the MCA. Further, wet storage plans will be included in the Construction Method Statement which will be required to be approved by MD-LOT in consultation with the MCA.

The most likely consequences of reduced under keel clearance is that a vessel transits over an area of reduced clearance but does not make contact.

Should an underwater allision occur, minor damage incurred is the most likely consequence, with foundering or grounding of the vessel resulting in PLL and pollution as an unlikely worst-case. Should pollution occur, the MPCP will be implemented, with adherence to the ERCoP in the case of risk of PLL, as well as under SOLAS (IMO, 1974) obligations.

Other relevant embedded mitigation measures include promulgation of information and any potential under keel interaction risk, including via the FLO. The location of the buoyed construction area will be clearly shown on appropriate nautical charts.

18.1.6.2 Frequency of Occurrence

The frequency of occurrence in relation to reduction of under keel clearance during the construction phase is considered **Extremely Unlikely**.

18.1.6.3 Severity of Consequences

The severity of consequence in relation to reduction of under keel clearance during the construction phase is considered **Serious**.

18.1.6.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced under keel clearance during the construction phase of the Proposed Development (Offshore) is considered to be tolerable. Assuming the implementation of ensuring locations of subsea infrastructure are made available to fishing vessels including via FLO liaison the hazard is considered **Tolerable with mitigation and ALARP and therefore Not Significant in EIA terms.**

18.1.7 Loss of Station

The floating substructures may suffer loss of station in the event that the mooring system fails, or there is damage to tow during WTG towage for installation. This may become a floating hazard to passing vessels. This hazard is only relevant to the floating WTGs within the Caledonia OWF, and thus there will be no risk of this hazard from the Caledonia OECC.

18.1.7.1 Qualification of Risk

The MCA require under their Regulatory Expectations on Moorings for Floating Wind and Marine Devices (HSE and MCA, 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 should there be any modifications to a system or if new information becomes available with regard to its reliability, additional TPV would be required.

The Regulatory Expectations also require the provision of continuous monitoring either by GPS or other suitable means. Each WTG should 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, which will depend upon the design of the substructure and any predefined emergency response protocols.

On the basis of compliance with the Regulatory Expectations, 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 (each WTG will have a minimum of six), which is more likely to occur in extreme storm conditions, during which it is unlikely vessels will be navigating within proximity to the WTGs.

Towing operations will be covered in the VMP. Any WTG towing operations will be subject to a dedicated internal risk assessment process undertaken prior to the tows occurring, once the full specifications of the operation is known. This risk assessment will cover all phases of the operations, including within port approach areas. During the tow, all vessels involved will be lit and marked as required under COLREGs (IMO, 1972/1977).

Relevant embedded mitigation measures include compliance with regulatory expectations on moorings for floating wind and marine devices (HSE and MCA, 2017) and MGN 654, adherence to a DSLP, promulgation of information, adherence to an ERCoP, compliance with international regulations (SOLAS; IMO, 1974), appropriate marking of the structures and adherence to an LMP.

18.1.7.2 Frequency of Occurrence

The frequency of occurrence relating to loss of station during the construction phase is considered to be **Extremely Unlikely**.

18.1.7.3 Severity of Consequence

The severity of consequence relating to loss of station during the construction phase is considered to be **Moderate**.

18.1.7.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of loss of station during the construction phase of the Proposed Development (Offshore) is considered to be **Broadly Acceptable and ALARP, and therefore Not Significant in EIA terms**.

18.1.8 Reduction of SAR Capabilities

The installation of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the construction phase of the Proposed Development (Offshore) by increasing the number of incidents, increasing consequences or reducing access for the responders.

18.1.8.1 Qualification of Risk

The spatial extent of this hazard is large given the area covered by the Caledonia OWF (123nm^2), as well as the distance covered by air-based SAR support (the SAR helicopter base is located at Inverness, 66nm southwest of the Caledonia OWF). It is unlikely that a SAR operation will require the entire Caledonia OWF to be searched, and it is probable that a search will be restricted to a smaller area in which a casualty is known to be located (accounting for assumptions on any potential drift of the casualty).

Up to 3,992 vessel movements may be made by construction vessels during the construction phase of the Proposed Development (Offshore). It is assumed that construction vessels will be on-site throughout the majority of the construction phase, although severe weather may lead to vessels being withdrawn. The presence of these vessels increase the likelihood of an incident and subsequently increase the likelihood of multiple incidents occurring simultaneously, diminishing emergency response capability. However, they may also be able to provide additional response resource in the event of an incident in liaison with the MCA.

The most likely consequence to occur would be a delay to any emergency response request. As an unlikely worst-case, this could result in a failure of emergency response to an incident resulting in PLL and pollution. However, project vessels will be managed via marine coordination and comply with flag state regulations which will minimise this risk. Additionally, the presence of project vessels themselves may mitigate this risk as they may self-help at incidents involving other project vessels under the obligation of SOLAS (IMO, 1974) and adherence to an ERCoP, noting this would be undertaken with liaison with the MCA. The MPCP will also be implemented should pollution occur.

From recent SAR data, the frequency of helicopter SAR operations in proximity to the Proposed Development (Offshore) is one per year on average, with no SAR helicopter incidents occurring within the Caledonia OWF. The frequency of incidents in proximity to the Caledonia OWF is not anticipated to increase significantly from the current level given the measures noted above which will be in place. The layout will be agreed with the MCA and in line with MGN 654 requirements to ensure any SAR operations that do occur within the Caledonia OWF are facilitated. A SAR checklist will also be completed and agreed with the MCA.

Relevant embedded mitigation measures include DSLP approval, promulgation of information, adherence to an LMP, marking on appropriate charts, marine coordination of project vessels, adherence to an ERCoP, adherence to an MPCP, adherence to a VMP and NSP, and compliance with MGN 654 and international marine regulations.

18.1.8.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of reduced emergency response capabilities during the construction phase is considered to be **Extremely Unlikely**.

18.1.8.3 Severity of Consequence

The severity of consequence relating to the risk of reduced emergency response capabilities during the construction phase is considered to be **Serious**.

18.1.8.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during construction of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.2 Operation and Maintenance Phase

18.2.1 Vessel Displacement

Operational activities associated with the Proposed Development (Offshore) as well as presence of structures throughout the lifetime of the Proposed Development (Offshore) may displace existing vessel routes or activity, which may be more prevalent during periods of adverse weather.

These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

18.2.1.1 Vessel Displacement

18.2.1.1.1 Qualification of Risk

Based on experience at existing operational OWFs and input during consultation, it is anticipated that the majority of commercial vessels will choose not to navigate within the Caledonia OWF, therefore some main route deviations will be required as per the respective construction phase hazard. Based on previous consultation, smaller commercial vessel operators may choose to transit through; however, it is likely that the majority of commercial vessels will deviate in line with other operational OWFs.

As discussed in relation to the equivalent construction phase hazard, a deviation will be required for three of the 10 main routes identified within the study area; however, they all represent relatively low magnitude of deviations, which aligns with feedback received during consultation including at the Hazard Workshop (see Section 4). Further, deviations will be well established during the construction phase, with it being likely that commercial vessels will continue these same established deviations into the O&M phase.

Minimum spacing of 944m within the Caledonia OWF is considered sufficient to accommodate transits of smaller vessels, noting there will be no restrictions on entry into the Caledonia OWF with the exception of any active 500m major maintenance safety zones.

As discussed in relation to the equivalent construction phase hazard, regular routeing involving RoRo vessels was identified within the vessel traffic datasets, however these transits would either not be displaced by the Proposed Development (Offshore) or it has been indicated during consultation that the deviation would be minor and not pose a concern.

Based on experience at existing operational OWFs, it is anticipated that fishing vessels and recreational vessels may also choose not to routinely navigate internally within the Caledonia OWF. However, they may be more likely to do so than commercial vessels. As discussed in relation to the equivalent construction phase hazard, input received during the Hazard Workshop from commercial fishing representatives was that only a minor deviation would be required for fishing vessels in transit and as such it is likely that such vessels will choose to deviate. The RYA Scotland indicated that this would likely apply to recreational vessels as well, noting that it is of the skippers preference as to whether or not a transit is made through a wind farm.

For any smaller vessels that do choose to deviate, there is considered to be sufficient sea room outside of the Caledonia OWF for transits from such vessels to be accommodated, noting this aligns with general consensus from the Hazard Workshop. It is noted that displacement of active commercial fishing is assessed separately in Volume 2, Chapter 8: Commercial Fisheries of the EIAR.

Given that any O&M activities associated with the Proposed Development (Offshore) will be infrequent and localised, the likelihood of vessel displacement due to these activities is considered to be very low.

The main consequences of vessel displacement will be increased journey times and distances for affected third party vessels, under the assumption that the WTGs will be built to the full extent of the Caledonia OWF. Any notable safety impacts are considered unlikely given the available sea room, noting this aligns with outputs of the Hazard Workshop. Vessels are expected to comply with international and flag state regulations (including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974) and will be able to passage plan in advance given the promulgation of information relating to the Proposed Development (Offshore) and relevant nautical charts.

Relevant embedded mitigation measures include DSLP approval, adherence to an LMP, adherence to an NSP, marking on nautical charts, and promulgation of information.

18.2.1.1.2 Frequency of Occurrence

The frequency of occurrence in relation to displacement of vessel traffic during the O&M phase is considered **Frequent**.

18.2.1.1.3 Severity of Consequence

The severity of consequence in relation to displacement of vessel traffic during the O&M phase is considered **Negligible**.

18.2.1.1.4 Significance of Effect

Taking the frequency of occurrence as frequent and the severity of consequence as negligible, the overall effect of vessel displacement during O&M of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.2.1.2 Vessel Displacement During Adverse Weather

As discussed within the equivalent construction phase hazard, adverse weather can severely affect a vessels journey, with the impact of this dependent on various factors including specific vessel parameters such as hull geometry or vessel size.

18.2.1.2.1 Qualification of Risk

Based on review of the input received, it is likely that no commercial vessels would choose to make transit through the Caledonia OWF during adverse weather conditions. Larger deviations may be required than during more favourable conditions (e.g., vessels may choose to increase passing distance from the Caledonia OWF or transit inshore of the Moray Firth OWFs); however, there is considered to be sufficient sea room to safely accommodate the chosen transits.

The long term vessel traffic data studied in Appendix E showed the presence of transits within the Caledonia OWF undertaken by Serco NorthLink Ferries, further inshore of their typical routeing. Consultation with Serco NorthLink Ferries confirmed these transits were utilised during adverse weather conditions. The presence of structures within the Caledonia OWF may therefore impact Serco NorthLink adverse weather transits, with the potential for delays in sailings, a large deviation inshore of the Moray Firth OWFs, or sailing cancellation. However, as each historical transit is based upon individual Master decisions based upon the conditions and factors on the day, Serco NorthLink have confirmed that the impact cannot be quantified (i.e., it cannot be confirmed whether any given historical transit would have been delayed, deviated or cancelled).

The Applicant engaged with Serco NorthLink Ferries throughout the NRA process, and this engagement culminated in the Applicant proposing a SEZ on the eastern boundary of the Caledonia OWF within which no surface piercing infrastructure will be placed for the purposes of increasing searoom and optionality for Serco NorthLink Ferries in adverse weather conditions. The SEZ was proposed to Serco NorthLink via a meeting on 12th August 2024. Feedback received was that the SEZ and associated increase in searoom would be a significant positive for NorthLink adverse weather routeing, and also shipping and navigation in general.

From a navigational safety perspective, worst case consequences are an increase in delays, deviations or cancellation, however based upon Serco NorthLink feedback it is considered that the implementation of the SEZ reduces the risk to ALARP parameters noting frequency of the hazard is reduced. Socioeconomic impacts are assessed in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation of the EIAR.

Full details of the assessment and consultation undertaken in relation to Serco NorthLink are provided in Sections 12 and 4.2, respectively.

18.2.1.2.2 Frequency of Occurrence

The frequency of occurrence relating to vessel displacement during periods of adverse weather during O&M is considered to be **Remote**.

18.2.1.2.3 Severity of Consequence

The severity of consequence relating to vessel displacement during periods of adverse weather during O&M is considered to be **Serious**.

18.2.1.2.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as serious, the overall effect of adverse weather during O&M is considered to be tolerable.

Assuming the implementation of the SEZ, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms**.

18.2.2 Increased Third Party Vessel to Vessel Collision Risk

18.2.2.1 Qualification of Risk

As noted in relation to the construction phase, three of the 10 main routes will likely deviate as a result of the presence of the Proposed Development (Offshore). Post wind farm collision frequency was estimated at one every 292 years, based on conservative post OWF modelling, which assumed that vessels would not use the full available sea room offshore of the Caledonia OWF. In reality, as per the construction phase hazard, it is likely that vessels will deviate to use the available sea space. This aligns with general stakeholder consensus of the Hazard Workshop which indicated that there is sufficient post wind farm sea room available to safely accommodate the likely number of users.

For the Caledonia OECC, any displacement of commercial vessels due to O&M activities is not anticipated to affect available sea room to such an extent that the risk of a collision between third party vessels is materially increased. This is due to the infrequency of operational activities, and spatially limited extent of the operation at any given time.

An additional factor is the potential for WTGs to obscure vessels from one another, thus hindering ability to comply with COLREGs (IMO, 1972/77). Minimum spacing of 944m between WTGs will likely provide sufficient sea room for visual observations, with full obstruction likely only to occur when vessels are at opposite ends of a WTG row. Collision risk is likely to be low in such cases due to the distance between vessels.

In the event of an encounter between third party vessels, it is likely to be localised and short in duration, with collision avoidance action implemented by the vessels involved, as per compliance with COLREGs (IMO, 1972/77), to ensure that a collision incident does not develop.

As per the respective construction phase hazard, historical collision incident data 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 the vessels involved able to resume their respective passages and undertake a full inspection at the next port.

As an unlikely worst-case scenario, a high impact collision event could occur. This may result in vessel foundering and subsequent PLL, as well as pollution. In such a circumstance, vessels associated with the Proposed Development (Offshore) may attend the incident under SOLAS obligations and in liaison with the MCA, and the procedures within the ERCoP and MPCP would be implemented.

Relevant embedded mitigation measures includes marking on nautical charts, promulgation of information, DSLP approval, adherence to an LMP, adherence to an MPCP, and adherence to an ERCoP.

18.2.2.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between third party vessels during the O&M phase is considered **Extremely Unlikely**.

18.2.2.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between third party vessels during the O&M phase is considered **Serious**.

18.2.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of third party vessel to vessel collision risk during O&M of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.2.3 Increased Third Party Vessel to Project Vessel Collision Risk

The presence of vessels associated with O&M activities of the Proposed Development (Offshore) may increase encounters and thus collision risk for vessels already operating in the area.

18.2.3.1 Qualification of Risk

During the O&M phase of the Proposed Development (Offshore) there may be up to 938 vessel movements annually, and up to 25 project vessels on-site simultaneously (during major maintenance; i.e., likely less during normal operations). This will include vessels which are RAM.

Encounter and collision risk involving project vessels will be managed through the implementation of marine coordination as will be set out in the VMP and NSP. Project vessels will also be expected to carry AIS and comply with flag state regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974). COLREGs will remain the navigational priority for project vessels at all times.

Applications for safety zones of 500m around major maintenance activities during O&M will be sought and will protect deployed project vessels, especially if they are RAM. Minimum advisory passing distances and guard vessels, as defined by risk assessment, may also be implemented where safety zones do not apply. Details of safety zones, minimum safe passing distances, and guard vessels will be promulgated including via Notifications to Mariners and Kingfisher Bulletins.

Appropriate operational marine lighting and marking will be agreed with the NLB and set out in an LMP. These navigational aids will further maximise mariner awareness when in proximity to the Caledonia OWF.

Third-party vessels may experience decreased capability to visually identify project vessels during reduced visibility, especially if visual observations are obscured by WTGs; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and the mandatory carriage of AIS by project vessels regardless of size.

As discussed in the equivalent construction phase hazard, there has been one instance of a third-party vessel colliding with a project vessel in the UK. Moderate vessel damage was reported with no harm to persons. It is noted that the incident occurred in 2011, 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.

As per the respective construction phase hazard, if an encounter between a project vessel and third party vessel occurs, it is likely to be localised and short in duration. Assuming the implementation of collision avoidance action as required by the COLREGs, the most likely outcome will be any vessels involved being able to resume their respective passages or activities with no long-term consequences.

In the event of a collision, the likely consequences will be minor contact between the vessels resulting in minor damage and no injuries to persons. As an unlikely worst-case scenario, foundering could occur resulting in PLL and pollution. Other project vessels may be able to assist in the event of a collision under SOLAS obligation and the adherence to the ERCoP, noting this would be done in liaison with the MCA. If pollution were to occur in proximity to the Proposed Development (Offshore) or involving a project vessel, the MPCP will be implemented to minimise the risks.

Relevant embedded mitigation measures include application for safety zones, guard vessels as required by risk assessment, DSLP approval, adherence to an LMP, VMP, and NSP, MPCP, ERCoP, promulgation of information, marine coordination, and marking on nautical charts.

18.2.3.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between project vessels and third party vessels during the O&M phase is considered to be **Extremely Unlikely**.

18.2.3.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between project vessels and third party vessels during the O&M phase is considered to be **Serious**.

18.2.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of encounters and collision risk between project vessels and third party vessels during O&M of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.2.4 Vessel to Structure Allision Risk

Presence of structures within the Caledonia OWF will lead to creation of powered, drifting and internal allision risk for vessels during the O&M phase.

The spatial extent of the hazard is small given that a vessel must be in close proximity to an OWF structure for an allision incident to occur. Each allision element is considered in turn in terms of frequency of occurrence and severity of consequence, with the resulting significance of the residual risk across the various elements summarised at the end of the assessment. The forms of allision considered include:

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

18.2.4.1 Powered Allision Risk

18.2.4.1.1 Qualification and Quantification of Risk

As discussed in relation to the respective construction phase hazard, the base case annual powered vessel to structure allision frequency was estimated to be 2.9×10^{-3}, corresponding to a return period of one every 341 years. This is reflective of the volume of traffic within the available sea room, noting that is has been conservatively assumed that vessels will not use the full available sea room offshore of the Caledonia OWF. In reality, it is likely that vessels will increase passing distance from the Caledonia OWF, which aligns with feedback received at the Hazard Workshop.

Based on historical incident data, there have been two reported instances of a third-party vessel alliding with an operational OWF structure in the UK (in the Irish Sea and Southern North Sea). Both of these incidents involved a fishing vessel. These allisions resulted in minor to moderate damage to the vessels with minor injury to crew members.

Marine lighting and marking will be implemented in agreement with the NLB and defined within the LMP. These discussions will include contingency measures for the event that a WTG with a key navigational light needs to be towed away from site. Promulgation of information and marking on charts will ensure vessels can passage plan in advance to minimise risk.

Should an allision occur, the consequences will depend on multiple factors as discussed in relation to the equivalent construction phase hazard. Fishing vessels and recreational vessels are considered most vulnerable to the hazard and 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 founder resulting in PLL and pollution. Project vessels may assist in the event of an allision under SOLAS obligation and the adherence to the ERCoP, in liaison with the MCA. If pollution were to occur, then the MPCP will be implemented to minimise the environmental risk.

Relevant embedded mitigation measures include DSLP approval, adherence to a MPCP, adherence to an LMP, adherence to an NSP, promulgation of information, application for safety zones, adherence to an ERCoP, and marking on nautical charts.

18.2.4.1.2 Frequency of Occurrence

The frequency of occurrence in relation to powered vessel to structure allision risk during the O&M phase is considered to be **Extremely Unlikely**.

18.2.4.1.3 Severity of Consequence

The severity of consequence in relation to powered vessel to structure allision risk during the O&M phase is considered to be **Moderate**.

18.2.4.1.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during O&M of the Proposed Development (Offshore) is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

18.2.4.2 Drifting Allision Risk

18.2.4.2.1 Qualification and Quantification of Risk

Based on quantitative assessment undertaken (see Section 16.3) the base case annual drifting vessel to structure allision frequency was estimated to be 2.5×10^{-4}, corresponding to a return period of one every 4,054 years. This is reflective of the volume of traffic within the available sea room.

Based on historical incident data, there have been no instances of a third-party vessel alliding with an operational OWF structure whilst NUC. However, there is considered to be potential for a vessel to be adrift; this is reflected in the MAIB incident data, where two incidents of machinery failure were recorded between 2012 and 2021, as discussed in relation to the equivalent construction phase hazard. Promulgation of information, lighting and marking, and marking on charts will help vessels to passage plan and mitigate the risks of a drifting allision.

In circumstances where a vessel drifts towards a structure in the Caledonia OWF, powered vessels may be able to regain power prior to reaching the Caledonia OWF (that is, by rectifying any fault). Failing this, the vessel's emergency response procedures would be implemented which may include an emergency anchoring event or the use of thrusters (depending on availability and power supply).

Where the deployment of the anchor is not possible (e.g., for small craft), any project vessels on-site may be able to render assistance in liaison with the MCA and in line with SOLAS obligations (IMO, 1974). This response will be managed via the coastguard and marine coordination, and depends on the type and capability of vessels on site. This would be particularly relevant for sailing vessels relying on metocean conditions for propulsion, noting if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance.

Should an allision occur, the consequences will be similar to those noted for the respective construction phase hazard including the unlikely worst-case of foundering, PLL, and pollution. In the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the MPCP will minimise the environmental risk. Project vessels may assist in the event of an allision under SOLAS (IMO, 19742) obligation and the adherence to the ERCoP, in line with the MCA. Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel, thus reducing the energy of the impact, including in the case of a recreational vessel under sail.

Relevant embedded mitigation measures include adherence to an ERCoP, adherence to an MPCP, marking on nautical charts, adherence to an LMP, and project vessel compliance with SOLAS (IMO, 1974).

18.2.4.2.2 Frequency of Occurrence

The frequency of occurrence in relation to drifting vessel to structure allision risk during the O&M phase is considered to be **Extremely Unlikely**.

18.2.4.2.3 Severity of Consequence

The severity of consequence in relation to drifting vessel to structure allision risk during the O&M phase is considered to be **Moderate**.

18.2.4.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during O&M of the Proposed Development (Offshore) is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

18.2.4.3 Internal Allision Risk

18.2.4.3.1 Qualification and Quantification of Risk

As noted previously, based on experience at existing operational OWFs, it is anticipated that commercial vessels will be unlikely to navigate internally within the Caledonia OWF. Fishing and recreational vessels may be more likely to transit through noting they may choose not to depending on various conditions (this aligns with consultation input). Vessels may be less likely to navigate within a site which hosts floating wind farm structures due to the presence of mooring lines and dynamic cables.

As noted in the respective construction phase hazard, the base case fishing vessel to structure allision frequency is estimated to be 2.9×10^{-1}, corresponding to a return period of approximately one in 3.5 years. This return period is reflective of the volume of fishing vessel traffic in the study area, both in transit and engaged in active fishing. Conservative modelling has been undertaken with the assumption that fishing levels in proximity to the WTGs will not change. In reality, as discussed within the equivalent construction phase hazard, fishing vessels will account for the presence of the WTGs, and may choose to transit or fish elsewhere (noting this aligns with consultation input).

The worst-case consequences reported for vessels involved in an allision incident involving a UK OWF has been flooding, with no life-threatening injuries to persons reported. If an allision incident were to occur, project vessels may assist under obligation of SOLAS (IMO, 1974) and adherence to the ERCoP in liaison with the MCA. Additionally, if pollution occurs as a result of an allision incident, the MPCP would be implemented where appropriate.

If a vessel chooses to transit within the Caledonia OWF, the minimum spacing of 944m between wind farm structures is considered sufficient for safe internal navigation. Furthermore, operational lighting and marking and marking on nautical charts provide mitigation against internal allision risk. Should a WTG with a key navigational light need towed, sufficient alternative lighting will be agreed with the NLB. Any vessel planning to transit through the Caledonia OWF is expected to passage plan in advance in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information including through ongoing liaison with fishing fleets via an appointed FLO will seek to ensure that such vessels have good awareness of the Proposed Development (Offshore). Locations of relevant infrastructure will be provided in the weekly notices distributed during the construction phase as per the Outline FMMSs (Volume 7, Appendix 17 and Volume 17, Appendix 18).

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. As noted in the equivalent construction phase hazard, from previous studies of offshore wind developments, it has been concluded that WTGs do reduce wind velocity downwind of a WTG (MCA, 2022) 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 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.

Relevant embedded mitigation measures include application for safety zones, DSLP approval, adherence to an LMP, marking on nautical charts, promulgation of information, adherence to an ERCoP, adherence to an MPCP, appointment of a FLO and adherence to an FMMS.

18.2.4.3.2 Frequency of Occurrence

The frequency of occurrence of internal vessel to structure allision risk during the O&M phase is considered to be **Remote**.

18.2.4.3.3 Severity of Consequence

The severity of consequence of internal vessel to structure allision risk during the O&M phase is considered to be **Moderate**.

18.2.4.3.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during O&M of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and ALARP and Not Significant in EIA terms.**

18.2.5 Reduced Access to Local Ports

18.2.5.1 Qualification of Risk

Up to 938 vessel movements annually by O&M vessels may be made throughout the O&M phase, which will include vessels which are RAM. Project vessels will be managed by marine coordination, including the use of traffic management procedures such as the designation of entry and exit points to and from the Caledonia OWF, and designated routes to and from the base port. Project vessels will also carry AIS and be compliant with flag state regulations including the COLREGs (IMO 1972/77).

As discussed in the baseline description and equivalent construction phase hazard, the closest port or harbour is Wick Harbour, located approximately 13.2nm to the northwest, with Banff Harbour located approximately 20nm to the south. Given the relative distance to ports in the area and the anticipated deviations for the main commercial routes, it is not anticipated that there will be any substantial effect on vessel approaches to and from the local ports beyond the deviations already outlined for impacts on vessel displacement.

For offshore export cable O&M activity, there is a greater risk given the proximity to Whitehills Harbour and Marina which is located approximately 0.37nm (682m) southeast of the Caledonia OECC. Recreational vessels may be particularly sensitive given that the RYA Scotland has indicated that Whitehills Marina is a key stopping point for vessels travelling north as well as along the northeast coast. No concerns were raised over access to ports during the O&M phase in relation to the Caledonia OWF nor the offshore export cables. Additionally, offshore export cable maintenance activities will likely be very infrequent, short-term in duration and localised at any given time, thus any reduced access will likely be minor and temporary (and less than during construction).

The most likely consequences are increased journey times and distances, as per the vessel displacement hazard. There is only one pilot boarding station nearby, at Macduff, where the service is not compulsory. Thus, no effect is anticipated on port related services such as pilotage.

Relevant embedded mitigation measures includes adherence to an LMP, adherence to a VMP, marine coordination of project vessels, marking on nautical charts, and promulgation of information.

18.2.5.2 Frequency of Occurrence

The frequency of the risk of reduced access to local ports during the O&M phase is considered to be **Remote**.

18.2.5.3 Severity of Consequence

The severity of consequence of the risk of reduced access to local ports during the O&M phase is considered to be **Minor**.

18.2.5.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as minor, the overall effect of reduced port access during O&M of the Proposed Development (Offshore) is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

18.2.6 Reduction of Under keel Clearance

The presence of subsea cable protection, dynamic inter-array cables and mooring lines may reduce under keel clearance during the O&M phase of the Proposed Development (Offshore).

18.2.6.1 Subsea Cable Protection

18.2.6.1.1 Qualification of Risk

Reduced water depth due to the presence of subsea infrastructure will lead to a reduction in under keel clearance. The target burial depth for all subsea cables is 1m, noting actual burial depth will be determined via the CBRA process which will be undertaken post consent.

Where burial is not feasible, cable protection may be used instead, which again will be determined by the CBRA. In line with MGN 654, any reduction in water depth which exceeds 5% will be discussed with the MCA to determine if additional mitigation is necessary. This aligns with the RYA's recommendation that the "minimum safe under keel clearance over submerged structures and associated infrastructure should be determined in accordance with the methodology set out in MGN 543 [since superseded by MGN 654]" (RYA, 2019).

Given that depths within the Caledonia OWF range between 39m to 82m, it is not anticipated that subsea cable protection will reduce water depths over the 5% threshold. In terms of the offshore export cables, a water depth reduction of over 5% is possible in nearshore areas if cable protection is required. The vessel traffic data shows the majority of vessels operating near the Landfall Site tend to be recreational and fishing vessels which are generally smaller in size and have reduced draughts compared to larger commercial vessels. As discussed in the equivalent construction phase hazard, no specific concerns from stakeholders were raised during consultation including the Hazard Workshop, with MGN 654 compliance considered suitable to manage the impact.

In the event of an underwater allision, the most likely consequence is minor damage. The unlikely worst-case consequence may be vessel foundering resulting in PLL and pollution. Implementation of the MPCP will mitigate against pollution, whilst adherence to an ERCoP as well as operating under the obligations of SOLAS (IMO, 1974) will mitigate against the risk of PLL.

18.2.6.1.2 Frequency of Occurrence

The frequency of occurrence of the risk of reduced under keel clearance due to the presence of subsea cables during O&M is considered **Extremely Unlikely**.

18.2.6.1.3 Severity of Consequence

The severity of consequence of the risk of reduced under keel clearance due to the presence of subsea cables during O&M is considered to be **Moderate**.

18.2.6.1.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of reduced under keel clearance due to subsea cables during O&M of the Proposed Development (Offshore) is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

18.2.6.2 Dynamic Inter-array Cables and Mooring Lines

18.2.6.2.1 Qualification of Risk

The presence of inter-array cables and mooring lines associated with floating substructures of the Proposed Development (Offshore) may reduce under keel clearance during the O&M phase of the Proposed Development (Offshore).

There may be up to six mooring lines per floating WTG used to secure the substructures to the seabed. The highest risk areas will be the immediate vicinity of the floating substructures where mooring lines and inter-array cables will be closest to the surface.

As previously noted, it is likely that commercial vessels will not enter the Caledonia OWF. Moreover, experience indicates that commercial vessels frequently pass 1nm or more away from established developments. On this basis, taking into consideration the baseline and anticipated post wind farm vessel routeing, it is considered highly unlikely that a commercial vessel would pass within the Caledonia OWF, in particular in sufficiently close proximity to the floating substructures for an under keel interaction to arise.

As discussed in relation to the equivalent construction phase hazard, fishing and recreational vessels are more likely to transit in proximity to the Caledonia OWF compared to commercial vessels. However these vessels are smaller and tend to have lower draughts. Consultation input, including at the Hazard Workshop, was that fishing and recreational vessels would likely avoid any floating WTGs.

The mooring lines and inter-array cables will be appropriately marked on nautical charts and other electronic charts as appropriate to increase awareness. It was raised at the Hazard Workshop that making the locations of mooring lines and dynamic cables available to fishing vessels was a key mitigation. Locations of relevant infrastructure will be provided in the weekly notices distributed during the construction phase as per the Outline FMMSs (Volume 7, Appendix 17 and Volume 7, Appendix 18).

As discussed in the equivalent construction phase hazard, it will be necessary to confirm available under keel clearance from the mooring lines post installation, in particular if taut 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 floating offshore wind projects in UK waters; however, to date there have been no reported under keel interactions between passing vessels and the components associated with such projects.

The most likely consequences of reduced under keel clearance due to inter-array cables and mooring lines is that a vessel transits over an area of reduced clearance but does not make contact.

Should an underwater allision occur, minor damage incurred is the most likely consequence, with foundering or grounding of the vessel resulting in PLL and pollution as an unlikely worst-case. Should pollution occur, the MPCP will be implemented, with adherence to the ERCoP in the case of risk of PLL, as well as under SOLAS (IMO, 1974) obligations.

Other relevant embedded mitigation measures include promulgation of information and any potential under keel interaction risk, including via the FLO. The locations of the floating substructures will 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.

18.2.6.2.2 Frequency of Occurrence

The frequency of occurrence in relation to reduction of under keel clearance as a result of inter-array cables and mooring lines during the O&M phase is considered **Extremely Unlikely**.

18.2.6.2.3 Severity of Consequence

The severity of consequence in relation to reduction of under keel clearance as a result of inter-array cables and mooring lines during the O&M phase is considered **Serious**.

18.2.6.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced under keel clearance due to inter-array cables and mooring lines during O&M of the Proposed Development (Offshore) is considered to be tolerable.

Assuming the confirmation of available under keel clearance in agreement with MCA and NLB post installation, and the implementation of ensuring locations of subsea infrastructure are made available to fishing vessels including via FLO liaison as secured by the Outline FMMSs (Volume 7, Appendix 17 and Volume 7, Appendix 18) the hazard is considered **Tolerable with mitigation and ALARP and therefore Not Significant in EIA terms.**

18.2.7 Anchor Interaction with Subsea Cables and Mooring Lines

The presence of subsea cables and mooring lines within the Caledonia OWF and Caledonia OECC may increase the risk of anchor interaction.

18.2.7.1 Qualification of Risk

The spatial extent of the hazard is small given that a vessel must be in close proximity to an offshore export cable, inter-array cable or mooring line for an interaction to occur.

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

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

Although the second of these scenarios may involve limited decision-making time if drifting towards a hazard, in all three scenarios it is anticipated that the charting of infrastructure including the subsea cables and mooring lines will inform the decision to anchor, as per Regulation 34 of SOLAS (IMO, 1974).

No anchored vessels were observed within the study area for the during the survey periods or long-term vessel traffic data. Risk of interaction with an inter-array cable, interconnector cable, or mooring line on a planned anchoring or dragged anchoring basis is therefore anticipated to be extremely low. In terms of emergency anchoring, any areas of high traffic volume are likely to represent the areas of highest risk, particularly where there are hazards nearby (for example, structures, rocks, shallows). However; given the open sea room in proximity to the Caledonia OWF and water depths the likelihood of this scenario arising is very low. The majority of traffic is also anticipated to pass offshore of the Caledonia OWF, away from where the inter-array cables, interconnector cables and mooring lines associated with the Proposed Development (Offshore) are located.

The likelihood of anchor interaction with a subsea cable is further minimised by the burial of the cables and use of external cable protection where required, which will be informed by the CBRA process, noting this will account for traffic volumes and sizes. General consensus of the Hazard Workshop was that floating subsea infrastructure including mooring lines and dynamic cables would be avoided by vessels in transit, and therefore frequency of any anchoring in proximity is also likely to be low.

In terms of the offshore export cables, Macduff anchorage sits within the OECC study area adjacent to the Caledonia OECC. The volumes and sizes of vessels using this anchorage will be considered within the CBRA process, to ensure the cables are suitably buried and/or protected, noting promulgation of information and marking on nautical charts will further mitigate the risk. Additionally, it is likely that anchoring undertaken in Macduff anchorage will be planned, thus it is anticipated that mariners will take into account the presence of the offshore export cables via nautical charts before dropping anchor. With good practice, it is considered unlikely that an anchor interaction would occur. Final cable routeing within the Caledonia OECC will be defined within the CaP which will be approved by MD-LOT in consultation with the MCA.

Should an anchor interaction occur, the most likely consequence is no damage to the cable or anchor, based on previous anchor interaction incidents. As an unlikely worst-case consequence, a snagging incident could occur and the vessel’s anchor as well as the cable could be damaged, resulting in a loss of stability noting this would only occur for a smaller vessel which would be less likely to penetrate deeper into the seabed than a larger vessel.

Relevant embedded mitigation measures include promulgation of information, marking on nautical charts, adherence to a CBRA, development of and adherence to a CaP and vessel compliance with MGN 654 (MCA, 2021).

18.2.7.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of anchor interaction with subsea cables and mooring lines during O&M is considered to be **Extremely Unlikely**.

18.2.7.3 Severity of Consequence

The severity of consequence relating to the risk of anchor interaction with subsea cables and mooring lines during O&M is considered to be **Moderate**.

18.2.7.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of anchor interaction with subsea cables and mooring lines during O&M of the Proposed Development (Offshore) is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

18.2.8 Loss of Station

The floating substructures may suffer loss of station in the event that the mooring system fails, or there is damage to tow during WTG towage for maintenance. This may become a floating hazard to passing vessels. This hazard is only relevant to the floating WTGs within the Caledonia OWF, and thus there will be no risk of this hazard from the Caledonia OECC.

18.2.8.1 Qualification of Risk

During the O&M phase, towage of WTGs to and from site for maintenance will be subject to a dedicated risk assessment at the time of the towage operation when full specifications relating to the operations is available. This will be outlined in the VMP. It is anticipated that a maximum of 938 vessel movements annually will be carried out for WTG towage to port. This dedicated risk assessment should cover all elements of the towage operation including in port approaches and internally within the Caledonia OWF. Where possible, towage of WTGs will be avoided, with infield maintenance being the preferred method. During the tow, all vessels involved will be lit and marked as required under COLREGs (IMO, 1972/1977).

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

The Regulatory Expectations also require the provision of continuous monitoring either by GPS or other suitable means. Each WTG should 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, which will depend upon the design of the substructure and any predefined emergency response protocols.

On the basis of compliance with the Regulatory Expectations, 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 (each WTG will have a minimum of six), which is more likely to occur in extreme storm conditions, during which it is unlikely vessels will be navigating within proximity to the WTGs.

Relevant embedded mitigation measures include compliance with regulatory expectations on moorings for floating wind and marine devices (HSE and MCA, 2017) and MGN 654, adherence to a DSLP, promulgation of information, adherence to an ERCoP, compliance with international regulations (SOLAS; IMO, 1974), appropriate marking of the structures and adherence to an LMP.

18.2.8.2 Frequency of Occurrence

The frequency of occurrence relating to loss of station during the O&M phase is considered to be **Extremely Unlikely**.

18.2.8.3 Severity of Consequence

The severity of consequence relating to loss of station during the O&M phase is considered to be **Moderate**.

18.2.8.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of loss of station during the O&M of the Proposed Development (Offshore) is considered to be **Broadly Acceptable and ALARP, and therefore Not Significant in EIA terms.**

18.2.9 Reduction of SAR Capabilities

The presence of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the O&M phase of the Proposed Development (Offshore) by increasing the number of incidents, increasing consequences or reducing access for the responders.

18.2.9.1 Qualification of Risk

The spatial extent of this hazard is large given the area covered by the Caledonia OWF (123nm^2), as well as the distance covered by air-based SAR support (the SAR helicopter base is located at Inverness, 66nm southwest of the Caledonia OWF). It is unlikely that a SAR operation will require the entire Caledonia OWF to be searched, and it is probable that a search will be restricted to a smaller area in which a casualty is known to be located (accounting for assumptions on any potential drift of the casualty).

Up to 938 vessel movements annually may be made by O&M vessels during the lifetime of the Proposed Development (Offshore). It is assumed that O&M vessels will be on-site throughout the majority of the O&M phase, although severe weather may lead to vessels being withdrawn. The presence of these vessels increase the likelihood of an incident and subsequently increases the likelihood of multiple incidents occurring simultaneously, diminishing emergency response capability. However, they may also be able to provide additional response resource in the event of an incident in liaison with the MCA.

The most likely consequence to occur would be a delay to any emergency response request. As an unlikely worst-case, this could result in a failure of emergency response to an incident resulting in PLL and pollution. However, project vessels will be managed via marine coordination and comply with flag state regulations which will minimise this risk. Additionally, the presence of project vessels themselves may mitigate this risk as they may self-help at incidents involving other project vessels under the obligation of SOLAS (IMO, 1974) and adherence to an ERCoP, noting this would be undertaken with liaison with the MCA. The MPCP will also be implemented should pollution occur.

As discussed in the equivalent construction phase hazard, the frequency of SAR helicopter operations in proximity to the Proposed Development (Offshore) is one per year, with no SAR helicopter incidents occurring within the Caledonia OWF. The frequency of incidents in proximity to the Caledonia OWF is not anticipated to increase significantly from the current level given the measures noted above which will be in place. The layout will be agreed with the MCA and in line with MGN 654 requirements to ensure any SAR operations that do occur within the Caledonia OWF are facilitated. A SAR checklist will also be completed and agreed with the MCA.

Relevant embedded mitigation measures include DSLP approval, promulgation of information, adherence to an LMP, marking on appropriate charts, marine coordination of project vessels, adherence to an ERCoP, adherence to an MPCP, adherence to a VMP and NSP, and compliance with MGN 654 and international marine regulations.

18.2.9.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of reduced emergency response capabilities during the O&M phase is considered to be **Extremely Unlikely**.

18.2.9.3 Severity of Consequence

The severity of consequence relating to the risk of reduced emergency response capabilities during the O&M phase is considered to be **Serious**.

18.2.9.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during O&M of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.3 Decommissioning Phase

18.3.1 Vessel Displacement

Decommissioning activities associated with the Proposed Development (Offshore) may displace existing vessel routes or activity, which may be more prevalent during periods of adverse weather.

These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

18.3.1.1 Vessel Displacement

18.3.1.1.1 Qualification of Risk

Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, this hazard is expected to be similar in nature to the equivalent construction stage hazard. It is noted that in the case of subsea cables sections may be left *in situ* to avoid unnecessarily disturbing the seabed. This would be confirmed through consultation and assessment to ensure the most suitable approach was taken. But for the purposes of this assessment (as a worst-case) it has been assumed that all subsea cables will be removed during decommissioning with only cable protection left *in situ*.

The use of a buoyed decommissioning area analogous to the buoyed construction area is assumed and will result in similar main route deviations to those established for the equivalent construction stage hazard. By the time of decommissioning, deviations will be well established, with vessels likely to continue on their typical routeing around the buoyed decommissioning area.

Relevant embedded mitigation measures would be as per the respective construction phase.

18.3.1.1.2 Frequency of Occurrence

The frequency of occurrence in relation to displacement of vessel traffic during the decommissioning phase is considered **Frequent.**

18.3.1.1.3 Severity of Consequence

The severity of consequence in relation to displacement of vessel traffic during the decommissioning phase is considered **Negligible**.

18.3.1.1.4 Significance of Effect

Taking the frequency of occurrence as frequent and the severity of consequence as negligible, the overall effect of vessel displacement during decommissioning of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.3.1.2 Vessel Displacement During Adverse Weather

18.3.1.2.1 Qualification of Risk

As discussed within the equivalent construction phase hazard, adverse weather can severely affect a vessels journey, with the impact of this dependent on various factors including specific vessel parameters such as hull geometry or vessel size.

As discussed in relation to the equivalent construction phase hazard, it is likely that no commercial vessels would choose to make transit through the buoyed decommissioning area during adverse weather conditions. Larger deviations may be required than during more favourable conditions, however there is considered to be sufficient sea room to safely accommodate the chosen transits.

The long term vessel traffic data studied in Appendix E showed the presence of transits within the Caledonia OWF undertaken by Serco NorthLink Ferries, further inshore of their typical routeing. Consultation with Serco NorthLink Ferries confirmed these transits were utilised during adverse weather conditions. The presence of the buoyed decommissioning area may therefore impact Serco NorthLink adverse weather transits, with the potential for delays in sailings, a large deviation inshore of the Moray Firth OWFs, or sailing cancellation. However, as each historical transit is based upon individual Master decisions based upon the conditions and factors on the day, Serco NorthLink have confirmed that the impact cannot be quantified (i.e., it cannot be confirmed whether any given historical transit would have been delayed, deviated or cancelled).

The Applicant engaged with Serco NorthLink ferries throughout the NRA process, and this engagement culminated in the Applicant proposing a SEZ on the eastern boundary of the Caledonia OWF within which no surface piercing infrastructure will be placed for the purposes of increasing searoom and optionality for Serco NorthLink ferries in adverse weather conditions. The SEZ was proposed to Serco NorthLink via a meeting on 12th August 2024. Feedback received was that the SEZ and associated increase in searoom would be a significant positive for NorthLink adverse weather routeing, and also shipping and navigation in general.

There may still be works undertaken within the SEZ (e.g., associated with cables), however any such impact would be temporary in nature and spatially limited to the area around the operation. The placement of the buoyed decommissioning area will be agreed with NLB to ensure any impacts to shipping and navigation are managed.

From a navigational safety perspective, worst case consequences are an increase in delays, deviations or cancellation; however, based upon Serco NorthLink feedback, it is considered that the implementation of the SEZ reduces the risk to ALARP parameters noting frequency of the hazard is reduced. Socioeconomic impacts are assessed in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation of the EIAR.

18.3.1.2.2 Frequency of Occurrence

The frequency of occurrence relating to vessel displacement during periods of adverse weather during decommissioning is considered to be **Remote**.

18.3.1.2.3 Severity of Consequence

The severity of consequence relating to vessel displacement during periods of adverse weather during decommissioning is considered to be **Serious**.

18.3.1.2.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as serious, the overall effect of adverse weather during decommissioning of the Proposed Development (Offshore) is considered to be tolerable.

Assuming the implementation of the SEZ, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms**.

18.3.2 Increased Third Party Vessel to Vessel Collision Risk

18.3.2.1 Qualification of Risk

This hazard is expected to be similar in nature to the equivalent construction phase hazard. As above, it is noted that in the case of subsea cables sections may be left *in situ* to avoid unnecessarily disturbing the seabed. This would be confirmed through consultation and assessment to ensure the most suitable approach was taken. But for the purposes of this assessment it has been assumed that all subsea cables will be removed during decommissioning with only cable protection left *in situ*.

The use of a buoyed decommissioning area analogous to the buoyed construction area is assumed and will result in a similar collision risk to that established for the equivalent construction phase hazard. The same assumptions in terms of frequency and consequence apply.

Relevant embedded mitigation measures would be as per the respective construction phase.

18.3.2.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between third party vessels during the decommissioning phase is **Extremely Unlikely**.

18.3.2.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between third party vessels during the decommissioning phase is considered **Serious**.

18.3.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of third party vessel to vessel collision risk during decommissioning of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.3.3 Increased Third Party Vessel to Project Vessel Collision

The presence of vessels associated with decommissioning activities of the Proposed Development (Offshore) may increase encounters and thus collision risk for vessels already operating in the area.

18.3.3.1 Qualification of Risk

Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, including the vessels involved, this hazard is expected to be similar in nature to the equivalent construction phase, including the number of vessel movements by decommissioning vessels. It is noted that in the case of subsea cables it is expected that they will be left *in situ* but for the purposes of this assessment (as a worst-case) it has been assumed that all cables will be removed during decommissioning, with only cable protection left *in situ*.

On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.3.3.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between project vessels and third party vessels during the decommissioning phase is considered to be **Extremely Unlikely**.

18.3.3.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between project vessels and third party vessels during the decommissioning phase is considered to be **Serious**.

18.3.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of encounters and collision risk between project vessels and third party vessels during decommissioning of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.3.4 Vessel to Structure Allision

Presence of structures (including partially removed) during decommissioning will lead to creation of powered, drifting and internal allision risk for vessels.

18.3.4.1 Powered Allision Risk

18.3.4.1.1 Qualification and Quantification of Risk

It is likely that powered allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.3.4.1.2 Frequency of Occurrence

The frequency of occurrence in relation to powered vessel to structure allision risk during the decommissioning phase is considered to be **Extremely Unlikely**.

18.3.4.1.3 Severity of Consequence

The severity of consequence in relation to powered vessel to structure allision risk during the decommissioning phase is considered to be **Moderate.**

18.3.4.1.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during decommissioning of the Proposed Development (Offshore) is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

18.3.4.2 Drifting Allision Risk

18.3.4.2.1 Qualification and Quantification of Risk

It is likely that drifting allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.3.4.2.2 Frequency of Occurrence

The frequency of occurrence in relation to drifting vessel to structure allision risk during the decommissioning phase is considered to be **Extremely Unlikely**.

18.3.4.2.3 Severity of Consequence

The severity of consequence in relation to drifting vessel to structure allision risk during the decommissioning phase is considered to be **Moderate**.

18.3.4.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during decommissioning of the Proposed Development (Offshore) is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

18.3.4.3 Internal Allision Risk

18.3.4.3.1 Qualification and Quantification of Risk

It is likely that internal allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.3.4.3.2 Frequency of Occurrence

The frequency of occurrence of internal vessel to structure allision risk during the decommissioning phase is considered to be **Remote**.

18.3.4.3.3 Severity of Consequence

The severity of consequence of internal vessel to structure allision risk during the decommissioning phase is considered to be **Moderate**.

18.3.4.3.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during decommissioning of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

18.3.5 Reduced Access to Local Ports

18.3.5.1 Qualification of Risk

Decommissioning activities associated with the removal of structures and cables may displace existing routes/activity restricting access to ports/harbours.

Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, this hazard is expected to be similar in nature to the equivalent construction phase, including the number of vessel movements by decommissioning vessels. It is noted that in the case of subsea cables it is expected that they will be left *in situ* but for the purposes of this assessment (as a worst-case) it has been assumed that all cables will be removed during decommissioning, with only cable protection will be left *in situ*.

As with the construction stage, it is not yet known from which port(s) decommissioning activity will be based for the Proposed Development (Offshore).

On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.3.5.2 Frequency of Occurrence

The frequency of the risk of reduced access to local ports during the decommissioning phase is considered to be **Reasonably Probable**.

18.3.5.3 Severity of Consequence

The severity of consequence of the risk of reduced access to local ports during the decommissioning phase is considered to be **Minor**.

18.3.5.4 Significance of Effect

Taking the frequency of occurrence as reasonably probable and the severity of consequence as minor, the overall effect of reduced port access during decommissioning of the Proposed Development (Offshore) is considered to be tolerable.

Assuming liaison with the Whitehills, Banff, and Macduff harbour authorities in advance of and during decommissioning, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms**.

18.3.6 Loss of Station

As per the construction phase, the floating substructures may suffer loss of station in the event that the mooring system fails, or there is damage to tow during WTG towage during decommissioning. This may become a floating hazard to passing vessels. This hazard is only relevant to the floating WTGs within the Caledonia OWF, and thus there will be no risk of this hazard from the Caledonia OECC.

18.3.6.1 Qualification of Risk

Given that the process of removing floating WTGs is likely to be similar to the reverse of WTG installation in terms of vessel numbers, vessel movements, and duration of the decommissioning phase, the risk of loss of station during the decommissioning phase is likely to be as described in the equivalent construction phase hazard. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.3.6.2 Frequency of Occurrence

The frequency of occurrence relating to loss of station during the decommissioning phase is considered to be **Extremely Unlikely**.

18.3.6.3 Severity of Consequence

The severity of consequence relating to loss of station during the decommissioning phase is considered to be **Moderate**.

18.3.6.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of loss of station during the decommissioning phase of the Proposed Development (Offshore) is considered to be **Broadly Acceptable and ALARP, and therefore Not Significant in EIA terms.**

18.3.7 Reduction of SAR Capabilities

The removal of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the decommissioning phase of the Proposed Development (Offshore) by increasing the number of incidents, increasing consequences or reducing access for the responders.

18.3.7.1 Qualification of Risk

Given that removal of structures is likely to be similar to installation in terms of vessel numbers and duration, the risk is likely to be as described in the equivalent construction phase hazard. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.3.7.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of reduced emergency response capabilities during the decommissioning phase is considered to be **Extremely Unlikely**.

18.3.7.3 Severity of Consequence

The severity of consequence relating to the risk of reduced emergency response capabilities during the decommissioning phase is considered to be **Serious**.

18.3.7.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during decommissioning of the Proposed Development (Offshore) is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19 Risk Assessment – Caledonia North In Isolation

This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to Caledonia North, based on baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments. The hazards assessed are as follows:

- Vessel displacement (including during adverse weather);
- Increased third-party collision risk;
- Third-party with project vessel collision risk;
- Creation of vessel to structure allision risk;
- Changes in under keel clearance;
- Increased interaction with subsea cables;
- Reduced access to local ports and harbours; and
- Reduction of SAR capability.

For each hazard, embedded mitigation measures which have been identified as relevant to reducing risk are listed, with full descriptions provided in Section 17.1. This is followed by statements defining the frequency of occurrence, severity of consequence, and subsequent significance of risk based on the methodology defined in Section 3.

The risk control log (see Section 24 summarises the risk assessment and a concluding risk statement is provided (see Section 26.5).

19.1 Construction Phase

19.1.1 Vessel Displacement

Construction activities associated with Caledonia North may displace existing vessel routes or activity, which may be more prevalent during periods of adverse weather.

These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

19.1.1.1 Vessel Displacement

19.1.1.1.1 Qualification or Risk

Vessel traffic data collected during the winter and summer 2023 surveys have been used to establish the vessel traffic baseline, alongside 12 months of AIS collected via coastal receivers between November 2022 and October 2023. These vessel traffic datasets have been validated by Anatec's ShipRoutes database, and analysed to identify the volume of traffic passing within or in proximity to the Caledonia North Site. Additionally, main routes were recognised from these datasets using the principles set out in MGN 654 (MCA, 2021) (see Section 11).

Although there will be no restrictions on entry into the buoyed construction area, other than through active safety zones, based on experience at previously under construction OWFs and consultation it is anticipated that the majority of commercial vessels will choose not to navigate within the buoyed construction area, therefore some main route deviations will be required. It is noted that Tidal Transit, who provide offshore transport services, responded to the regular operators outreach (see Appendix D) stating they may choose to transit internally within the Caledonia North Site if it is allowable to save fuel or energy. On this basis, smaller commercial vessel operators may choose to transit through (noting Tidal Transit vessels are small wind farm crew transfer vessels (below 28m in length), and were recorded working between Wick and Beatrice OWF), however it is likely that the majority of commercial vessels will deviate in line with other developments.

The full methodology for classifying main route deviations is provided in Section 15.4, noting it is in line with MGN 654 (MCA, 2021). A deviation will be required for two of the 10 main routes identified within the study area, however all deviations were minor (no more than 1% based on the worst case assumptions).

This low magnitude of deviations aligns with feedback received during consultation including at the Hazard Workshop (see Section 4).

Regular routeing involving RoRo vessels was identified within the vessel traffic datasets and was attributed to Smyril Line and Serco NorthLink Ferries, both of which were observed to transit within the study area every one to two days. Smyril Line vessels were noted to intersect Caledonia North; however, during consultation, Smyril Line stated that there would not be any issues or concern with deviating to the east of Caledonia North.

Regular routeing of RoPax vessels operated by Serco NorthLink Ferries was also noted within the vessel traffic data. Route deviation was also deemed unnecessary for these regular journeys due to the distance from the Caledonia North Site. Serco NorthLink confirmed during consultation that they had no concerns with impacts on their regular routeing.

It is noted that certain transits from NorthLink Ferries were observed to intersect the Caledonia North Site. Consultation with NorthLink confirmed these transits were during adverse weather. Vessel displacement during adverse weather is considered in the relevant hazard below.

Based on experience at previously under construction OWFs, it is anticipated that fishing vessels and recreational vessels may also choose not to routinely navigate internally within the buoyed construction area, noting there would be no restriction on transit other than through active safety zones. However, they may be more likely to do so than commercial vessels, in particular in any areas of the Caledonia North Site where active construction is not ongoing, or structures are not yet present. Input received during the Hazard Workshop from commercial fishing representatives was that (as for commercial vessels) only a minor deviation would be required for fishing vessels in transit and as such it is likely that such vessels will choose to deviate. Input from the RYA Scotland indicated that this would likely apply to recreational vessels as well, noting that it is of the skippers preference as to whether or not a transit is made through a wind farm.

For any smaller vessels that do choose to deviate, there is considered to be sufficient sea room outside of the Caledonia North Site for transits from such vessels to be accommodated, noting this aligns with general consensus from the Hazard Workshop. It is noted that displacement of active commercial fishing is assessed separately in Volume 3, Chapter 8: Commercial Fisheries of the EIAR.

Given the east and west routeing of commercial vessels across the OECC, installation activities associated with the export cable will likely lead to vessel displacement. However, any associated displacement will be temporary in nature and spatially limited to the area immediately around the installation vessel position. Considering embedded mitigation measures such as promulgation of information, any displacement as a result of cable installation will be minor and manageable with appropriate passage planning.

The main consequences of vessel displacement will be increased journey times and distances for affected third party vessels, under the assumption that the buoyed construction area will be deployed around the maximum extent of the Caledonia North Site. Any notable safety impacts are considered unlikely given the available sea room, noting this aligns with outputs of the Hazard Workshop. Vessels are expected to comply with international and flag state regulations (including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974) and will be able to passage plan in advance given the promulgation of information relating to Caledonia North and relevant nautical charts.

Relevant embedded mitigation measures include DSLP approval, adherence to an LMP, adherence to an NSP, marking on nautical charts, and promulgation of information.

19.1.1.1.2 Frequency of Occurrence

The frequency of occurrence in relation to displacement of vessel traffic during the construction phase is considered **Frequent**.

19.1.1.1.3 Severity of Consequence

The severity of consequence in relation to displacement of vessel traffic during the construction phase is considered **Negligible**.

19.1.1.1.4 Significance of Effect

Taking the frequency of occurrence as frequent and the severity of consequence as negligible, the overall effect of vessel displacement during construction of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms**.

19.1.1.2 Vessel Displacement During Adverse Weather

19.1.1.2.1 Qualification of Risk

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

Based on review of the input received, it is unlikely that commercial vessels would choose to make transit through the buoyed construction area during adverse weather conditions. Larger deviations may be required than during more favourable conditions (e.g., vessels may choose to increase passing distance from the buoyed construction area or transit inshore of the Moray Firth OWFs), however there is considered to be sufficient sea room to safely accommodate these chosen transits.

The long term vessel traffic data studied in Appendix E showed the presence of transits within the Caledonia North Site undertaken by Serco NorthLink Ferries, further inshore of their typical routeing. Consultation with Serco NorthLink Ferries confirmed these transits were utilised during adverse weather conditions. The presence of the buoyed construction area may therefore impact Serco NorthLink adverse weather transits, with the potential for delays in sailings, a large deviation inshore of the Moray Firth OWFs, or sailing cancellation. However, as each historical transit is based upon individual Master decisions based upon the conditions and factors on the day, Serco NorthLink have confirmed that the impact cannot be quantified (i.e., it cannot be confirmed whether any given historical transit would have been delayed, deviated or cancelled).

Serco NorthLink transits during adverse weather were assessed within Section 12, where it was shown that Caledonia North would pose a lesser impact on adverse weather routeing than Caledonia South.

The placement of the buoyed construction area will be agreed with NLB as part of the LMP process to ensure any impacts to shipping and navigation are managed.

From a navigational safety perspective, worst case consequences are an increase in delays, deviations or cancellation, noting the most likely consequence is infrequent minor delays. Socioeconomic impacts are assessed in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation of the EIAR.

19.1.1.2.2 Frequency of Occurrence

The frequency of occurrence relating to vessel displacement during periods of adverse weather during construction is considered to be **Remote**.

19.1.1.2.3 Severity of Consequence

The severity of consequence relating to vessel displacement during periods of adverse weather during construction is considered to be **Serious**.

19.1.1.2.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as serious, the overall effect of adverse weather during construction of Caledonia North is considered to be tolerable.

The hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.1.2 Increased Third Party Vessel to Vessel Collision Risk

19.1.2.1 Qualification of Risk

As noted in relation to the hazard of vessel displacement, two of 10 main routes will deviate as a result of the construction of Caledonia North. This will likely cause an increase in vessel density in proximity to Caledonia North, leading to a higher chance of vessel to vessel encounters and therefore a greater collision risk.

Based on pre OWF modelling, the baseline collision risk levels within the study area are low, with an estimated vessel to vessel collision frequency of one every 520 years. This level of collision risk is due to the volume of traffic in the area relative to the available sea space, noting the presence of Moray East and Beatrice OWFs, as well as the under-construction Moray West OWF. Additionally, it is noted that no collisions occurring within the study area were recorded within the MAIB over the most recent 20 years of data, nor were any responded to by the RNLI between 2010 and 2022.

Based on post OWF modelling, the collision frequency was estimated at one every 332 years, with the change primarily associated with vessels displaced east of the Caledonia North Site. This represents an increase of 57% on the pre OWF scenario. Although there is an increase in risk, it should be considered that a conservative approach has been undertaken within the modelling process, with an assumption made that vessel routeing will remain in proximity to the north eastern boundary of the Caledonia North Site. In reality it is likely that vessels will deviate to use more of the available sea space offshore of the Caledonia North Site. This aligns with general stakeholder consensus of the Hazard Workshop which indicated that there is sufficient post wind farm sea room available to safely accommodate the likely number of users.

For the Caledonia North OECC, any displacement of commercial vessels due to installation activities is not anticipated to affect available sea room to such an extent that the risk of a collision between third party vessels is materially increased. This is due to the temporary nature of the installation process, and spatially limited extent of the operation at any given time.

An additional factor is the potential for installed or partially installed WTGs to obscure vessels from one another, thus hindering ability to comply with COLREGs (IMO, 1972/77). Minimum spacing of 944m between WTGs will likely provide sufficient sea room for visual observations, with full obstruction likely only to occur when vessels are at opposite ends of a WTG row.

Collision risk is likely to be low in such cases due to the distance between vessels and the avoidance of the buoyed construction area.

In the event of an encounter between third party vessels, it is likely to be localised and short in duration, with collision avoidance action implemented by the vessels involved, as per compliance with COLREGs (IMO, 1972/77), to ensure that a collision incident does not develop. This is supported by experience at previous under construction OWFs, where no collision incidents involving two third party vessels have been reported as a result of an OWF (see Section 9.6).

Historical collision incident data studied also indicates that the most likely consequences will be low should a collision occur, with contact between the vessels resulting in minor damage and no injuries to persons, with the vessels involved able to resume their respective passages and undertake a full inspection at the next port.

As an unlikely worst-case scenario, a high impact collision event could occur. This may result in vessel foundering and subsequent PLL, as well as pollution. In such a circumstance, vessels associated with Caledonia North may attend the incident under SOLAS obligations and in liaison with the MCA, and the procedures within the ERCoP and MPCP would be implemented.

Relevant embedded mitigation measures includes marking on nautical charts, clear buoyage to mark the construction area, promulgation of information, DSLP approval, adherence to an LMP, adherence to an MPCP, and adherence to an ERCoP.

19.1.2.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between third party vessels during the construction phase is **Extremely Unlikely**.

19.1.2.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between third party vessels during the construction phase is considered **Serious**.

19.1.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of third party vessel to vessel collision risk during construction of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.1.3 Increased Third Party Vessel to Project Vessel Collision Risk

The presence of vessels associated with construction activities of Caledonia North may increase encounters and thus collision risk for vessels already operating in the area.

19.1.3.1 Qualification of Risk

During the construction phase of Caledonia North there may be up to 2,200 vessel movements made by up to 25 project vessels on-site simultaneously. This will include vessels which are RAM. It is assumed that construction vessels will be on-site throughout the entire duration of the construction phase.

Encounter and collision risk involving project vessels will be managed through the implementation of marine coordination with full details of this to be provided in the VMP and NSP. Project vessels will also be expected to carry AIS and comply with flag state regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974). COLREGs will remain the navigational priority for project vessels at all times.

Applications for safety zones of 500m around on-going construction activities will be sought during the construction phase and will protect deployed project vessels, especially if they are RAM. Minimum advisory passing distances and guard vessels, as defined by risk assessment, may also be implemented where safety zones do not apply, for example around cable installation vessels. Details of safety zones, minimum safe passing distances, and guard vessels will be promulgated including via Notifications to Mariners and Kingfisher Bulletins.

Appropriate marine lighting and marking during construction including the buoyed construction area will be agreed with the NLB. These navigational aids will further maximise mariner awareness when in proximity to ongoing construction works in the Caledonia North Site.

Third-party vessels may experience decreased capability to visually identify project vessels entering and exiting the Caledonia North Site during reduced visibility; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and the mandatory carriage of AIS by project vessels regardless of size. It is noted that the likelihood of a collision is likely to be greater in reduced visibility when the identification of project vessels entering and exiting the Caledonia North Site may be impeded.

Based on historical incident data, there has been one instance of a third-party vessel colliding with a project vessel in the UK (see Section 9.6). In this case, moderate vessel damage was reported with no harm to persons. It is noted that the incident occurred in 2011, 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.

If an encounter between a project vessel and third party vessel occurs, it is likely to be localised and short in duration. Assuming the implementation of collision avoidance action as required by the COLREGs, the most likely outcome will be any vessels involved being able to resume their respective passages or activities with no long-term consequences.

In the event of a collision, the likely consequences will be minor contact between the vessels resulting in minor damage and no injuries to persons. As an unlikely worst-case scenario, foundering could occur resulting in PLL and pollution. Other project vessels may be able to assist in the event of a collision under SOLAS obligation and the adherence to the ERCoP, noting this would be done in liaison with the MCA. If pollution were to occur in proximity to Caledonia North or involving a project vessel, the MPCP will be implemented to minimise the risks.

Relevant embedded mitigation measures include application for safety zones, a buoyed construction area, guard vessels as required by risk assessment, DSLP approval, adherence to an LMP, VMP, and NSP, MPCP, ERCoP, promulgation of information, marine coordination, and marking on nautical charts.

19.1.3.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between project vessels and third party vessels during the construction phase is considered to be **Extremely Unlikely.**

19.1.3.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between project vessels and third party vessels during the construction phase is considered to be **Serious**.

19.1.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of encounters and collision risk between project vessels and third party vessels during construction of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.1.4 Vessel to Structure Allision Risk

Presence of structures (including partially constructed) within the buoyed construction area will lead to creation of powered, drifting and internal allision risk for vessels.

The spatial extent of the hazard is small given that a vessel must be in close proximity to an OWF structure for an allision incident to occur. Each allision element is considered in turn in terms of frequency of occurrence and severity of consequence, with the resulting significance of the residual risk across the various elements summarised at the end of the assessment. The forms of allision considered include:

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

19.1.4.1 Powered Allision Risk

19.1.4.1.1 Qualification and Quantification of Risk

Based on quantitative assessment undertaken, the base case annual powered vessel to structure allision frequency was estimated to be 5.15×10^{-4}, corresponding to a return period of one every 1,943 years. It is noted that it has been conservatively assumed that vessels will not use the full available sea room offshore of the Caledonia North Site. In reality, it is likely that vessels will increase passing distance from the Caledonia North Site, noting this aligns with feedback received at the Hazard Workshop, where general consensus was that there was sufficient sea room to accommodate likely users.

Based on historical incident data, there have been two reported instances of a third-party vessel alliding with an operational OWF structure in the UK (in the Irish Sea and Southern North Sea). Both of these incidents involved a fishing vessel. These allisions resulted in minor to moderate damage to the vessels with minor injury to crew members.

Temporary marine lighting and marking will be implemented including the buoyed construction area in agreement with the NLB. Promulgation of information and marking on charts will ensure vessels can passage plan in advance to minimise risk. Safety zones of 50m in radius around structures will also be applied for during the construction phase up until the point of commissioning of Caledonia North (rising to 500m where active construction is ongoing).

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 hazard given the potential for a non-steel construction and possible internal navigation within the Caledonia North Site. 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 founder resulting in PLL and pollution. Project vessels may assist in the event of an allision under SOLAS obligation and the adherence to the ERCoP, in line with the MCA. If pollution were to occur, then the MPCP will be implemented to minimise the environmental risk.

Relevant embedded mitigation measures include DSLP approval, adherence to a MPCP, adherence to an LMP, adherence to an NSP, promulgation of information, application for safety zones, adherence to an ERCoP, guard vessels where required by risk assessment, and appropriate marking via construction buoyage as well as on nautical charts.

19.1.4.1.2 Frequency of Occurrence

The frequency of occurrence in relation to powered vessel to structure allision risk during the construction phase is considered to be **Extremely Unlikely**.

19.1.4.1.3 Severity of Consequence

The severity of consequence in relation to powered vessel to structure allision risk during the construction phase is considered to be **Moderate**.

19.1.4.1.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during construction of Caledonia North is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

19.1.4.2 Drifting Allision Risk

19.1.4.2.1 Qualification and Quantification of Risk

Based on quantitative assessment undertaken, the base case annual drifting vessel to structure allision frequency was estimated to be 9.18×10^{-5}, corresponding to a return period of one every 10,897 years.

Based on historical incident data, there have been no instances of a third-party vessel alliding with an under-construction OWF structure whilst NUC. However, there is considered to be potential for a vessel to be adrift; this is reflected in the MAIB incident data reviewed in proximity to Caledonia North which indicates that machinery failure is the most common incident type (approximately 50%) in the 2012-2021 dataset, noting that only two were recorded. A vessel adrift may only develop into an allision situation if in proximity to a OWF structure. This is only the case where the adrift vessel is located internally or in close proximity to the Caledonia North Site and the direction of the wind and/or tide directs the vessel towards a structure. Promulgation of information and marking on charts will help mitigate the risks of a drifting allision.

In circumstances where a vessel drifts towards a structure in the Caledonia North Site, there are actions which the vessel may take to prevent the drift incident developing into an allision situation. Powered vessels may be able to regain power prior to reaching the Caledonia North Site (i.e., by rectifying any fault). Failing this, the vessel's emergency response procedures would be implemented which may include an emergency anchoring event following a check of the relevant nautical charts to ensure the deployment of the anchor will not lead to other risks (such as anchor snagging on a subsea cable), or the use of thrusters (depending on availability and power supply).

Where the deployment of the anchor is not possible (e.g., for small craft), any project vessels on-site may be able to render assistance in liaison with the MCA and in line with SOLAS obligations (IMO, 1974). This response will be managed via the coastguard and marine coordination, and depends on the type and capability of vessels on site. This would be particularly relevant for sailing vessels relying on metocean conditions for propulsion, noting if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance.

Should an allision occur, the consequences will be similar to those noted for the case of a powered allision including the unlikely worst-case of foundering, PLL, and pollution; in the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the MPCP will minimise the environmental risk. Project vessels may assist in the event of an allision under SOLAS obligation and the adherence to the ERCoP, in line with the MCA. Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel, thus reducing the energy of the impact, including in the case of a recreational vessel under sail.

Relevant embedded mitigation measures include adherence to an ERCoP, adherence to an MPCP marking on nautical charts, and project vessel compliance with SOLAS (IMO, 1974).

19.1.4.2.2 Frequency of Occurrence

The frequency of occurrence in relation to drifting vessel to structure allision risk during the construction phase is considered to be **Extremely Unlikely**.

19.1.4.2.3 Severity of Consequence

The severity of consequence in relation to drifting vessel to structure allision risk during the construction phase is considered to be **Moderate.**

19.1.4.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during construction of Caledonia North is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

19.1.4.3 Internal Allision Risk

19.1.4.3.1 Qualification and Quantification of Risk

As noted previously, based on experience at previously under-construction OWFs, it is anticipated that commercial vessels will be unlikely to navigate internally within the Caledonia North Site. Fishing and recreational vessels may be more likely to transit through noting they may choose not to depending on various conditions.

The base case fishing vessel to structure allision frequency is estimated to be 1.38×10^{-1}, corresponding to a return period of approximately one in 7.2 years. This return period is reflective of the volume of fishing vessel traffic in the study area, both in transit and engaged in active fishing. Conservative modelling has been undertaken with the assumption that fishing levels in proximity to the WTGs will not change. In reality fishing vessels will account for the presence of the WTGs, and may choose to transit or fish elsewhere, noting this aligns with feedback received during the Hazard Workshop.

The worst-case consequences reported for vessels involved in an allision incident involving a UK OWF has been flooding, with no life-threatening injuries to persons reported (the model is calibrated against known reported incidents). If an allision incident were to occur, project vessels may assist under obligation of SOLAS (IMO, 1974) and adherence to the ERCoP.

Additionally, if pollution occurs as a result of an allision incident, the MPCP would be implemented where appropriate.

If a vessel chooses to transit within the Caledonia North Site, the minimum spacing of 944m between wind farm structures is considered sufficient for safe internal navigation. Furthermore, application for safety zones around construction activities, as well as the buoyed construction area and temporary lighting and marking provides mitigation against internal allision risk. Any vessel planning to transit through the Caledonia North Site is expected to passage plan in advance in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information including through ongoing liaison with fishing fleets via an appointed FLO to ensure that such vessels have good awareness of Caledonia North.

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, 2022) 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.

Relevant embedded mitigation measures include application for safety zones, buoyed construction area, DSLP approval, adherence to an LMP, marking on nautical charts, promulgation of information, adherence to an ERCoP, adherence to an MPCP, appointment of a FLO and adherence to an FMMS.

19.1.4.3.2 Frequency of Occurrence

The frequency of occurrence of internal vessel to structure allision risk during the construction phase is considered to be **Remote**.

19.1.4.3.3 Severity of Consequence

The severity of consequence of internal vessel to structure allision risk during the construction phase is considered to be **Moderate.**

19.1.4.3.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during construction of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and ALARP and Not Significant in EIA terms**.

19.1.5 Reduced Access to Local Ports

19.1.5.1 Qualification of Risk

Up to 2,200 vessel movements by construction vessels (excluding site preparation activities) may be made throughout the construction phase and will include vessels which are RAM. Project vessels will be managed by marine coordination, including the use of traffic management procedures such as the designation of entry and exit points to and from the buoyed construction area, and designated routes to and from construction ports. Project vessels will also carry AIS and be compliant with flag state regulations including the COLREGs (IMO 1972/77).

The closest port or harbour to the Caledonia North Site is Wick Harbour, located approximately 13.2nm to the northwest. Given the relative distance to ports in the area and the anticipated deviations for the main commercial routes, it is not anticipated that there will be any substantial effect on vessel approaches to and from the local ports beyond the deviations already outlined for impacts on vessel displacement.

For offshore cable installation activity, there is a greater likelihood of impact on port access given the proximity to Whitehills Harbour and Marina which is located in proximity to the Landfall Site. Additionally, the Landfall Site lies in proximity to approaches to Banff and Macduff harbours, which are located at their closest approximately 2.3nm southeast of the Caledonia North OECC.

Where cable installation is ongoing, vessel displacement is possible. Recreational vessels may be particularly sensitive given that the RYA Scotland has indicated that Whitehills Marina is a key stopping point for vessels travelling north as well as along the northeast coast. No concerns were raised during consultation over access to ports during the construction phase in relation to the Caledonia North Site nor the offshore export cables. Additionally, offshore export cable installation activities will likely be short-term in duration and localised at any given time, thus any reduced access will likely be minor and temporary. Regardless, liaison in advance of and during installation is considered necessary with the Whitehills, Banff, and Macduff harbour authorities based on proximity to the Caledonia North OECC. It is noted that no known issues have been raised regarding the installation or operation of Moray East OWF offshore export cables, the landfall of which is situated approximately 1nm east of the Caledonia North OECC.

The most likely consequences are increased journey times and distances, as per the vessel displacement hazard. There is only one pilot boarding station nearby, at Macduff and outside of the Caledonia North OECC, where the service is not compulsory. However, the charted anchorage is adjacent to the Caledonia North OECC, and therefore liaison may be needed with local harbour authorities depending on the final cable routeing.

Relevant embedded mitigation measures includes clear buoyage of the construction area, adherence to an LMP, adherence to a VMP, marine coordination of project vessels, marking on nautical charts, and promulgation of information.

19.1.5.2 Frequency of Occurrence

The frequency of the risk of reduced access to local ports during the construction phase is considered to be **Reasonably Probable**.

19.1.5.3 Severity of Consequence

The severity of consequence of the risk of reduced access to local ports during the construction phase is considered to be **Minor**.

19.1.5.4 Significance of Effect

Taking the frequency of occurrence as reasonably probable and the severity of consequence as minor, the overall effect of reduced port access during construction of Caledonia North is considered to be tolerable.

Assuming liaison with the Whitehills, Banff, and Macduff harbour authorities in advance of and during installation, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.1.6 Reduction of SAR Capabilities

The installation of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the construction phase of Caledonia North by increasing the number of incidents, increasing consequences or reducing access for the responders.

19.1.6.1 Qualification of Risk

The spatial extent of this hazard is large given the area covered by the Caledonia North Site ($64nm^2$), as well as the distance covered by air-based SAR support (the SAR helicopter base is located at Inverness, 66nm southwest of the Caledonia North Site). It is unlikely that a SAR operation will require the entirety of the Caledonia North Site to be searched, and it is probable that a search will be restricted to a smaller area in which a casualty is known to be located (accounting for assumptions on any potential drift of the casualty).

Up to 2,200 vessel movements may be made by construction vessels during the construction phase of Caledonia North. It is assumed that construction vessels will be on-site throughout the majority of the construction phase, although severe weather may lead to vessels being withdrawn. The presence of these vessels increase the likelihood of an incident and subsequently increase the likelihood of multiple incidents occurring simultaneously, diminishing emergency response capability. However, they may also be able to provide additional response resource in the event of an incident in liaison with the MCA.

The most likely consequence to occur would be a delay to any emergency response request. As an unlikely worst-case, this could result in a failure of emergency response to an incident resulting in PLL and pollution. However, project vessels will be managed via marine coordination and comply with flag state regulations which will minimise this risk. Additionally, the presence of project vessels themselves may mitigate this risk as they may self-help at incidents involving other project vessels under the obligation of SOLAS (IMO, 1974) and adherence to an ERCoP, noting this would be undertaken with liaison with the MCA. The MPCP will also be implemented should pollution occur.

From recent SAR data, the frequency of helicopter SAR operations in proximity to Caledonia North is one per year on average, with no SAR helicopter incidents occurring within the Caledonia North Site itself. The frequency of incidents in proximity to the Caledonia North Site is not anticipated to increase significantly from the current level given the measures noted above which will be in place. The layout will be agreed with the MCA and in line with MGN 654 requirements to ensure any SAR operations that do occur within the Caledonia North Site are facilitated. A SAR checklist will also be completed and agreed with the MCA.

Relevant embedded mitigation measures include DSLP approval, promulgation of information, adherence to an LMP, marking on appropriate charts, marine coordination of project vessels, adherence to an ERCoP, adherence to an MPCP, adherence to a VMP and NSP, and compliance with MGN 654 and international marine regulations.

19.1.6.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of reduced emergency response capabilities during the construction phase is considered to be **Extremely Unlikely**.

19.1.6.3 Severity of Consequence

The severity of consequence relating to the risk of reduced emergency response capabilities during the construction phase is considered to be **Serious.**

19.1.6.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during construction of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.2 Operation and Maintenance Phase

19.2.1 Vessel Displacement

Operational activities associated with Caledonia North as well as presence of structures throughout its lifetime of Caledonia North may displace existing vessel routes or activity, which may be more prevalent during periods of adverse weather.

These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

19.2.1.1 Vessel Displacement

19.2.1.1.1 Qualification of Risk

Based on experience at existing operational OWFs and input during consultation, it is anticipated that the majority of commercial vessels will choose not to navigate within the Caledonia North Site, therefore some main route deviations will be required as per the respective construction phase hazard. Based on previous consultation, smaller commercial vessel operators may choose to transit through; however, it is likely that the majority of commercial vessels will deviate in line with other operational OWFs.

As discussed in relation to the equivalent construction phase hazard, a deviation will be required for two of the 10 main routes identified within the study area; however, they both represent relatively low magnitude of deviations (approximately 1%), which aligns with feedback received during consultation including at the Hazard Workshop (see Section 4). Further, deviations will be well established during the construction phase, with it being likely that commercial vessels will continue these same established deviations into the O&M phase.

Minimum spacing of 944m within the Caledonia North Site is considered sufficient to accommodate transits of smaller vessels, noting there will be no restrictions on entry into the Caledonia North Site with the exception of any active 500m major maintenance safety zones.

As discussed in relation to the equivalent construction phase hazard, regular routeing involving RoRo vessels was identified within the vessel traffic datasets, however these transits would either not be displaced by Caledonia North or it has been indicated during consultation that the deviation would be minor and not pose a concern.

Based on experience at existing operational OWFs, it is anticipated that fishing vessels and recreational vessels may also choose not to routinely navigate internally within the Caledonia North Site. However, they may be more likely to do so than commercial vessels. As discussed in relation to the equivalent construction phase hazard, input received during the Hazard Workshop from commercial fishing representatives was that only a minor deviation would be required for fishing vessels in transit and as such it is likely that such vessels will choose to deviate. The RYA Scotland indicated that this would likely apply to recreational vessels as well, noting that it is of the skippers preference as to whether or not a transit is made through a wind farm.

For any smaller vessels that do choose to deviate, there is considered to be sufficient sea room outside of the Caledonia North Site for transits from such vessels to be accommodated, noting this aligns with general consensus from the Hazard Workshop. It is noted that displacement of active commercial fishing is assessed separately in Volume 3, Chapter 8: Commercial Fisheries of the EIAR.

Given that any O&M activities associated with Caledonia North will be infrequent and localised, the likelihood of vessel displacement due to these activities is considered to be very low.

The main consequences of vessel displacement will be increased journey times and distances for affected third party vessels, under the assumption that the WTGs will be built to the full extent of the Caledonia North Site. Any notable safety impacts are considered unlikely given the available sea room, noting this aligns with outputs of the Hazard Workshop. Vessels are expected to comply with international and flag state regulations (including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974) and will be able to passage plan in advance given the promulgation of information relating to Caledonia North and relevant nautical charts.

Relevant embedded mitigation measures include DSLP approval, adherence to an LMP, adherence to an NSP, marking on nautical charts, and promulgation of information.

19.2.1.1.2 Frequency of Occurrence

The frequency of occurrence in relation to displacement of vessel traffic during the O&M phase is considered **Frequent**.

19.2.1.1.3 Severity of Consequence

The severity of consequence in relation to displacement of vessel traffic during the O&M phase is considered **Negligible**.

19.2.1.1.4 Significance of Effect

Taking the frequency of occurrence as frequent and the severity of consequence as negligible, the overall effect of vessel displacement during O&M of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.2.1.2 Vessel Displacement During Adverse Weather

19.2.1.2.1 Qualification of Risk

As discussed within the equivalent construction phase hazard, adverse weather can severely affect a vessels journey, with the impact of this dependent on various factors including specific vessel parameters such as hull geometry or vessel size.

Based on review of the input received, it is likely that no commercial vessels would choose to make transit through the Caledonia North Site during adverse weather conditions. Larger deviations may be required than during more favourable conditions (e.g., vessels may choose to increase passing distance from the Caledonia North Site or transit inshore of the Moray Firth OWFs); however, there is considered to be sufficient sea room to safely accommodate the chosen transits.

The long term vessel traffic data studied in Appendix E showed the presence of transits within the Caledonia North Site undertaken by Serco NorthLink Ferries, further inshore of their typical routeing. Consultation with Serco NorthLink Ferries confirmed these transits were utilised during adverse weather conditions. The presence of structures within the Caledonia North Site may therefore impact Serco NorthLink adverse weather transits, with the potential for delays in sailings, a large deviation inshore of the Moray Firth OWFs, or sailing cancellation. However, as each historical transit is based upon individual Master decisions based upon the conditions and factors on the day, Serco NorthLink have confirmed that the impact cannot be quantified (i.e., it cannot be confirmed whether any given historical transit would have been delayed, deviated or cancelled).

Serco NorthLink transits during adverse weather were assessed within Section 12, where it was shown that Caledonia North would likely pose a lesser impact on adverse weather routeing than Caledonia South.

From a navigational safety perspective, worst case consequences are an increase in delays, deviations or cancellation, noting the most likely consequence is infrequent minor delays. Socioeconomic impacts are assessed in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation of the EIAR.

19.2.1.2.2 Frequency of Occurrence

The frequency of occurrence relating to vessel displacement during periods of adverse weather during O&M is considered to be **Remote**.

19.2.1.2.3 Severity of Consequence

The severity of consequence relating to vessel displacement during periods of adverse weather during O&M is considered to be **Serious**.

19.2.1.2.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as serious, the overall effect of adverse weather during O&M of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with the embedded mitigation in place. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.2.2 Increased Third Party Vessel to Vessel Collision Risk

19.2.2.1 Qualification of Risk

As noted in relation to the construction phase, two of the 10 main routes will likely deviate as a result of the presence of Caledonia North. Post wind farm collision frequency was estimated at one every 332 years, based on conservative post OWF modelling, which assumed that vessels would not use the full available sea room offshore of the Caledonia North Site. In reality, as per the construction phase hazard, it is likely that vessels will deviate to use the available sea space. This aligns with general stakeholder consensus of the Hazard Workshop which indicated that there is sufficient post wind farm sea room available to safely accommodate the likely number of users.

For the Caledonia North OECC, any displacement of commercial vessels due to O&M activities is not anticipated to affect available sea room to such an extent that the risk of a collision between third party vessels is materially increased. This is due to the infrequency of operational activities, and spatially limited extent of the operation at any given time.

An additional factor is the potential for WTGs to obscure vessels from one another, thus hindering ability to comply with COLREGs (IMO, 1972/77). Minimum spacing of 944m between WTGs will likely provide sufficient sea room for visual observations, with full obstruction likely only to occur when vessels are at opposite ends of a WTG row. Collision risk is likely to be low in such cases due to the distance between vessels.

In the event of an encounter between third party vessels, it is likely to be localised and short in duration, with collision avoidance action implemented by the vessels involved, as per compliance with COLREGs (IMO, 1972/77), to ensure that a collision incident does not develop.

As per the respective construction phase hazard, historical collision incident data 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 the vessels involved able to resume their respective passages and undertake a full inspection at the next port.

As an unlikely worst-case scenario, a high impact collision event could occur. This may result in vessel foundering and subsequent PLL, as well as pollution. In such a circumstance, vessels associated with Caledonia North may attend the incident under SOLAS obligations and in liaison with the MCA, and the procedures within the ERCoP and MPCP would be implemented.

Relevant embedded mitigation measures includes marking on nautical charts, promulgation of information, DSLP approval, adherence to an LMP, adherence to an MPCP, and adherence to an ERCoP.

19.2.2.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between third party vessels during the O&M phase is considered **Extremely Unlikely**.

19.2.2.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between third party vessels during the O&M phase is considered **Serious**.

19.2.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of third party vessel to vessel collision risk during O&M of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.2.3 Increased Third Party Vessel to Project Vessel Collision Risk

The presence of vessels associated with O&M activities of Caledonia North may increase encounters and thus collision risk for vessels already operating in the area.

19.2.3.1 Qualification of Risk

During the O&M phase of Caledonia North there may be up to 938 vessel movements annually, and up to 25 project vessels on-site simultaneously (during major maintenance; i.e., likely less during normal operations). This will include vessels which are RAM.

Encounter and collision risk involving project vessels will be managed through the implementation of marine coordination as will be set out in the VMP and NSP. Project vessels will also be expected to carry AIS and comply with flag state regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974). COLREGs will remain the navigational priority for project vessels at all times.

Applications for safety zones of 500m around major maintenance activities during O&M will be sought and will protect deployed project vessels, especially if they are RAM. Minimum advisory passing distances and guard vessels, as defined by risk assessment, may also be implemented where safety zones do not apply. Details of safety zones, minimum safe passing distances, and guard vessels will be promulgated including via Notifications to Mariners and Kingfisher Bulletins.

Appropriate operational marine lighting and marking will be agreed with the NLB and set out in an LMP. These navigational aids will further maximise mariner awareness when in proximity to the Caledonia North Site.

Third-party vessels may experience decreased capability to visually identify project vessels during reduced visibility, especially if visual observations are obscured by WTGs; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and the mandatory carriage of AIS by project vessels regardless of size.

As discussed in the equivalent construction phase hazard, there has been one instance of a third-party vessel colliding with a project vessel in the UK (see Section 9.6 for further details). Moderate vessel damage was reported with no harm to persons. It is noted that the incident occurred in 2011, 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.

As per the respective construction phase hazard, if an encounter between a project vessel and third party vessel occurs, it is likely to be localised and short in duration. Assuming the implementation of collision avoidance action as required by the COLREGs, the most likely outcome will be any vessels involved being able to resume their respective passages or activities with no long-term consequences.

In the event of a collision, the likely consequences will be minor contact between the vessels resulting in minor damage and no injuries to persons. As an unlikely worst-case scenario, foundering could occur resulting in PLL and pollution. Other project vessels may be able to assist in the event of a collision under SOLAS obligation and the adherence to the ERCoP, noting this would be done in liaison with the MCA. If pollution were to occur in proximity to Caledonia North or involving a project vessel, the MPCP will be implemented to minimise the risks.

Relevant embedded mitigation measures include application for safety zones, guard vessels as required by risk assessment, DSLP approval, adherence to an LMP, VMP, and NSP, MPCP, ERCoP, promulgation of information, marine coordination, and marking on nautical charts.

19.2.3.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between project vessels and third party vessels during the O&M phase is considered to be **Extremely Unlikely**.

19.2.3.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between project vessels and third party vessels during the O&M phase is considered to be **Serious**.

19.2.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of encounters and collision risk between project vessels and third party vessels during O&M of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms**.

19.2.4 Vessel to Structure Allision Risk

Presence of structures within the Caledonia North Site will lead to creation of powered, drifting and internal allision risk for vessels during the O&M phase.

The spatial extent of the hazard is small given that a vessel must be in close proximity to an OWF structure for an allision incident to occur. Each allision element is considered in turn in terms of frequency of occurrence and severity of consequence, with the resulting significance of the residual risk across the various elements summarised at the end of the assessment. The forms of allision considered include:

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

19.2.4.1 Powered Allision Risk

19.2.4.1.1 Qualification and Quantification of Risk

As discussed in relation to the respective construction phase hazard, the base case annual powered vessel to structure allision frequency was estimated to be 5.15×10^{-4}, corresponding to a return period of one every 1,943 years. It is noted that it has been conservatively assumed that vessels will not use the full available sea room offshore of the Caledonia North Site. In reality, it is likely that vessels will increase passing distance from the Caledonia North Site, which aligns with feedback received at the Hazard Workshop.

Based on historical incident data, there have been two reported instances of a third-party vessel alliding with an operational OWF structure in the UK (in the Irish Sea and Southern North Sea). Both of these incidents involved a fishing vessel. These allisions resulted in minor to moderate damage to the vessels with minor injury to crew members.

Marine lighting and marking will be implemented in agreement with the NLB and defined within the LMP. These discussions will include contingency measures for the event that a WTG with a key navigational light needs to be towed away from site. Promulgation of information and marking on charts will ensure vessels can passage plan in advance to minimise risk.

Should an allision occur, the consequences will depend on multiple factors as discussed in relation to the equivalent construction phase hazard. Fishing vessels and recreational vessels are considered most vulnerable to the hazard and 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 founder resulting in PLL and pollution. Project vessels may assist in the event of an allision under SOLAS obligation and the adherence to the ERCoP, in liaison with the MCA. If pollution were to occur, then the MPCP will be implemented to minimise the environmental risk.

Relevant embedded mitigation measures include DSLP approval, adherence to a MPCP, adherence to an LMP, adherence to an NSP, promulgation of information, application for safety zones, adherence to an ERCoP, and marking on nautical charts.

19.2.4.1.2 Frequency of Occurrence

The frequency of occurrence in relation to powered vessel to structure allision risk during the O&M phase is considered to be **Extremely Unlikely**.

19.2.4.1.3 Severity of Consequence

The severity of consequence in relation to powered vessel to structure allision risk during the O&M phase is considered to be **Moderate**.

19.2.4.1.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during O&M of the Caledonia North is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

19.2.4.2 Drifting Allision Risk

19.2.4.2.1 Qualification and Quantification of Risk

Based on quantitative assessment undertaken, the base case annual drifting vessel to structure allision frequency was estimated to be 9.18×10^{-5}, corresponding to a return period of one every 10,897 years. This is reflective of the volume of traffic within the available sea room.

Based on historical incident data, there have been no instances of a third-party vessel alliding with an operational OWF structure whilst NUC. However, there is considered to be potential for a vessel to be adrift; this is reflected in the MAIB incident data, where two incidents of machinery failure were recorded between 2012 and 2021, as discussed in relation to the equivalent construction phase hazard. Promulgation of information, lighting and marking, and marking on charts will help vessels to passage plan and mitigate the risks of a drifting allision.

In circumstances where a vessel drifts towards a structure in the Caledonia North Site, powered vessels may be able to regain power prior to reaching the Caledonia North Site (that is, by rectifying any fault). Failing this, the vessel's emergency response procedures would be implemented which may include an emergency anchoring event or the use of thrusters (depending on availability and power supply).

Where the deployment of the anchor is not possible (e.g., for small craft), any project vessels on-site may be able to render assistance in liaison with the MCA and in line with SOLAS obligations (IMO, 1974). This response will be managed via the coastguard and marine coordination, and depends on the type and capability of vessels on site. This would be particularly relevant for sailing vessels relying on metocean conditions for propulsion, noting if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance.

Should an allision occur, the consequences will be similar to those noted for the respective construction phase hazard including the unlikely worst-case of foundering, PLL, and pollution. In the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the MPCP will minimise the environmental risk. Project vessels may assist in the event of an allision under SOLAS (IMO, 1974) obligation and the adherence to the ERCoP, in line with the MCA. Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel, thus reducing the energy of the impact, including in the case of a recreational vessel under sail.

Relevant embedded mitigation measures include adherence to an ERCoP, adherence to an MPCP, marking on nautical charts, adherence to an LMP, and project vessel compliance with SOLAS (IMO, 1974).

19.2.4.2.2 Frequency of Occurrence

The frequency of occurrence in relation to drifting vessel to structure allision risk during the O&M phase is considered to be **Extremely Unlikely**.

19.2.4.2.3 Severity of Consequence

The severity of consequence in relation to drifting vessel to structure allision risk during the O&M phase is considered to be **Moderate**.

19.2.4.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during O&M of Caledonia North is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

19.2.4.3 Internal Allision Risk

19.2.4.3.1 Qualification and Quantification of Risk

As noted previously, based on experience at existing operational OWFs, it is anticipated that commercial vessels will be unlikely to navigate internally within the Caledonia North site. Fishing and recreational vessels may be more likely to transit through noting they may choose not to depending on various conditions (this aligns with consultation input).

As noted in the respective construction phase hazard, the base case fishing vessel to structure allision frequency is estimated to be 1.38×10^{-1}, corresponding to a return period of approximately one in 7.2 years. This return period is reflective of the volume of fishing vessel traffic in the study area, both in transit and engaged in active fishing. Conservative modelling has been undertaken with the assumption that fishing levels in proximity to the WTGs will not change. In reality, as discussed within the equivalent construction phase hazard, fishing vessels will account for the presence of the WTGs, and may choose to transit or fish elsewhere (noting this aligns with consultation input).

The worst-case consequences reported for vessels involved in an allision incident involving a UK OWF has been flooding, with no life-threatening injuries to persons reported. If an allision incident were to occur, project vessels may assist under obligation of SOLAS (IMO, 1974) and adherence to the ERCoP in liaison with the MCA. Additionally, if pollution occurs as a result of an allision incident, the MPCP would be implemented where appropriate.

If a vessel chooses to transit within the Caledonia North Site, the minimum spacing of 944m between wind farm structures is considered sufficient for safe internal navigation. Furthermore, operational lighting and marking and marking on nautical charts provide mitigation against internal allision risk. Should a WTG with a key navigational light need towed, sufficient alternative lighting will be agreed with the NLB. Any vessel planning to transit through the Caledonia North Site is expected to passage plan in advance in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information including through ongoing liaison with fishing fleets via an appointed FLO will seek to ensure that such vessels have good awareness of Caledonia North. Locations of relevant infrastructure will be provided in the weekly notices distributed during the construction phase as per the Outline FMMS (Volume 7, Appendix 17).

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. As noted in the equivalent construction phase hazard, from previous studies of offshore wind developments, it has been concluded that WTGs do reduce wind velocity downwind of a WTG (MCA, 2022) 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 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.

Relevant embedded mitigation measures include application for safety zones, DSLP approval, adherence to an LMP, marking on nautical charts, promulgation of information, adherence to an ERCoP, adherence to an MPCP, appointment of a FLO and adherence to an FMMS.

19.2.4.3.2 Frequency of Occurrence

The frequency of occurrence of internal vessel to structure allision risk during the O&M phase is considered to be **Remote**.

19.2.4.3.3 Severity of Consequence

The severity of consequence of internal vessel to structure allision risk during the O&M phase is considered to be **Moderate**.

19.2.4.3.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during O&M of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and ALARP and Not Significant in EIA terms.**

19.2.5 Reduced Access to Local Ports

19.2.5.1 Qualification of Risk

Up to 938 vessel movements annually by O&M vessels may be made throughout the O&M phase, which will include vessels which are RAM. Project vessels will be managed by marine coordination, including the use of traffic management procedures such as the designation of entry and exit points to and from the Caledonia North Site, and designated routes to and from the base port. Project vessels will also carry AIS and be compliant with flag state regulations including the COLREGs (IMO 1972/77).

As discussed in the baseline description and equivalent construction phase hazard, the closest port or harbour is Wick Harbour, located approximately 13.2nm to the northwest. Given the relative distance to ports in the area and the anticipated deviations for the main commercial routes, it is not anticipated that there will be any substantial effect on vessel approaches to and from the local ports beyond the deviations already outlined for hazards on vessel displacement.

For offshore export cable O&M activity, there is a greater risk given the proximity to Whitehills Harbour and Marina which is located approximately 0.37nm (682m) southeast of the Caledonia North OECC. Recreational vessels may be particularly sensitive given that the RYA Scotland has indicated that Whitehills Marina is a key stopping point for vessels travelling north as well as along the northeast coast. No concerns were raised over access to ports during the O&M phase in relation to the Caledonia North site nor the offshore export cables. Additionally, offshore export cable maintenance activities will likely be very infrequent, short-term in duration and localised at any given time, thus any reduced access will likely be minor and temporary (and less than during construction).

The most likely consequences are increased journey times and distances, as per the vessel displacement hazard. There is only one pilot boarding station nearby, at Macduff, where the service is not compulsory. Thus, no effect is anticipated on port related services such as pilotage.

Relevant embedded mitigation measures includes adherence to an LMP, adherence to a VMP, marine coordination of project vessels, marking on nautical charts, and promulgation of information.

19.2.5.2 Frequency of Occurrence

The frequency of the risk of reduced access to local ports during the O&M phase is considered to be **Remote**.

19.2.5.3 Severity of Consequence

The severity of consequence of the risk of reduced access to local ports during the O&M phase is considered to be **Minor**.

19.2.5.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as minor, the overall effect of reduced port access during O&M of Caledonia North is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms**.

19.2.6 Reduction in Under Keel Clearance

The presence of subsea cable protection may reduce under keel clearance during the O&M phase of Caledonia North.

19.2.6.1 Qualification of Risk

Reduced water depth due to the presence of subsea infrastructure will lead to a reduction in under keel clearance. The target burial depth for all subsea cables is 1m, noting actual burial depth will be determined via the CBRA process which will be undertaken post consent.

Where burial is not feasible, cable protection may be used instead, which again will be determined by the CBRA. In line with MGN 654, any reduction in water depth which exceeds 5% will be discussed with the MCA to determine if additional mitigation is necessary. This aligns with the RYA's recommendation that the "minimum safe under keel clearance over submerged structures and associated infrastructure should be determined in accordance with the methodology set out in MGN 543 [since superseded by MGN 654]" (RYA, 2019).

Given that depths within the Caledonia North Site range between 39m to 60m, it is not anticipated that subsea cable protection will reduce water depths over the 5% threshold. In terms of the offshore export cables, a water depth reduction of over 5% is possible in nearshore areas if cable protection is required. The vessel traffic data shows the majority of vessels operating near the Landfall Site tend to be recreational and fishing vessels which are generally smaller in size and have reduced draughts compared to larger commercial vessels. As discussed in the equivalent construction phase hazard, no specific concerns from stakeholders were raised during consultation including the Hazard Workshop, with MGN 654 compliance considered suitable to manage the impact.

In the event of an underwater allision, the most likely consequence is minor damage. The unlikely worst-case consequence may be vessel foundering resulting in PLL and pollution. Implementation of the MPCP will mitigate against pollution, whilst adherence to an ERCoP as well as operating under the obligations of SOLAS (IMO, 1974) will mitigate against the risk of PLL.

19.2.6.2 Frequency of Occurrence

The frequency of occurrence of the risk of reduced under keel clearance due to the presence of subsea cables during O&M is considered **Extremely Unlikely**.

19.2.6.3 Severity of Consequence

The severity of consequence of the risk of reduced under keel clearance due to the presence of subsea cables during O&M is considered to be **Moderate**.

19.2.6.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of reduced under keel clearance due to subsea cables during O&M of Caledonia North is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

19.2.7 Anchor Interaction with Subsea Cables

The presence of subsea cables within the Caledonia North Site and the Caledonia North OECC may increase the risk of anchor interaction.

19.2.7.1 Qualification of Risk

The spatial extent of the hazard is small given that a vessel must be in close proximity to an offshore export cable or inter-array cable for an interaction to occur.

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

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

Although the second of these scenarios may involve limited decision-making time if drifting towards a hazard, in all three scenarios it is anticipated that the charting of infrastructure will inform the decision to anchor, as per Regulation 34 of SOLAS (IMO, 1974).

No anchored vessels were observed within the study area for the during the survey periods or long-term vessel traffic data. Risk of interaction with an inter-array cable or interconnector cable on a planned anchoring or dragged anchoring basis is therefore anticipated to be extremely low. In terms of emergency anchoring, any areas of high traffic volume are likely to represent the areas of highest risk, particularly where there are hazards nearby (for example, structures, rocks, shallows). However; given the open sea room in proximity to the Caledonia North Site and water depths the likelihood of this scenario arising is very low. The majority of traffic is also anticipated to pass offshore of the Caledonia North Site, away from its associated inter-array cables and interconnector cable.

The likelihood of anchor interaction with a subsea cable is further minimised by the burial of the cables and use of external cable protection where required, which will be informed by the CBRA process, noting this will account for traffic volumes and sizes.

In terms of the offshore export cables, Macduff anchorage sits adjacent to the Caledonia North OECC. The volumes and sizes of vessels using this anchorage will be considered within the CBRA process, to ensure the cables are suitably buried and/or protected, noting promulgation of information and marking on nautical charts will further mitigate the risk. Additionally, it is likely that anchoring undertaken in Macduff anchorage will be planned, thus it is anticipated that mariners will take into account the presence of the export cables via nautical charts before dropping anchor. With good practice, it is considered unlikely that an anchor interaction would occur. Final cable routeing within the Caledonia North OECC will be defined within the CaP which will be approved by MD-LOT in consultation with the MCA.

Should an anchor interaction occur, the most likely consequence is no damage to the cable or anchor, based on previous anchor interaction incidents. As an unlikely worst-case consequence, a snagging incident could occur and the vessel's anchor as well as the cable could be damaged, resulting in a loss of stability noting this would only occur for a smaller vessel which would be less likely to penetrate deeper into the seabed than a larger vessel.

Relevant embedded mitigation measures include promulgation of information, marking on nautical charts, adherence to a CBRA, development of and adherence to a CaP and vessel compliance with MGN 654 (MCA, 2021).

19.2.7.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of anchor interaction with subsea cables during O&M is considered to be **Extremely Unlikely**.

19.2.7.3 Severity of Consequence

The severity of consequence relating to the risk of anchor interaction with subsea cables during O&M is considered to be **Moderate**.

19.2.7.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of anchor interaction with subsea cables during O&M of Caledonia North is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

19.2.8 Reduction of SAR Capabilities

The presence of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the O&M phase of Caledonia North by increasing the number of incidents, increasing consequences or reducing access for the responders.

19.2.8.1 Qualification of Risk

The spatial extent of this hazard is large given the area covered by the Caledonia North Site (64nm^2), as well as the distance covered by air-based SAR support (the SAR helicopter base is located at Inverness, 66nm southwest of the Caledonia North Site). It is unlikely that a SAR operation will require the entirety of the Caledonia North Site to be searched, and it is probable that a search will be restricted to a smaller area in which a casualty is known to be located (accounting for assumptions on any potential drift of the casualty).

Up to 938 vessel movements annually may be made by O&M vessels during the lifetime of Caledonia North. It is assumed that O&M vessels will be on-site throughout the majority of the O&M phase, although severe weather may lead to vessels being withdrawn. The presence of these vessels increase the likelihood of an incident and subsequently increases the likelihood of multiple incidents occurring simultaneously, diminishing emergency response capability. However, they may also be able to provide additional response resource in the event of an incident in liaison with the MCA.

The most likely consequence to occur would be a delay to any emergency response request. As an unlikely worst-case, this could result in a failure of emergency response to an incident resulting in PLL and pollution. However, project vessels will be managed via marine coordination and comply with flag state regulations which will minimise this risk. Additionally, the presence of project vessels themselves may mitigate this risk as they may self-help at incidents involving other project vessels under the obligation of SOLAS (IMO, 1974) and adherence to an ERCoP, noting this would be undertaken with liaison with the MCA. The MPCP will also be implemented should pollution occur.

As discussed in the equivalent construction phase hazard, the frequency of SAR helicopter operations in proximity to Caledonia North is one per year, with no SAR helicopter incidents occurring within the Caledonia North Site. The frequency of incidents in proximity to the Caledonia North Site is not anticipated to increase significantly from the current level given the measures noted above which will be in place. The layout will be agreed with the MCA and in line with MGN 654 requirements to ensure any SAR operations that do occur within the Caledonia North Site are facilitated. A SAR checklist will also be completed and agreed with the MCA.

Relevant embedded mitigation measures include DSLP approval, promulgation of information, adherence to an LMP, marking on appropriate charts, marine coordination of project vessels, adherence to an ERCoP, adherence to an MPCP, adherence to a VMP and NSP, and compliance with MGN 654 and international marine regulations.

19.2.8.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of reduced emergency response capabilities during the O&M phase is considered to be **Extremely Unlikely**.

19.2.8.3 Severity of Consequence

The severity of consequence relating to the risk of reduced emergency response capabilities during the O&M phase is considered to be **Serious**.

19.2.8.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during O&M of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.3 Decommissioning Phase

19.3.1 Vessel Displacement

Decommissioning activities associated with Caledonia North may displace existing vessel routes or activity, which may be more prevalent during periods of adverse weather.

These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

19.3.1.1 Vessel Displacement

19.3.1.1.1 Qualification of Risk

Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, this hazard is expected to be similar in nature to the equivalent construction stage hazard. It is noted that in the case of subsea cables sections may be left *in situ* to avoid unnecessarily disturbing the seabed. This would be confirmed through consultation and assessment to ensure the most suitable approach was taken. But for the purposes of this assessment (as a worst-case) it has been assumed that all subsea cables will be removed during decommissioning with only cable protection left *in situ.*

The use of a buoyed decommissioning area analogous to the buoyed construction area is assumed and will result in similar main route deviations to those established for the equivalent construction stage hazard. By the time of decommissioning, deviations will be well established, with vessels likely to continue on their typical routeing around the buoyed decommissioning area.

Relevant embedded mitigation measures would be as per the respective construction phase.

19.3.1.1.2 Frequency of Occurrence

The frequency of occurrence in relation to displacement of vessel traffic during the decommissioning phase is considered **Frequent**.

19.3.1.1.3 Severity of Consequence

The severity of consequence in relation to displacement of vessel traffic during the decommissioning phase is considered **Negligible**.

19.3.1.1.4 Significance of Effect

Taking the frequency of occurrence as frequent and the severity of consequence as negligible, the overall effect of vessel displacement during decommissioning of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.3.1.2 Vessel Placement During Adverse Weather

19.3.1.2.1 Qualification of Risk

As discussed within the equivalent construction phase hazard, adverse weather can severely affect a vessels journey, with the impact of this dependent on various factors including specific vessel parameters such as hull geometry or vessel size.

As discussed in relation to the equivalent construction phase hazard, it is likely that no commercial vessels would choose to make transit through the buoyed decommissioning area during adverse weather conditions. Larger deviations may be required than during more favourable conditions, however there is considered to be sufficient sea room to safely accommodate the chosen transits.

The long term vessel traffic data studied in Appendix E showed the presence of transits within the Caledonia North Site undertaken by Serco NorthLink Ferries, further inshore of their typical routeing. Consultation with Serco NorthLink Ferries confirmed these transits were utilised during adverse weather conditions. The presence of the buoyed decommissioning area may therefore impact Serco NorthLink adverse weather transits, with the potential for delays in sailings, a large deviation inshore of the Moray Firth OWFs, or sailing cancellation. However, as each historical transit is based upon individual Master decisions based upon the conditions and factors on the day, Serco NorthLink have confirmed that the impact cannot be quantified (i.e., it cannot be confirmed whether any given historical transit would have been delayed, deviated or cancelled).

Serco NorthLink transits during adverse weather were assessed within Section 12, where it was shown that the Caledonia North Site would likely pose a lesser impact on adverse weather routeing than the Caledonia South Site.

The placement of the buoyed decommissioning area will be agreed with NLB to ensure any impacts to shipping and navigation are managed.

From a navigational safety perspective, worst case consequences are an increase in delays, deviations or cancellation, noting the most likely consequence is infrequent minor delays.

Socioeconomic impacts are assessed in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation of the EIAR.

19.3.1.2.2 Frequency of Occurrence

The frequency of occurrence relating to vessel displacement during periods of adverse weather during decommissioning is considered to be **Remote.**

19.3.1.2.3 Severity of Consequence

The severity of consequence relating to vessel displacement during periods of adverse weather during decommissioning is considered to be **Serious.**

19.3.1.2.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as serious, the overall effect of adverse weather during decommissioning of Caledonia North is considered to be tolerable.

The hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.3.2 Increased Third Party Vessel to Vessel Collision Risk

19.3.2.1 Qualification of Risk

This hazard is expected to be similar in nature to the equivalent construction phase hazard. As above, it is noted that in the case of subsea cables sections may be left *in situ* to avoid unnecessarily disturbing the seabed. This would be confirmed through consultation and assessment to ensure the most suitable approach was taken. But for the purposes of this assessment it has been assumed that all subsea cables will be removed during decommissioning with only cable protection left *in situ*.

The use of a buoyed decommissioning area analogous to the buoyed construction area is assumed and will result in a similar collision risk to that established for the equivalent construction phase hazard. The same assumptions in terms of frequency and consequence apply.

Relevant embedded mitigation measures would be as per the respective construction phase.

19.3.2.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between third party vessels during the decommissioning phase is **Extremely Unlikely**.

19.3.2.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between third party vessels during the decommissioning phase is considered **Serious**.

19.3.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of third party vessel to vessel collision risk during decommissioning of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.3.3 Increased Third Party Vessel to Project Vessel Collision Risk

The presence of vessels associated with decommissioning activities of Caledonia North may increase encounters and thus collision risk for vessels already operating in the area.

19.3.3.1 Qualification of Risk

Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, including the vessels involved, this hazard is expected to be similar in nature to the equivalent construction phase, including the number of vessel movements by decommissioning vessels. It is noted that in the case of subsea cables it is expected that they will be left *in situ* but for the purposes of this assessment (as a worst-case) it has been assumed that all cables will be removed during decommissioning, with only cable protection left *in situ*.

On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

19.3.3.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between project vessels and third party vessels during the decommissioning phase is considered to be **Extremely Unlikely**.

19.3.3.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between project vessels and third party vessels during the decommissioning phase is considered to be **Serious**.

19.3.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of encounters and collision risk between project vessels and third party vessels during decommissioning of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.3.4 Vessel to Structure Allision Risk

Presence of structures (including partially removed) during decommissioning will lead to creation of powered, drifting and internal allision risk for vessels.

19.3.4.1 Powered Allision Risk

19.3.4.1.1 Qualification and Quantification of Risk

It is likely that powered allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

19.3.4.1.2 Frequency of Occurrence

The frequency of occurrence in relation to powered vessel to structure allision risk during the decommissioning phase is considered to be **Extremely Unlikely**.

19.3.4.1.3 Severity of Consequence

The severity of consequence in relation to powered vessel to structure allision risk during the decommissioning phase is considered to be **Moderate**.

19.3.4.1.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during decommissioning of Caledonia North is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

19.3.4.2 Drifting Allision Risk

19.3.4.2.1 Qualification and Quantification of Risk

It is likely that drifting allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

19.3.4.2.2 Frequency of Occurrence

The frequency of occurrence in relation to drifting vessel to structure allision risk during the decommissioning phase is considered to be **Extremely Unlikely**.

19.3.4.2.3 Severity of Consequence

The severity of consequence in relation to drifting vessel to structure allision risk during the decommissioning phase is considered to be **Moderate**.

19.3.4.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during decommissioning of Caledonia North is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

19.3.4.3 Internal Allision Risk

19.3.4.3.1 Qualification and Quantification of Risk

It is likely that internal allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

19.3.4.3.2 Frequency of Occurrence

The frequency of occurrence of internal vessel to structure allision risk during the decommissioning phase is considered to be **Remote**.

19.3.4.3.3 Severity of Consequence

The severity of consequence of internal vessel to structure allision risk during the decommissioning phase is considered to be **Moderate**.

19.3.4.3.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during decommissioning of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.3.5 Reduced Access to Local Ports

19.3.5.1 Qualification of Risk

Decommissioning activities associated with the removal of structures and cables may displace existing routes/activity restricting access to ports/harbours.

Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, this hazard is expected to be similar in nature to the equivalent construction phase, including the number of vessel movements by decommissioning vessels. It is noted that in the case of subsea cables it is expected that they will be left *in situ* but for the purposes of this assessment (as a worst-case) it has been assumed that all cables will be removed during decommissioning, with only cable protection will be left *in situ*.

As with the construction stage, it is not yet known from which port(s) decommissioning activity will be based from for Caledonia North.

On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

19.3.5.2 Frequency of Occurrence

The frequency of the risk of reduced access to local ports during the decommissioning phase is considered to be **Reasonably Probable.**

19.3.5.3 Severity of Consequence

The severity of consequence of the risk of reduced access to local ports during the decommissioning phase is considered to be **Minor.**

19.3.5.4 Significance of Effect

Taking the frequency of occurrence as reasonably probable and the severity of consequence as minor, the overall effect of reduced port access during decommissioning of Caledonia North is considered to be tolerable.

Assuming liaison with the Whitehills, Banff, and Macduff harbour authorities in advance of and during decommissioning, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

19.3.6 Reduction of SAR Capabilities

The removal of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the decommissioning phase of Caledonia North by increasing the number of incidents, increasing consequences or reducing access for the responders.

19.3.6.1 Qualification of Risk

Given that removal of structures is likely to be similar to installation in terms of vessel numbers and duration, the risk is likely to be as described in the equivalent construction phase hazard. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

19.3.6.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of reduced emergency response capabilities during the decommissioning phase is considered to be **Extremely Unlikely.**

19.3.6.3 Severity of Consequence

The severity of consequence relating to the risk of reduced emergency response capabilities during the decommissioning phase is considered to be **Serious.**

19.3.6.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during decommissioning of Caledonia North is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20 Risk Assessment – Caledonia South In Isolation

This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to Caledonia South, based on baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments. The hazards assessed are as follows:

- Vessel displacement (including during adverse weather);
- Increased third-party collision risk;
- Third-party with project vessel collision risk;
- Creation of vessel to structure allision risk;
- Changes in under keel clearance;
- Increased interaction with subsea cables and mooring lines;
- Loss of station;
- Reduced access to local ports and harbours; and
- Reduction of SAR capability.

For each hazard, embedded mitigation measures which have been identified as relevant to reducing risk are listed, with full descriptions provided in Section 17.1. This is followed by statements defining the frequency of occurrence, severity of consequence, and subsequent significance of risk based on the methodology defined in Section 3.

The risk control log (see Section 24) summarises the risk assessment and a concluding risk statement is provided (see Section 26.5).

20.1 Construction Phase

20.1.1 Vessel Displacement

Construction activities associated with Caledonia South may displace existing vessel routes or activity, which may be more prevalent during periods of adverse weather.

These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

20.1.1.1 Vessel Displacement

20.1.1.1.1 Qualification of Risk

Vessel traffic data collected during the winter and summer 2023 surveys have been used to establish the vessel traffic baseline, alongside 12 months of AIS collected via coastal receivers between November 2022 and October 2023. These vessel traffic datasets have been validated by Anatec's ShipRoutes database, and analysed to identify the volume of traffic passing within or in proximity to the Caledonia South Site. Additionally, main routes were recognised from these datasets using the principles set out in MGN 654 (MCA, 2021) (see Section 11).

Although there will be no restrictions on entry into the buoyed construction area, other than through active safety zones, based on experience at previously under construction OWFs and consultation it is anticipated that the majority of commercial vessels will choose not to navigate within the buoyed construction area, therefore some main route deviations will be required. It is noted that Tidal Transit, who provide offshore transport services, responded to the regular operators outreach (see Appendix D) stating they may choose to transit internally within the Caledonia South Site if it is allowable to save fuel or energy. On this basis, smaller commercial vessel operators may choose to transit through (noting Tidal Transit vessels are small wind farm crew transfer vessels (below 28m in length), and were recorded working between Wick and Beatrice OWF), however it is likely that the majority of commercial vessels will deviate in line with other developments.

The full methodology for classifying main route deviations is provided in Section 15.4, noting it is in line with MGN 654 (MCA, 2021). A deviation will be required for three of the 10 main routes identified within the study area, however all deviations were minor (no more than 1% based on the worst case NRA assumptions).

This low magnitude of deviations aligns with feedback received during consultation including at the Hazard Workshop (see Section 4).

Regular routeing involving RoRo vessels was identified within the vessel traffic datasets and was attributed to Smyril Line and Serco NorthLink Ferries, both of which were observed to transit within the study area every one to two days. Smyril Line vessels were noted to intersect Caledonia South; however, during consultation, Smyril Line stated that there would not be any issues or concern with deviating to the east of Caledonia South.

Regular routeing of RoPax vessels operated by Serco NorthLink Ferries was also noted within the vessel traffic data. Route deviation was also deemed unnecessary for these regular journeys due to the distance from the Caledonia South Site. Serco NorthLink confirmed during consultation that they had no concerns with impacts on their regular routeing.

It is noted that certain transits from NorthLink Ferries were observed to intersect the Caledonia South Site. Consultation with NorthLink confirmed these transits were during adverse weather. Vessel displacement during adverse weather is considered in the relevant hazard below.

Based on experience at previously under construction OWFs, it is anticipated that fishing vessels and recreational vessels may also choose not to routinely navigate internally within the buoyed construction area, noting there would be no restriction on transit other than through active safety zones. However, they may be more likely to do so than commercial vessels, in particular in any areas of the Caledonia South Site where active construction is not ongoing, or structures are not yet present. Input received during the Hazard Workshop from commercial fishing representatives was that (as for commercial vessels) only a minor deviation would be required for fishing vessels in transit and as such it is likely that such vessels will choose to deviate. Input from the RYA Scotland indicated that this would likely apply to recreational vessels as well, noting that it is of the skippers preference as to whether or not a transit is made through a wind farm.

For any smaller vessels that do choose to deviate, there is considered to be sufficient sea room outside of the Caledonia South Site for transits from such vessels to be accommodated, noting this aligns with general consensus from the Hazard Workshop. It is noted that displacement of active commercial fishing is assessed separately in Volume 4, Chapter 8: Commercial Fisheries of the EIAR.

Given the east and west routeing of commercial vessels across the Caledonia South OECC, installation activities associated with the export cable will likely lead to vessel displacement. However, any associated displacement will be temporary in nature and spatially limited to the area immediately around the installation vessel position. Considering embedded mitigation measures such as promulgation of information, any displacement as a result of cable installation will be minor and manageable with appropriate passage planning.

The main consequences of vessel displacement will be increased journey times and distances for affected third party vessels, under the assumption that the buoyed construction area will be deployed around the maximum extent of the Caledonia South Site. Any notable safety impacts are considered unlikely given the available sea room, noting this aligns with outputs of the Hazard Workshop. Vessels are expected to comply with international and flag state regulations (including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974) and will be able to passage plan in advance given the promulgation of information relating to Caledonia South and relevant nautical charts.

Relevant embedded mitigation measures include DSLP approval, adherence to an LMP, adherence to an NSP, marking on nautical charts, and promulgation of information.

20.1.1.1.2 Frequency of Occurrence

The frequency of occurrence in relation to displacement of vessel traffic during the construction phase is considered **Frequent**.

20.1.1.1.3 Severity of Consequence

The severity of consequence in relation to displacement of vessel traffic during the construction phase is considered **Negligible.**

20.1.1.1.4 Significance of Effect

Taking the frequency of occurrence as frequent and the severity of consequence as negligible, the overall effect of vessel displacement during construction of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.1.1.2 Vessel Displacement During Adverse Weather

20.1.1.2.1 Qualification of Risk

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

Based on review of the input received, it is unlikely that commercial vessels would choose to make transit through the buoyed construction area during adverse weather conditions. Larger deviations may be required than during more favourable conditions (e.g., vessels may choose to increase passing distance from the buoyed construction area or transit inshore of the Moray Firth OWFs), however there is considered to be sufficient sea room to safely accommodate these chosen transits.

The long term vessel traffic data studied in Appendix E showed the presence of transits within the Caledonia South Site undertaken by Serco NorthLink Ferries, further inshore of their typical routeing. Consultation with Serco NorthLink Ferries confirmed these transits were utilised during adverse weather conditions. The presence of the buoyed construction area may therefore impact Serco NorthLink adverse weather transits, with the potential for delays in sailings, a large deviation inshore of the Moray Firth OWFs, or sailing cancellation. However, as each historical transit is based upon individual Master decisions based upon the conditions and factors on the day, Serco NorthLink have confirmed that the impact cannot be quantified (i.e., it cannot be confirmed whether any given historical transit would have been delayed, deviated or cancelled).

The Applicant engaged with Serco NorthLink Ferries throughout the NRA process, and this engagement culminated in the Applicant proposing an SEZ on the eastern boundary of the Caledonia South Site within which no surface piercing infrastructure will be placed for the purposes of increasing searoom and optionality for Serco NorthLink Ferries in adverse weather conditions. The SEZ was proposed to Serco NorthLink via a meeting on 12th August 2024. Feedback received was that the SEZ and associated increase in searoom would be a significant positive for NorthLink adverse weather routeing, and also shipping and navigation in general.

There may still be works undertaken within the SEZ (e.g., cable installation), however any such impact would be temporary in nature and spatially limited to the area around the operation. The placement of the buoyed construction area will be agreed with NLB as part of the LMP process to ensure any impacts to shipping and navigation are managed.

From a navigational safety perspective, worst case consequences are an increase in delays, deviations or cancellation, however based upon Serco NorthLink feedback it is considered that the implementation of the SEZ reduces the risk to ALARP parameters noting frequency of the hazard is reduced. Socioeconomic impacts are assessed in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation of the EIAR.

Full details of the assessment and consultation undertaken in relation to Serco NorthLink are provided in Sections 12 and 4.2.

20.1.1.2.2 Frequency of Occurrence

The frequency of occurrence relating to vessel displacement during periods of adverse weather during construction is considered to be **Remote**.

20.1.1.2.3 Severity of Consequence

The severity of consequence relating to vessel displacement during periods of adverse weather during construction is considered to be **Serious**.

20.1.1.2.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as serious, the overall effect of adverse weather during construction of Caledonia South is considered to be tolerable.

Assuming the implementation of the SEZ, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.1.2 Increased Third Party Vessel to Vessel Collision Risk

20.1.2.1 Qualification of Risk

As noted in relation to the hazard of vessel displacement, three of 10 main routes will deviate as a result of the construction of Caledonia South. This will likely cause an increase in vessel density in proximity to Caledonia South, leading to a higher chance of vessel to vessel encounters and therefore a greater collision risk.

Based on pre OWF modelling, the baseline collision risk levels within the study area are low, with an estimated vessel to vessel collision frequency of one every 520 years. This level of collision risk is due to the volume of traffic in the area relative to the available sea space, noting the presence of Moray East and Beatrice OWFs, as well as the under-construction Moray West OWF. Additionally, it is noted that no collisions occurring within the study area were recorded within the MAIB over the most recent 20 years of data, nor were any responded to by the RNLI between 2010 and 2022.

Based on post OWF modelling, the collision frequency was estimated at one every 319 years, with the change primarily associated with vessels displaced east of the Caledonia South Site. This represents an increase of 63% on the pre OWF scenario. Although there is an increase in risk, it should be considered that a conservative approach has been undertaken within the modelling process, with an assumption made that vessel routeing will remain in proximity to the north eastern boundary of the Caledonia South Site. In reality it is likely that vessels will deviate to use more of the available sea space offshore of the Caledonia South Site. This aligns with general stakeholder consensus of the Hazard Workshop which indicated that there is sufficient post wind farm sea room available to safely accommodate the likely number of users.

For the Caledonia South OECC, any displacement of commercial vessels due to installation activities is not anticipated to affect available sea room to such an extent that the risk of a collision between third party vessels is materially increased. This is due to the temporary nature of the installation process, and spatially limited extent of the operation at any given time.

An additional factor is the potential for installed or partially installed WTGs to obscure vessels from one another, thus hindering ability to comply with COLREGs (IMO, 1972/77). Minimum spacing of 944m between WTGs will likely provide sufficient sea room for visual observations, with full obstruction likely only to occur when vessels are at opposite ends of a WTG row. Collision risk is likely to be low in such cases due to the distance between vessels and the avoidance of the buoyed construction area.

In the event of an encounter between third party vessels, it is likely to be localised and short in duration, with collision avoidance action implemented by the vessels involved, as per compliance with COLREGs (IMO, 1972/77), to ensure that a collision incident does not develop. This is supported by experience at previous under construction OWFs, where no collision incidents involving two third party vessels have been reported as a result of an OWF (as detailed in Section 9.6).

Historical collision incident data studied also indicates that the most likely consequences will be low should a collision occur, with contact between the vessels resulting in minor damage and no injuries to persons, with the vessels involved able to resume their respective passages and undertake a full inspection at the next port.

As an unlikely worst-case scenario, a high impact collision event could occur. This may result in vessel foundering and subsequent PLL, as well as pollution. In such a circumstance, vessels associated with Caledonia South may attend the incident under SOLAS obligations and in liaison with the MCA, and the procedures within the ERCoP and MPCP would be implemented.

Relevant embedded mitigation measures includes marking on nautical charts, clear buoyage to mark the construction area, promulgation of information, DSLP approval, adherence to an LMP, adherence to an MPCP, and adherence to an ERCoP.

20.1.2.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between third party vessels during the construction phase is **Extremely Unlikely**.

20.1.2.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between third party vessels during the construction phase is considered **Serious**.

20.1.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of third party vessel to vessel collision risk during construction of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.1.3 Increased Third Party Vessel to Project Vessel Collision Risk

The presence of vessels associated with construction activities of Caledonia South may increase encounters and thus collision risk for vessels already operating in the area.

20.1.3.1 Qualification of Risk

During the construction phase of Caledonia South there may be up to 2,225 vessel movements made by up to 25 project vessels. This will include vessels which are RAM. It is assumed that construction vessels will be on-site throughout the entire duration of the construction phase.

Encounter and collision risk involving project vessels will be managed through the implementation of marine coordination with full details of this to be provided in the VMP and NSP. Project vessels will also be expected to carry AIS and comply with flag state regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974). COLREGs will remain the navigational priority for project vessels at all times.

Applications for safety zones of 500m around on-going construction activities will be sought during the construction phase and will protect deployed project vessels, especially if they are RAM. Minimum advisory passing distances and guard vessels, as defined by risk assessment, may also be implemented where safety zones do not apply, for example around cable installation vessels. Details of safety zones, minimum safe passing distances, and guard vessels will be promulgated including via Notifications to Mariners and Kingfisher Bulletins.

Appropriate marine lighting and marking during construction including the buoyed construction area will be agreed with the NLB. These navigational aids will further maximise mariner awareness when in proximity to ongoing construction works in the Caledonia South Site.

Third-party vessels may experience decreased capability to visually identify project vessels entering and exiting the Caledonia South Site during reduced visibility; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and the mandatory carriage of AIS by project vessels regardless of size. It is noted that the likelihood of a collision is likely to be greater in reduced visibility when the identification of project vessels entering and exiting the Caledonia South Site may be impeded.

Based on historical incident data, there has been one instance of a third-party vessel colliding with a project vessel in the UK (see Section 9.6 for further details). In this case, moderate vessel damage was reported with no harm to persons. It is noted that the incident occurred in 2011, 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.

If an encounter between a project vessel and third party vessel occurs, it is likely to be localised and short in duration. Assuming the implementation of collision avoidance action as required by the COLREGs, the most likely outcome will be any vessels involved being able to resume their respective passages or activities with no long-term consequences.

In the event of a collision, the likely consequences will be minor contact between the vessels resulting in minor damage and no injuries to persons. As an unlikely worst-case scenario, foundering could occur resulting in PLL and pollution. Other project vessels may be able to assist in the event of a collision under SOLAS obligation and the adherence to the ERCoP, noting this would be done in liaison with the MCA. If pollution were to occur in proximity to Caledonia South or involving a project vessel, the MPCP will be implemented to minimise the risks.

Relevant embedded mitigation measures include application for safety zones, a buoyed construction area, guard vessels as required by risk assessment, DSLP approval, adherence to an LMP, VMP, and NSP, MPCP, ERCoP, promulgation of information, marine coordination, and marking on nautical charts.

20.1.3.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between project vessels and third party vessels during the construction phase is considered to be **Extremely Unlikely.**

20.1.3.3 Severity of Consequences

The severity of consequence in relation to encounters and collision risk between project vessels and third party vessels during the construction phase is considered to be **Serious**.

20.1.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of encounters and collision risk between project vessels and third party vessels during construction of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.1.4 Vessel to Structure Allision Risk

Presence of structures (including partially constructed) within the buoyed construction area will lead to creation of powered, drifting and internal allision risk for vessels.

The spatial extent of the hazard is small given that a vessel must be in close proximity to an OWF structure for an allision incident to occur. Each allision element is considered in turn in terms of frequency of occurrence and severity of consequence, with the resulting significance of the residual risk across the various elements summarised at the end of the assessment. The forms of allision considered include:

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

20.1.4.1 Powered Allision Risk

20.1.4.1.1 Qualification and Quantification of Risk

Based on quantitative assessment undertaken, the base case annual powered vessel to structure allision frequency was estimated to be 2.43×10^{-3}, corresponding to a return period of one every 412 years. This is reflective of the volume of traffic within the available sea room, noting that it has been conservatively assumed that vessels will not use the full available sea room offshore of the Caledonia South Site. In reality, it is likely that vessels will increase passing distance from the Caledonia South Site, noting this aligns with feedback received at the Hazard Workshop, where general consensus was that there was sufficient sea room to accommodate likely users.

Based on historical incident data, there have been two reported instances of a third-party vessel alliding with an operational OWF structure in the UK (in the Irish Sea and Southern North Sea). Both of these incidents involved a fishing vessel. These allisions resulted in minor to moderate damage to the vessels with minor injury to crew members.

Temporary marine lighting and marking will be implemented including the buoyed construction area in agreement with the NLB. Promulgation of information and marking on charts will ensure vessels can passage plan in advance to minimise risk. Safety zones of 50m in radius around structures will also be applied for during the construction phase up until the point of commissioning of Caledonia South (rising to 500m where active construction is ongoing).

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 hazard given the potential for a non-steel construction and possible internal navigation within the Caledonia South Site. 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 founder resulting in PLL and pollution. Project vessels may assist in the event of an allision under SOLAS obligation and the adherence to the ERCoP, in line with the MCA. If pollution were to occur, then the MPCP will be implemented to minimise the environmental risk.

Relevant embedded mitigation measures include DSLP approval, adherence to a MPCP, adherence to an LMP, adherence to an NSP, promulgation of information, application for safety zones, adherence to an ERCoP, guard vessels where required by risk assessment, and appropriate marking via construction buoyage as well as on nautical charts.

20.1.4.1.2 Frequency of Occurrence

The frequency of occurrence in relation to powered vessel to structure allision risk during the construction phase is considered to be **Extremely Unlikely**.

20.1.4.1.3 Severity of Consequences

The severity of consequence in relation to powered vessel to structure allision risk during the construction phase is considered to be **Moderate**.

20.1.4.1.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during construction of Caledonia South is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

20.1.4.2 Drifting Allision Risk

20.1.4.2.1 Qualification and Quantification of Risk

Based on quantitative assessment undertaken, the base case annual drifting vessel to structure allision frequency was estimated to be 1.42×10^{-4}, corresponding to a return period of one every 7,018 years.

Based on historical incident data, there have been no instances of a third-party vessel alliding with an under-construction OWF structure whilst NUC. However, there is considered to be potential for a vessel to be adrift; this is reflected in the MAIB incident data reviewed in proximity to Caledonia South which indicates that machinery failure is the most common incident type (approximately 50%) in the 2012-2021 dataset, noting that only two were recorded. A vessel adrift may only develop into an allision situation if in proximity to a OWF structure. This is only the case where the adrift vessel is located internally or in close proximity to the Caledonia South Site and the direction of the wind and/or tide directs the vessel towards a structure. Promulgation of information and marking on charts will help mitigate the risks of a drifting allision.

In circumstances where a vessel drifts towards a structure in the Caledonia South Site, there are actions which the vessel may take to prevent the drift incident developing into an allision situation. Powered vessels may be able to regain power prior to reaching the Caledonia South Site (i.e., by rectifying any fault). Failing this, the vessel’s emergency response procedures would be implemented which may include an emergency anchoring event following a check of the relevant nautical charts to ensure the deployment of the anchor will not lead to other risks (such as anchor snagging on a subsea cable), or the use of thrusters (depending on availability and power supply).

Where the deployment of the anchor is not possible (e.g., for small craft), any project vessels on-site may be able to render assistance in liaison with the MCA and in line with SOLAS obligations (IMO, 19742). This response will be managed via the coastguard and marine coordination, and depends on the type and capability of vessels on site. This would be particularly relevant for sailing vessels relying on metocean conditions for propulsion, noting if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance.

Should an allision occur, the consequences will be similar to those noted for the case of a powered allision including the unlikely worst-case of foundering, PLL, and pollution; in the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the MPCP will minimise the environmental risk. Project vessels may assist in the event of an allision under SOLAS obligation and the adherence to the ERCoP, in line with the MCA. Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel, thus reducing the energy of the hazard, including in the case of a recreational vessel under sail.

Relevant embedded mitigation measures include adherence to an ERCoP, adherence to an MPCP, marking on nautical charts, and project vessel compliance with SOLAS (IMO, 1974).

20.1.4.2.2 Frequency of Occurrence

The frequency of occurrence in relation to drifting vessel to structure allision risk during the construction phase is considered to be **Extremely Unlikely**.

20.1.4.2.3 Severity of Consequence

The severity of consequence in relation to drifting vessel to structure allision risk during the construction phase is considered to be **Moderate**.

20.1.4.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during construction of Caledonia South is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

20.1.4.3 Internal Allision Risk

20.1.4.3.1 Qualification and Quantification of Risk

As noted previously, based on experience at previously under-construction OWFs, it is anticipated that commercial vessels will be unlikely to navigate internally within the Caledonia

South Site. Fishing and recreational vessels may be more likely to transit through noting they may choose not to depending on various conditions. They may be less likely to navigate within a site which hosts floating wind farm structures due to the presence of mooring lines and dynamic cables.

The base case fishing vessel to structure allision frequency is estimated to be 1.85×10^{-1}, corresponding to a return period of approximately one in 5.4 years. This return period is reflective of the volume of fishing vessel traffic in the study area, both in transit and engaged in active fishing. Conservative modelling has been undertaken with the assumption that fishing levels in proximity to the WTGs will not change. In reality fishing vessels will account for the presence of the WTGs, and may choose to transit or fish elsewhere, noting this aligns with feedback received during the Hazard Workshop.

The worst-case consequences reported for vessels involved in an allision incident involving a UK OWF has been flooding, with no life-threatening injuries to persons reported (the model is calibrated against known reported incidents). If an allision incident were to occur, project vessels may assist under obligation of SOLAS (IMO, 1974) and adherence to the ERCoP. Additionally, if pollution occurs as a result of an allision incident, the MPCP would be implemented (where appropriate).

If a vessel chooses to transit within the Caledonia South Site, the minimum spacing of 944m between wind farm structures is considered sufficient for safe internal navigation. Furthermore, application for safety zones around construction activities, as well as the buoyed construction area and temporary lighting and marking provides mitigation against internal allision risk. Any vessel planning to transit through the Caledonia South Site is expected to passage plan in advance in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information including through ongoing liaison with fishing fleets via an appointed FLO to ensure that such vessels have good awareness of Caledonia South.

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, 2022) 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.

Relevant embedded mitigation measures include application for safety zones, buoyed construction area, DSLP approval, adherence to an LMP, marking on nautical charts, promulgation of information, adherence to an ERCoP, adherence to an MPCP, appointment of a FLO and adherence to an FMMS.

20.1.4.3.2 Frequency of Occurrence

The frequency of occurrence of internal vessel to structure allision risk during the construction phase is considered to be **Remote**.

20.1.4.3.3 Severity of Consequence

The severity of consequence of internal vessel to structure allision risk during the construction phase is considered to be **Moderate.**

20.1.4.3.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during construction of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and ALARP and Not Significant in EIA terms.**

20.1.5 Reduced Access to Local Ports

20.1.5.1 Qualification of Risk

Up to 2,225 vessel movements by construction vessels (excluding site preparation activities) may be made throughout the construction phase and will include vessels which are RAM. Project vessels will be managed by marine coordination, including the use of traffic management procedures such as the designation of entry and exit points to and from the buoyed construction area, and designated routes to and from construction ports. Project vessels will also carry AIS and be compliant with flag state regulations including the COLREGs (IMO 1972/77).

The closest port or harbours to the Caledonia South Site are Banff and Macduff, which are located approximately 20nm to the south. Given the relative distance to ports in the area and the anticipated deviations for the main commercial routes, it is not anticipated that there will be any substantial effect on vessel approaches to and from the local ports beyond the deviations already outlined for hazards on vessel displacement.

For offshore cable installation activity, there is a greater likelihood of impact on port access given the proximity to Whitehills Harbour and Marina which is located in proximity to the Landfall Site. Additionally, the Landfall Site lies in proximity to approaches to Banff and Macduff harbours, which are located at their closest approximately 2.3nm southeast of the Caledonia South OECC.

Where cable installation is ongoing, vessel displacement is possible. Recreational vessels may be particularly sensitive given that the RYA Scotland has indicated that Whitehills Marina is a key stopping point for vessels travelling north as well as along the northeast coast. No concerns were raised during consultation over access to ports during the construction phase in relation to the Caledonia South Site nor the offshore export cables. Additionally, offshore export cable installation activities will likely be short-term in duration and localised at any given time, thus any reduced access will likely be minor and temporary. Regardless, liaison in advance of and during installation is considered necessary with the Whitehills, Banff, and Macduff harbour authorities based on proximity to the Caledonia South OECC. It is noted that no known issues have been raised regarding the installation or operation of Moray East OWF offshore export cables, the landfall of which is situated approximately 1nm east of the Caledonia South OECC.

The most likely consequences are increased journey times and distances, as per the vessel displacement hazard. There is only one pilot boarding station nearby, at Macduff and outside of the Caledonia South OECC, where the service is not compulsory. However, the charted anchorage is adjacent to the Caledonia South OECC, and therefore liaison may be needed with local harbour authorities depending on the final cable routeing.

Relevant embedded mitigation measures includes clear buoyage of the construction area, adherence to an LMP, adherence to a VMP, marine coordination of project vessels, marking on nautical charts, and promulgation of information.

20.1.5.2 Frequency of Occurrence

The frequency of the risk of reduced access to local ports during the construction phase is considered to be **Reasonably Probable**.

20.1.5.3 Severity of Consequence

The severity of consequence of the risk of reduced access to local ports during the construction phase is considered to be **Minor**.

20.1.5.4 Significance of Effect

Taking the frequency of occurrence as reasonably probable and the severity of consequence as minor, the overall effect of reduced port access during construction of Caledonia South is considered to be tolerable.

Assuming liaison with the Whitehills, Banff, and Macduff harbour authorities in advance of and during installation, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.1.6 Reduction of Under Keel Clearance

The presence of subsea cables and mooring lines may reduce under keel clearance during the construction phase of Caledonia South.

20.1.6.1 Qualification of Risk

There may be up to six mooring lines per floating WTG used to secure the substructures to the seabed, and use of subsea cabling. During the construction phase, such components may be wet stored within the Caledonia South Site or Caledonia South OECC prior to attachment to the substructures noting at this stage it is likely only the export cables may be wet stored.

Taking into consideration the baseline and anticipated post wind farm vessel routeing, it is considered highly unlikely that a commercial vessel would pass within the buoyed construction area. Though fishing and recreational vessels are more likely to transit in proximity to the buoyed construction area compared to commercial vessels, these vessels are smaller and tend to have lower draughts.

The buoyed construction area will be appropriately marked on nautical charts and other electronic charts as appropriate to increase awareness. It was raised at the Hazard Workshop that making the locations of mooring lines and dynamic cables available to fishing vessels was a key mitigation. Locations of relevant infrastructure will be provided in the weekly notices distributed during the construction phase as per the Outline FMMS (Volume 7, Appendix 18).

There is limited experience of deployment of floating offshore wind projects in UK waters; however, to date there have been no reported under keel interactions between passing vessels and the components associated with such projects.

In line with MGN 654 (MCA, 2021), water depths will not be reduced by more than 5% without prior agreement with the MCA. Further, wet storage plans will be included in the Construction Method Statement which will be required to be approved by MD-LOT in consultation with the MCA.

The most likely consequences of reduced under keel clearance is that a vessel transits over an area of reduced clearance but does not make contact.

Should an underwater allision occur, minor damage incurred is the most likely consequence, with foundering or grounding of the vessel resulting in PLL and pollution as an unlikely worst-case. Should pollution occur, the MPCP will be implemented, with adherence to the ERCoP in the case of risk of PLL, as well as under SOLAS (IMO, 1974) obligations.

Other relevant embedded mitigation measures include promulgation of information and any potential under keel interaction risk, including via the FLO. The location of the buoyed construction area will be clearly shown on appropriate nautical charts.

20.1.6.2 Frequency of Occurrence

The frequency of occurrence in relation to reduction of under keel clearance during the construction phase is considered **Extremely Unlikely**.

20.1.6.3 Severity of Consequence

The severity of consequence in relation to reduction of under keel clearance during the construction phase is considered **Serious**.

20.1.6.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced under keel clearance during the construction phase of Caledonia South is considered to be tolerable.

Assuming the implementation of ensuring locations of subsea infrastructure are made available to fishing vessels including via FLO liaison the hazard is considered **Tolerable with mitigation and ALARP and therefore Not Significant in EIA terms**.

20.1.7 Loss of Station

The floating substructures may suffer loss of station in the event that the mooring system fails, or there is damage to tow during WTG towage for installation. This may become a floating hazard to passing vessels. This hazard is only relevant to the floating WTGs within the Caledonia South Site, and thus there will be no risk of this hazard from the Caledonia South OECC.

20.1.7.1 Qualification of Risk

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

The Regulatory Expectations also require the provision of continuous monitoring either by GPS or other suitable means. Each WTG should 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, which will depend upon the design of the substructure and any predefined emergency response protocols.

On the basis of compliance with the Regulatory Expectations, 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 (each WTG will have a minimum of six), which is more likely to occur in extreme storm conditions, during which it is unlikely vessels will be navigating within proximity to the WTGs.

Any WTG towing operations will be subject to a dedicated internal risk assessment process undertaken prior to the tows occurring, once the full specifications of the operation is known. This risk assessment will cover all phases of the operations, including within port approach areas. During the tow, all vessels involved will be lit and marked as required under COLREGs (IMO, 1972/1977).

Relevant embedded mitigation measures include compliance with regulatory expectations on moorings for floating wind and marine devices (HSE and MCA, 2017) and MGN 654, adherence to a DSLP, promulgation of information, adherence to an ERCoP, compliance with international regulations (SOLAS; IMO, 1974), appropriate marking of the structures and adherence to an LMP.

20.1.7.2 Frequency of Occurrence

The frequency of occurrence relating to loss of station during the construction phase is considered to be **Extremely Unlikely.**

20.1.7.3 Severity of Consequence

The severity of consequence relating to loss of station during the construction phase is considered to be **Moderate.**

20.1.7.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of loss of station during the construction phase of Caledonia South is considered to be **Broadly Acceptable and ALARP, and therefore Not Significant in EIA terms.**

20.1.8 Reduction of SAR Capabilities

The installation of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the construction phase of Caledonia South by increasing the number of incidents, increasing consequences or reducing access for the responders.

20.1.8.1 Qualification of Risk

The spatial extent of this hazard is large given the area covered by the Caledonia South Site ($60nm^2$), as well as the distance covered by air-based SAR support (the SAR helicopter base is located at Inverness, 66nm southwest of the Caledonia South Site). It is unlikely that a SAR operation will require the entirety of the Caledonia South Site to be searched, and it is probable that a search will be restricted to a smaller area in which a casualty is known to be located (accounting for assumptions on any potential drift of the casualty).

Up to 2,225 vessel movements may be made by construction vessels during the construction phase of Caledonia South. It is assumed that construction vessels will be on-site throughout the majority of the construction phase, although severe weather may lead to vessels being withdrawn. The presence of these vessels increase the likelihood of an incident and subsequently increase the likelihood of multiple incidents occurring simultaneously, diminishing emergency response capability. However, they may also be able to provide additional response resource in the event of an incident in liaison with the MCA.

The most likely consequence to occur would be a delay to any emergency response request. As an unlikely worst-case, this could result in a failure of emergency response to an incident resulting in PLL and pollution. However, project vessels will be managed via marine coordination and comply with flag state regulations which will minimise this risk. Additionally, the presence of project vessels themselves may mitigate this risk as they may self-help at incidents involving other project vessels under the obligation of SOLAS (IMO, 1974) and adherence to an ERCoP, noting this would be undertaken with liaison with the MCA. The MPCP will also be implemented should pollution occur.

From recent SAR data, the frequency of helicopter SAR operations in proximity to Caledonia South is one per year on average, with no SAR helicopter incidents occurring within the Caledonia South Site itself. The frequency of incidents in proximity to the Caledonia South Site is not anticipated to increase significantly from the current level given the measures noted above which will be in place. The layout will be agreed with the MCA and in line with MGN 654 requirements to ensure any SAR operations that do occur within the Caledonia South Site are facilitated. A SAR checklist will also be completed and agreed with the MCA.

Relevant embedded mitigation measures include DSLP approval, promulgation of information, adherence to an LMP, marking on appropriate charts, marine coordination of project vessels, adherence to an ERCoP, adherence to an MPCP, adherence to a VMP and NSP, and compliance with MGN 654 and international marine regulations.

20.1.8.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of reduced emergency response capabilities during the construction phase is considered to be **Extremely Unlikely**.

20.1.8.3 Severity of Consequence

The severity of consequence relating to the risk of reduced emergency response capabilities during the construction phase is considered to be **Serious**.

20.1.8.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during construction of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.2 Operation and Maintenance Phase

20.2.1 Vessel Displacement

Operational activities associated with Caledonia South as well as presence of structures throughout the lifetime of Caledonia South may displace existing vessel routes or activity, which may be more prevalent during periods of adverse weather.

These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

20.2.1.1 Vessel Displacement

20.2.1.1.1 Qualification of Risk

Based on experience at existing operational OWFs and input during consultation, it is anticipated that the majority of commercial vessels will choose not to navigate within the Caledonia South Site, therefore some main route deviations will be required as per the respective construction phase hazard. Based on previous consultation, smaller commercial vessel operators may choose to transit through; however, it is likely that the majority of commercial vessels will deviate in line with other operational OWFs.

As discussed in relation to the equivalent construction phase hazard, a deviation will be required for three of the 10 main routes identified within the study area; however, they all represent relatively low magnitude of deviations (approximately 1%), which aligns with feedback received during consultation including at the Hazard Workshop (see Section 4.2). Further, deviations will be well established during the construction phase, with it being likely that commercial vessels will continue these same established deviations into the O&M phase.

Minimum spacing of 944m within the Caledonia South Site is considered sufficient to accommodate transits of smaller vessels, noting there will be no restrictions on entry into the Caledonia South Site with the exception of any active 500m major maintenance safety zones.

As discussed in relation to the equivalent construction phase hazard, regular routeing involving RoRo vessels was identified within the vessel traffic datasets, however these transits would either not be displaced by Caledonia South or it has been indicated during consultation that the deviation would be minor and not pose a concern.

Based on experience at existing operational OWFs, it is anticipated that fishing vessels and recreational vessels may also choose not to routinely navigate internally within the Caledonia South Site. However, they may be more likely to do so than commercial vessels. As discussed in relation to the equivalent construction phase hazard, input received during the Hazard Workshop from commercial fishing representatives was that only a minor deviation would be required for fishing vessels in transit and as such it is likely that such vessels will choose to deviate. The RYA Scotland indicated that this would likely apply to recreational vessels as well, noting that it is of the skippers preference as to whether or not a transit is made through a wind farm.

For any smaller vessels that do choose to deviate, there is considered to be sufficient sea room outside of the Caledonia South Site for transits from such vessels to be accommodated, noting this aligns with general consensus from the Hazard Workshop. It is noted that displacement of active commercial fishing is assessed separately in Volume 4, Chapter 8: Commercial Fisheries of the EIAR.

Given that any O&M activities associated with Caledonia South will be infrequent and localised, the likelihood of vessel displacement due to these activities is considered to be very low.

The main consequences of vessel displacement will be increased journey times and distances for affected third party vessels, under the assumption that the WTGs will be built to the full extent of the Caledonia South Site. Any notable safety impacts are considered unlikely given the available sea room, noting this aligns with outputs of the Hazard Workshop. Vessels are expected to comply with international and flag state regulations (including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974) and will be able to passage plan in advance given the promulgation of information relating to Caledonia South and relevant nautical charts.

Relevant embedded mitigation measures include DSLP approval, adherence to an LMP, adherence to an NSP, marking on nautical charts, and promulgation of information.

20.2.1.1.2 Frequency of Occurrence

The frequency of occurrence in relation to displacement of vessel traffic during the O&M phase is considered **Frequent**.

20.2.1.1.3 Severity of Consequence

The severity of consequence in relation to displacement of vessel traffic during the O&M phase is considered **Negligible**.

20.2.1.1.4 Significance of Effect

Taking the frequency of occurrence as frequent and the severity of consequence as negligible, the overall effect of vessel displacement during O&M of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.2.1.2 Vessel Displacement During Adverse Weather

20.2.1.2.1 Qualification of Risk

As discussed within the equivalent construction phase hazard, adverse weather can severely affect a vessels journey, with the impact of this dependent on various factors including specific vessel parameters such as hull geometry or vessel size.

Based on review of the input received, it is likely that no commercial vessels would choose to make transit through the Caledonia South Site during adverse weather conditions. Larger deviations may be required than during more favourable conditions (e.g., vessels may choose to increase passing distance from the Caledonia South Site or transit inshore of the Moray Firth OWFs); however, there is considered to be sufficient sea room to safely accommodate the chosen transits.

The long term vessel traffic data studied in Appendix E showed the presence of transits within the Caledonia South Site undertaken by Serco NorthLink Ferries, further inshore of their typical routeing. Consultation with Serco NorthLink Ferries confirmed these transits were utilised during adverse weather conditions. The presence of structures within the Caledonia South Site may therefore impact Serco NorthLink adverse weather transits, with the potential for delays in sailings, a large deviation inshore of the Moray Firth OWFs, or sailing cancellation. However, as each historical transit is based upon individual Master decisions based upon the conditions and factors on the day, Serco NorthLink have confirmed that the impact cannot be quantified (i.e., it cannot be confirmed whether any given historical transit would have been delayed, deviated or cancelled).

The Applicant engaged with Serco NorthLink Ferries throughout the NRA process, and this engagement culminated in the Applicant proposing a SEZ on the eastern boundary of the Caledonia South Site within which no surface piercing infrastructure will be placed for the purposes of increasing searoom and optionality for Serco NorthLink Ferries in adverse weather conditions. The SEZ was proposed to Serco NorthLink via a meeting on 12th August 2024. Feedback received was that the SEZ and associated increase in searoom would be a significant positive for NorthLink adverse weather routeing, and also shipping and navigation in general.

From a navigational safety perspective, worst case consequences are an increase in delays, deviations or cancellation, however based upon Serco NorthLink feedback it is considered that the implementation of the SEZ reduces the risk to ALARP parameters noting frequency of the hazard is reduced. Socioeconomic impacts are assessed in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation of the EIAR.

20.2.1.2.2 Frequency of Occurrence

The frequency of occurrence relating to vessel displacement during periods of adverse weather during O&M is considered to be **Remote**.

20.2.1.2.3 Severity of Consequence

The severity of consequence relating to vessel displacement during periods of adverse weather during O&M is considered to be **Serious**.

20.2.1.2.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as serious, the overall effect of adverse weather during O&M is considered to be tolerable.

Assuming the implementation of the SEZ, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.2.2 Increased Third Party Vessel to Vessel Collision Risk

20.2.2.1 Qualification of Risk

As noted in relation to the construction phase, three of the 10 main routes will likely deviate as a result of the presence of Caledonia South. Post wind farm collision frequency was estimated at one every 319 years, based on conservative post OWF modelling, which assumed that vessels would not use the full available sea room offshore of the Caledonia South Site. In reality, as per the construction phase hazard, it is likely that vessels will deviate to use the available sea space. This aligns with general stakeholder consensus of the Hazard Workshop which indicated that there is sufficient post wind farm sea room available to safely accommodate the likely number of users.

For the Caledonia South OECC, any displacement of commercial vessels due to O&M activities is not anticipated to affect available sea room to such an extent that the risk of a collision between third party vessels is materially increased. This is due to the infrequency of operational activities, and spatially limited extent of the operation at any given time.

An additional factor is the potential for WTGs to obscure vessels from one another, thus hindering ability to comply with COLREGs (IMO, 1972/77). Minimum spacing of 944m between WTGs will likely provide sufficient sea room for visual observations, with full obstruction likely only to occur when vessels are at opposite ends of a WTG row. Collision risk is likely to be low in such cases due to the distance between vessels.

In the event of an encounter between third party vessels, it is likely to be localised and short in duration, with collision avoidance action implemented by the vessels involved, as per compliance with COLREGs (IMO, 1972/77), to ensure that a collision incident does not develop.

As per the respective construction phase hazard, historical collision incident data 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 the vessels involved able to resume their respective passages and undertake a full inspection at the next port.

As an unlikely worst-case scenario, a high impact collision event could occur. This may result in vessel foundering and subsequent PLL, as well as pollution. In such a circumstance, vessels associated with Caledonia South may attend the incident under SOLAS obligations and in liaison with the MCA, and the procedures within the ERCoP and MPCP would be implemented.

Relevant embedded mitigation measures includes marking on nautical charts, promulgation of information, DSLP approval, adherence to an LMP, adherence to an MPCP, and adherence to an ERCoP.

20.2.2.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between third party vessels during the O&M phase is considered **Extremely Unlikely**.

20.2.2.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between third party vessels during the O&M phase is considered **Serious**.

20.2.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of third party vessel to vessel collision risk during O&M of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.2.3 Increased Third Party Vessel to Project Vessel Collision Risk

The presence of vessels associated with O&M activities of Caledonia South may increase encounters and thus collision risk for vessels already operating in the area.

20.2.3.1 Qualification of Risk

During the O&M phase of Caledonia South there may be up to 938 vessel movements annually, and up to 25 project vessels on-site simultaneously (during major maintenance; i.e., likely less during normal operations). This will include vessels which are RAM.

Encounter and collision risk involving project vessels will be managed through the implementation of marine coordination as will be set out in the VMP and NSP. Project vessels will also be expected to carry AIS and comply with flag state regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974). COLREGs will remain the navigational priority for project vessels at all times.

Applications for safety zones of 500m around major maintenance activities during O&M will be sought and will protect deployed project vessels, especially if they are RAM. Minimum advisory passing distances and guard vessels, as defined by risk assessment, may also be implemented where safety zones do not apply. Details of safety zones, minimum safe passing distances, and guard vessels will be promulgated including via Notifications to Mariners and Kingfisher Bulletins.

Appropriate operational marine lighting and marking will be agreed with the NLB and set out in an LMP. These navigational aids will further maximise mariner awareness when in proximity to the Caledonia South Site.

Third-party vessels may experience decreased capability to visually identify project vessels during reduced visibility, especially if visual observations are obscured by WTGs; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and the mandatory carriage of AIS by project vessels regardless of size.

As discussed in the equivalent construction phase hazard, there has been one instance of a third-party vessel colliding with a project vessel in the UK (see Section 9.6 for further details). Moderate vessel damage was reported with no harm to persons. It is noted that the incident occurred in 2011, 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.

As per the respective construction phase hazard, if an encounter between a project vessel and third party vessel occurs, it is likely to be localised and short in duration. Assuming the implementation of collision avoidance action as required by the COLREGs, the most likely outcome will be any vessels involved being able to resume their respective passages or activities with no long-term consequences.

In the event of a collision, the likely consequences will be minor contact between the vessels resulting in minor damage and no injuries to persons. As an unlikely worst-case scenario, foundering could occur resulting in PLL and pollution. Other project vessels may be able to assist in the event of a collision under SOLAS obligation and the adherence to the ERCoP, noting this would be done in liaison with the MCA. If pollution were to occur in proximity to Caledonia South or involving a project vessel, the MPCP will be implemented to minimise the risks.

Relevant embedded mitigation measures include application for safety zones, guard vessels as required by risk assessment, DSLP approval, adherence to an LMP, VMP, and NSP, MPCP, ERCoP, promulgation of information, marine coordination, and marking on nautical charts.

20.2.3.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between project vessels and third party vessels during the O&M phase is considered to be **Extremely Unlikely.**

20.2.3.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between project vessels and third party vessels during the O&M phase is considered to be **Serious.**

20.2.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of encounters and collision risk between project vessels and third party vessels during O&M of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.2.4 Vessel to Structure Allision Risk

Presence of structures within the Caledonia South Site will lead to creation of powered, drifting and internal allision risk for vessels during the O&M phase.

The spatial extent of the hazard is small given that a vessel must be in close proximity to an OWF structure for an allision incident to occur. Each allision element is considered in turn in terms of frequency of occurrence and severity of consequence, with the resulting significance of the residual risk across the various elements summarised at the end of the assessment. The forms of allision considered include:

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

20.2.4.1 Powered Allision Risk

20.2.4.1.1 Qualification and Quantification of Risk

As discussed in relation to the respective construction phase hazard, the base case annual powered vessel to structure allision frequency was estimated to be 2.43×10^{-3}, corresponding to a return period of one every 412 years. This is reflective of the volume of traffic within the available sea room, noting that it has been conservatively assumed that vessels will not use the full available sea room offshore of the Caledonia South Site. In reality, it is likely that vessels will increase passing distance from the Caledonia South Site, which aligns with feedback received at the Hazard Workshop.

Based on historical incident data, there have been two reported instances of a third-party vessel alliding with an operational OWF structure in the UK (in the Irish Sea and Southern North Sea). Both of these incidents involved a fishing vessel. These allisions resulted in minor to moderate damage to the vessels with minor injury to crew members.

Marine lighting and marking will be implemented in agreement with the NLB and defined within the LMP. These discussions will include contingency measures for the event that a WTG with a key navigational light needs to be towed away from site. Promulgation of information and marking on charts will ensure vessels can passage plan in advance to minimise risk.

Should an allision occur, the consequences will depend on multiple factors as discussed in relation to the equivalent construction phase hazard. Fishing vessels and recreational vessels are considered most vulnerable to the hazard and 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 founder resulting in PLL and pollution. Project vessels may assist in the event of an allision under SOLAS obligation and the adherence to the ERCoP, in liaison with the MCA. If pollution were to occur, then the MPCP will be implemented to minimise the environmental risk.

Relevant embedded mitigation measures include DSLP approval, adherence to a MPCP, adherence to an LMP, adherence to an NSP, promulgation of information, application for safety zones, adherence to an ERCoP, and marking on nautical charts.

20.2.4.1.2 Frequency of Occurrence

The frequency of occurrence in relation to powered vessel to structure allision risk during the O&M phase is considered to be **Extremely Unlikely**.

20.2.4.1.3 Severity of Consequence
The severity of consequence in relation to powered vessel to structure allision risk during the O&M phase is considered to be **Moderate**.

20.2.4.1.4 Significance of Effect
Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during O&M of the Caledonia South is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

20.2.4.2 Drifting Allision Risk

20.2.4.2.1 Qualification and Quantification of Risk
Based on quantitative assessment undertaken, the base case annual drifting vessel to structure allision frequency was estimated to be 1.42×10^{-4}, corresponding to a return period of one every 7,018 years. This is reflective of the volume of traffic within the available sea room.

Based on historical incident data, there have been no instances of a third-party vessel alliding with an operational OWF structure whilst NUC. However, there is considered to be potential for a vessel to be adrift; this is reflected in the MAIB incident data, where two incidents of machinery failure were recorded between 2012 and 2021, as discussed in relation to the equivalent construction phase hazard. Promulgation of information, lighting and marking, and marking on charts will help vessels to passage plan and mitigate the risks of a drifting allision.

In circumstances where a vessel drifts towards a structure in the Caledonia South Site, powered vessels may be able to regain power prior to reaching the Caledonia South Site (that is, by rectifying any fault). Failing this, the vessel's emergency response procedures would be implemented which may include an emergency anchoring event or the use of thrusters (depending on availability and power supply).

Where the deployment of the anchor is not possible (e.g., for small craft), any project vessels on-site may be able to render assistance in liaison with the MCA and in line with SOLAS obligations (IMO, 1974). This response will be managed via the coastguard and marine coordination, and depends on the type and capability of vessels on site. This would be particularly relevant for sailing vessels relying on metocean conditions for propulsion, noting if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance.

Should an allision occur, the consequences will be similar to those noted for the respective construction phase hazard including the unlikely worst-case of foundering, PLL, and pollution. In the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the MPCP will minimise the environmental risk. Project vessels may assist in the event of an allision under SOLAS (IMO, 1974) obligation and the adherence to the

ERCoP, in line with the MCA. Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel, thus reducing the energy of the impact, including in the case of a recreational vessel under sail.

Relevant embedded mitigation measures include adherence to an ERCoP, adherence to an MPCP, marking on nautical charts, adherence to an LMP, and project vessel compliance with SOLAS (IMO, 1974).

20.2.4.2.2 Frequency of Occurrence

The frequency of occurrence in relation to drifting vessel to structure allision risk during the O&M phase is considered to be **Extremely Unlikely**.

20.2.4.2.3 Severity of Consequence

The severity of consequence in relation to drifting vessel to structure allision risk during the O&M phase is considered to be **Moderate.**

20.2.4.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during O&M of Caledonia South is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

20.2.4.3 Internal Allision Risk

20.2.4.3.1 Qualification and Quantification of Risk

As noted previously, based on experience at existing operational OWFs, it is anticipated that commercial vessels will be unlikely to navigate internally within the Caledonia South Site. Fishing and recreational vessels may be more likely to transit through noting they may choose not to depending on various conditions (this aligns with consultation input). Vessels may be less likely to navigate within a site which hosts floating wind farm structures due to the presence of mooring lines and dynamic cables.

As noted in the respective construction phase hazard, the base case fishing vessel to structure allision frequency is estimated to be 1.85×10^{-1}, corresponding to a return period of approximately one in 5.4 years. This return period is reflective of the volume of fishing vessel traffic in the study area, both in transit and engaged in active fishing. Conservative modelling has been undertaken with the assumption that fishing levels in proximity to the WTGs will not change. In reality, as discussed within the equivalent construction phase hazard, fishing vessels will account for the presence of the WTGs, and may choose to transit or fish elsewhere (noting this aligns with consultation input).

The worst-case consequences reported for vessels involved in an allision incident involving a UK OWF has been flooding, with no life-threatening injuries to persons reported. If an allision incident were to occur, project vessels may assist under obligation of SOLAS (IMO, 1974) and adherence to the ERCoP in liaison with the MCA. Additionally, if pollution occurs as a result of an allision incident, the MPCP would be implemented where appropriate.

If a vessel chooses to transit within the Caledonia South Site, the minimum spacing of 944m between wind farm structures is considered sufficient for safe internal navigation. Furthermore, operational lighting and marking and marking on nautical charts provide mitigation against internal allision risk. Should a WTG with a key navigational light need towed, sufficient alternative lighting will be agreed with the NLB. Any vessel planning to transit through the Caledonia South Site is expected to passage plan in advance in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information including through ongoing liaison with fishing fleets via an appointed FLO will seek to ensure that such vessels have good awareness of Caledonia South. Locations of relevant infrastructure will be provided in the weekly notices distributed during the construction phase as per the Outline FMMS (Volume 7, Appendix 18).

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. As noted in the equivalent construction phase hazard, from previous studies of offshore wind developments, it has been concluded that WTGs do reduce wind velocity downwind of a WTG (MCA, 2022) 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 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.

Relevant embedded mitigation measures include application for safety zones, DSLP approval, adherence to an LMP, marking on nautical charts, promulgation of information, adherence to an ERCoP, adherence to an MPCP, appointment of a FLO and adherence to an FMMS.

20.2.4.3.2 Frequency of Occurrence

The frequency of occurrence of internal vessel to structure allision risk during the O&M phase is considered to be **Remote**.

20.2.4.3.3 Severity of Consequence

The severity of consequence of internal vessel to structure allision risk during the O&M phase is considered to be **Moderate**.

20.2.4.3.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during O&M of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and ALARP and Not Significant in EIA terms.**

20.2.5 Reduced Access to Local Ports

20.2.5.1 Qualification of Risk

Up to 938 vessel movements annually by O&M vessels may be made throughout the O&M phase, which will include vessels which are RAM. Project vessels will be managed by marine coordination, including the use of traffic management procedures such as the designation of entry and exit points to and from the Caledonia South Site, and designated routes to and from the base port. Project vessels will also carry AIS and be compliant with flag state regulations including the COLREGs (IMO 1972/77).

As discussed in the baseline description and equivalent construction phase hazard, the closest port or harbours are Banff and Macduff Harbours which are located approximately 20nm to the south. Given the relative distance to ports in the area and the anticipated deviations for the main commercial routes, it is not anticipated that there will be any substantial effect on vessel approaches to and from the local ports beyond the deviations already outlined for hazards on vessel displacement.

For offshore export cable O&M activity, there is a greater risk given the proximity to Whitehills Harbour and Marina which is located approximately 0.37nm (682m) southeast of the Caledonia South OECC. Recreational vessels may be particularly sensitive given that the RYA Scotland has indicated that Whitehills Marina is a key stopping point for vessels travelling north as well as along the northeast coast. No concerns were raised over access to ports during the O&M phase in relation to the Caledonia South Site nor the offshore export cables. Additionally, offshore export cable maintenance activities will likely be very infrequent, short-term in duration and localised at any given time, thus any reduced access will likely be minor and temporary (and less than during construction).

The most likely consequences are increased journey times and distances, as per the vessel displacement hazard. There is only one pilot boarding station nearby, at Macduff, where the service is not compulsory. Thus, no effect is anticipated on port related services such as pilotage.

Relevant embedded mitigation measures includes adherence to an LMP, adherence to a VMP, marine coordination of project vessels, marking on nautical charts, and promulgation of information.

20.2.5.2 Frequency of Occurrence

The frequency of the risk of reduced access to local ports during the O&M phase is considered to be **Remote**.

20.2.5.3 Severity of Consequence

The severity of consequence of the risk of reduced access to local ports during the O&M phase is considered to be **Minor**.

20.2.5.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as minor, the overall effect of reduced port access during O&M of Caledonia South is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

20.2.6 Reduction of Under Keel Clearance

The presence of subsea cable protection, dynamic inter-array cables and mooring lines may reduce under keel clearance during the O&M phase of Caledonia South.

20.2.6.1 Subsea Cable Protection

20.2.6.1.1 Qualification of Risk

Reduced water depth due to the presence of subsea infrastructure will lead to a reduction in under keel clearance. The target burial depth for all subsea cables is 1m, noting actual burial depth will be determined via the CBRA process which will be undertaken post consent.

Where burial is not feasible, cable protection may be used instead, which again will be determined by the CBRA. In line with MGN 654, any reduction in water depth which exceeds 5% will be discussed with the MCA to determine if additional mitigation is necessary. This aligns with the RYA's recommendation that the "minimum safe under keel clearance over submerged structures and associated infrastructure should be determined in accordance with the methodology set out in MGN 543 [since superseded by MGN 654]" (RYA, 2019).

Given that depths within the Caledonia South Site range between 52m to 82m, it is not anticipated that subsea cable protection will reduce water depths over the 5% threshold. In terms of the offshore export cables, a water depth reduction of over 5% is possible in nearshore areas if cable protection is required. The vessel traffic data shows the majority of vessels operating near the Landfall Site tend to be recreational and fishing vessels which are generally smaller in size and have reduced draughts compared to larger commercial vessels. As discussed in the equivalent construction phase hazard, no specific concerns from stakeholders were raised during consultation including the Hazard Workshop, with MGN 654 compliance considered suitable to manage the impact.

In the event of an underwater allision, the most likely consequence is minor damage. The unlikely worst-case consequence may be vessel foundering resulting in PLL and pollution. Implementation of the MPCP will mitigate against pollution, whilst adherence to an ERCoP as well as operating under the obligations of SOLAS (IMO, 1974) will mitigate against the risk of PLL.

20.2.6.1.2 Frequency of Occurrence

The frequency of occurrence of the risk of reduced under keel clearance due to the presence of subsea cables during O&M is considered **Extremely Unlikely**.

20.2.6.1.3 Severity of Consequence

The severity of consequence of the risk of reduced under keel clearance due to the presence of subsea cables during O&M is considered to be **Moderate**.

20.2.6.1.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of reduced under keel clearance due to subsea cables during O&M of Caledonia South is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

20.2.6.2 Dynamic Inter-array Cables and Mooring Lines

20.2.6.2.1 Qualification of Risk

The presence of inter-array cables and mooring lines associated with floating substructures of Caledonia South may reduce under keel clearance during the O&M phase of Caledonia South.

There may be up to six mooring lines per floating WTG used to secure the substructures to the seabed. The highest risk areas will be the immediate vicinity of the floating substructures where mooring lines and inter-array cables will be closest to the surface.

As previously noted, it is likely that commercial vessels will not enter the Caledonia South Site. Moreover, experience indicates that commercial vessels frequently pass 1nm or more away from established developments. On this basis, taking into consideration the baseline and anticipated post wind farm vessel routeing, it is considered highly unlikely that a commercial vessel would pass within the Caledonia South Site, in particular in sufficiently close proximity to the floating substructures for an under keel interaction to arise.

As discussed in relation to the equivalent construction phase hazard, fishing and recreational vessels are more likely to transit in proximity to the Caledonia South Site compared to commercial vessels. However these vessels are smaller and tend to have lower draughts. Consultation input, including at the Hazard Workshop, was that fishing and recreational vessels would likely avoid any floating WTGs.

The mooring lines and inter-array cables will be appropriately marked on nautical charts and other electronic charts as appropriate to increase awareness. It was raised at the Hazard Workshop that making the locations of mooring lines and dynamic cables available to fishing vessels was a key mitigation. Locations of relevant infrastructure will be provided in the weekly notices distributed during the construction phase as per the Outline FMMS (Volume 7, Appendix 18).

As discussed in the equivalent construction phase hazard, it will be necessary to confirm available under keel clearance from the mooring lines post installation, in particular if taut 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 floating offshore wind projects in UK waters; however, to date there have been no reported under keel interactions between passing vessels and the components associated with such projects.

The most likely consequences of reduced under keel clearance due to inter-array cables and mooring lines is that a vessel transits over an area of reduced clearance but does not make contact.

Should an underwater allision occur, minor damage incurred is the most likely consequence, with foundering or grounding of the vessel resulting in PLL and pollution as an unlikely worst-case. Should pollution occur, the MPCP will be implemented, with adherence to the ERCoP in the case of risk of PLL, as well as under SOLAS (IMO, 1974) obligations.

Other relevant embedded mitigation measures include promulgation of information and any potential under keel interaction risk, including via the FLO. The locations of the floating substructures will 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.

20.2.6.2.2 Frequency of Occurrence

The frequency of occurrence in relation to reduction of under keel clearance as a result of inter-array cables and mooring lines during the O&M phase is considered **Extremely Unlikely**.

20.2.6.2.3 Severity of Consequence

The severity of consequence in relation to reduction of under keel clearance as a result of inter-array cables and mooring lines during the O&M phase is considered **Serious**.

20.2.6.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced under keel clearance due to inter-array cables and mooring lines during O&M of Caledonia South is considered to be tolerable.

Assuming the confirmation of available under keel clearance in agreement with MCA and NLB post installation, and the implementation of ensuring locations of subsea infrastructure are made available to fishing vessels including via FLO liaison as secured by the Outline FMMS (Volume 7, Appendix 18) the hazard is considered **Tolerable with mitigation and ALARP and therefore Not Significant in EIA terms.**

20.2.7 Anchor Interaction with Subsea Cables and Mooring Lines

The presence of subsea cables and mooring lines within the Caledonia South Site and Caledonia South OECC may increase the risk of anchor interaction.

20.2.7.1 Qualification of Risk

The spatial extent of the hazard is small given that a vessel must be in close proximity to an offshore export cable, inter-array cable or mooring line for an interaction to occur.

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

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

Although the second of these scenarios may involve limited decision-making time if drifting towards a hazard, in all three scenarios it is anticipated that the charting of infrastructure including the subsea cables and mooring lines will inform the decision to anchor, as per Regulation 34 of SOLAS (IMO, 1974).

No anchored vessels were observed within the study area for the during the survey periods or long-term vessel traffic data. Risk of interaction with an inter-array cable, interconnector cable, or mooring line on a planned anchoring or dragged anchoring basis is therefore anticipated to be extremely low. In terms of emergency anchoring, any areas of high traffic volume are likely to represent the areas of highest risk, particularly where there are hazards nearby (for example, structures, rocks, shallows). However; given the open sea room in proximity to the Caledonia South Site and water depths the likelihood of this scenario arising is very low. The majority of traffic is also anticipated to pass offshore of the Caledonia South Site, away from where the inter-array cables, interconnector cable and mooring lines associated with Caledonia South are located.

The likelihood of anchor interaction with a subsea cable is further minimised by the burial of the cables and use of external cable protection where required, which will be informed by the CBRA process, noting this will account for traffic volumes and sizes. General consensus of the Hazard Workshop was that floating subsea infrastructure including mooring lines and dynamic cables would be avoided by vessels in transit, and therefore frequency of any anchoring in proximity is also likely to be low.

In terms of the offshore export cables, Macduff anchorage sits within the OECC study area adjacent to the Caledonia South OECC. The volumes and sizes of vessels using this anchorage will be considered within the CBRA process, to ensure the cables are suitably buried and/or protected, noting promulgation of information and marking on nautical charts will further mitigate the risk. Additionally, it is likely that anchoring undertaken in Macduff anchorage will be planned, thus it is anticipated that mariners will take into account the presence of the export cables via nautical charts before dropping anchor. With good practice, it is considered unlikely that an anchor interaction would occur. Final cable routeing within the Caledonia South OECC will be defined within the CaP which will be approved by MD-LOT in consultation with the MCA.

Should an anchor interaction occur, the most likely consequence is no damage to the cable or anchor, based on previous anchor interaction incidents. As an unlikely worst-case consequence, a snagging incident could occur and the vessel's anchor as well as the cable could be damaged, resulting in a loss of stability noting this would only occur for a smaller vessel which would be less likely to penetrate deeper into the seabed than a larger vessel.

Relevant embedded mitigation measures include promulgation of information, marking on nautical charts, adherence to a CBRA, development of and adherence to a CaP and vessel compliance with MGN 654 (MCA, 2021).

20.2.7.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of anchor interaction with subsea cables and mooring lines during O&M is considered to be **Extremely Unlikely**.

20.2.7.3 Severity of Consequence

The severity of consequence relating to the risk of anchor interaction with subsea cables and mooring lines during O&M is considered to be **Moderate**.

20.2.7.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of anchor interaction with subsea cables and mooring lines during O&M of Caledonia South is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

20.2.8 Loss of Station

The floating substructures may suffer loss of station in the event that the mooring system fails, or there is damage to tow during WTG towage for maintenance. This may become a floating hazard to passing vessels. This hazard is only relevant to the floating WTGs within the Caledonia South Site, and thus there will be no risk of this hazard from the Caledonia South OECC.

20.2.8.1 Qualification of Risk

During the O&M phase, towage of WTGs to and from site for maintenance will be subject to a dedicated risk assessment at the time of the towage operation when full specifications relating to the operations is available. This will be outlined in the VMP. It is anticipated that a maximum of 938 vessel movements per year will be carried out for WTG towage to port. This dedicated risk assessment should cover all elements of the towage operation including in port approaches and internally within the Caledonia South Site. Where possible, towage of WTGs will be avoided, with infield maintenance being the preferred method. During the tow, all vessels involved will be lit and marked as required under COLREGs (IMO, 1972/1977).

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

The Regulatory Expectations also require the provision of continuous monitoring either by GPS or other suitable means. Each WTG should 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, which will depend upon the design of the substructure and any predefined emergency response protocols.

On the basis of compliance with the Regulatory Expectations, 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 (each WTG will have a minimum of six), which is more likely to occur in extreme storm conditions, during which it is unlikely vessels will be navigating within proximity to the WTGs.

Relevant embedded mitigation measures include compliance with regulatory expectations on moorings for floating wind and marine devices (HSE and MCA, 2017) and MGN 654, adherence to a DSLP, promulgation of information, adherence to an ERCoP, compliance with international regulations (SOLAS; IMO, 1974), appropriate marking of the structures and adherence to an LMP.

20.2.8.2 Frequency of Occurrence

The frequency of occurrence relating to loss of station during the O&M phase is considered to be **Extremely Unlikely**.

20.2.8.3 Severity of Consequence

The severity of consequence relating to loss of station during the O&M phase is considered to be **Moderate**.

20.2.8.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of loss of station during the O&M of Caledonia South is considered to be **Broadly Acceptable and ALARP, and therefore Not Significant in EIA terms.**

20.2.9 Reduction of SAR Capabilities

The presence of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the O&M phase of Caledonia South by increasing the number of incidents, increasing consequences or reducing access for the responders.

20.2.9.1 Qualification of Risk

The spatial extent of this hazard is large given the area covered by the Caledonia South Site (60nm^2), as well as the distance covered by air-based SAR support (the SAR helicopter base is located at Inverness, 66nm southwest of the Caledonia South Site). It is unlikely that a SAR operation will require the entirety of the Caledonia South Site to be searched, and it is probable that a search will be restricted to a smaller area in which a casualty is known to be located (accounting for assumptions on any potential drift of the casualty).

Up to 938 vessel movements annually may be made by O&M vessels during the lifetime of Caledonia South. It is assumed that O&M vessels will be on-site throughout the majority of the O&M phase, although severe weather may lead to vessels being withdrawn. The presence of these vessels increase the likelihood of an incident and subsequently increases the likelihood of multiple incidents occurring simultaneously, diminishing emergency response capability. However, they may also be able to provide additional response resource in the event of an incident in liaison with the MCA.

The most likely consequence to occur would be a delay to any emergency response request. As an unlikely worst-case, this could result in a failure of emergency response to an incident resulting in PLL and pollution. However, project vessels will be managed via marine coordination and comply with flag state regulations which will minimise this risk. Additionally, the presence of project vessels themselves may mitigate this risk as they may self-help at incidents involving other project vessels under the obligation of SOLAS (IMO, 1974) and adherence to an ERCoP, noting this would be undertaken with liaison with the MCA. The MPCP will also be implemented should pollution occur.

As discussed in the equivalent construction phase hazard, the frequency of SAR helicopter operations in proximity to Caledonia South is one per year, with no SAR helicopter incidents occurring within the Caledonia South Site. The frequency of incidents in proximity to the Caledonia South Site is not anticipated to increase significantly from the current level given the measures noted above which will be in place. The layout will be agreed with the MCA and in line with MGN 654 requirements to ensure any SAR operations that do occur within the Caledonia South Site are facilitated. A SAR checklist will also be completed and agreed with the MCA.

Relevant embedded mitigation measures include DSLP approval, promulgation of information, adherence to an LMP, marking on appropriate charts, marine coordination of project vessels, adherence to an ERCoP, adherence to an MPCP, adherence to a VMP and NSP, and compliance with MGN 654 and international marine regulations.

20.2.9.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of reduced emergency response capabilities during the O&M phase is considered to be **Extremely Unlikely.**

20.2.9.3 Severity of Consequence

The severity of consequence relating to the risk of reduced emergency response capabilities during the O&M phase is considered to be **Serious**.

20.2.9.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during O&M of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.3 Decommissioning Phase

20.3.1 Vessel Displacement

Decommissioning activities associated with Caledonia South may displace existing vessel routes or activity, which may be more prevalent during periods of adverse weather.

These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

20.3.1.1 Vessel Displacement

20.3.1.1.1 Qualification of Risk

Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, this hazard is expected to be similar in nature to the equivalent construction stage hazard. It is noted that in the case of subsea cables sections may be left *in situ* to avoid unnecessarily disturbing the seabed. This would be confirmed through consultation and assessment to ensure the most suitable approach was taken. But for the purposes of this assessment (as a worst-case) it has been assumed that all subsea cables will be removed during decommissioning with only cable protection left *in situ*.

The use of a buoyed decommissioning area analogous to the buoyed construction area is assumed and will result in similar main route deviations to those established for the equivalent construction stage hazard. By the time of decommissioning, deviations will be well established, with vessels likely to continue on their typical routeing around the buoyed decommissioning area.

Relevant embedded mitigation measures would be as per the respective construction phase.

20.3.1.1.2 Frequency of Occurrence

The frequency of occurrence in relation to displacement of vessel traffic during the decommissioning phase is considered **Frequent**.

20.3.1.1.3 Severity of Consequence

The severity of consequence in relation to displacement of vessel traffic during the decommissioning phase is considered **Negligible**.

20.3.1.1.4 Significance of Effect

Taking the frequency of occurrence as frequent and the severity of consequence as negligible, the overall effect of vessel displacement during decommissioning of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.3.1.2 Vessel Displacement During Adverse Weather

20.3.1.2.1 Qualification of Risk

As discussed within the equivalent construction phase hazard, adverse weather can severely affect a vessels journey, with the impact of this dependent on various factors including specific vessel parameters such as hull geometry or vessel size.

As discussed in relation to the equivalent construction phase hazard, it is likely that no commercial vessels would choose to make transit through the buoyed decommissioning area during adverse weather conditions. Larger deviations may be required than during more favourable conditions, however there is considered to be sufficient sea room to safely accommodate the chosen transits.

The long term vessel traffic data studied in Appendix E showed the presence of transits within the Caledonia South Site undertaken by Serco NorthLink Ferries, further inshore of their typical routeing. Consultation with Serco NorthLink Ferries confirmed these transits were utilised during adverse weather conditions. The presence of the buoyed decommissioning area may therefore impact Serco NorthLink adverse weather transits, with the potential for delays in sailings, a large deviation inshore of the Moray Firth OWFs, or sailing cancellation. However, as each historical transit is based upon individual Master decisions based upon the conditions and factors on the day, Serco NorthLink have confirmed that the impact cannot be quantified (i.e., it cannot be confirmed whether any given historical transit would have been delayed, deviated or cancelled).

The Applicant engaged with Serco NorthLink ferries throughout the NRA process, and this engagement culminated in the Applicant proposing a SEZ on the eastern boundary of the Caledonia South Site within which no surface piercing infrastructure will be placed for the purposes of increasing searoom and optionality for Serco NorthLink ferries in adverse weather conditions. The SEZ was proposed to Serco NorthLink via a meeting on 12th August 2024. Feedback received was that the SEZ and associated increase in searoom would be a significant positive for NorthLink adverse weather routeing, and also shipping and navigation in general.

There may still be works undertaken within the SEZ (e.g., associated with cables), however any such impact would be temporary in nature and spatially limited to the area around the operation. The placement of the buoyed decommissioning area will be agreed with NLB to ensure any impacts to shipping and navigation are managed.

From a navigational safety perspective, worst case consequences are an increase in delays, deviations or cancellation; however, based upon Serco NorthLink feedback, it is considered that the implementation of the SEZ reduces the risk to ALARP parameters noting frequency of the hazard is reduced. Socioeconomic impacts are assessed in Volume 6, Chapter 2: Socioeconomics, Tourism and Recreation of the EIAR.

20.3.1.2.2 Frequency of Occurrence

The frequency of occurrence relating to vessel displacement during periods of adverse weather during decommissioning is considered to be **Remote**.

20.3.1.2.3 Severity of Consequence

The severity of consequence relating to vessel displacement during periods of adverse weather during decommissioning is considered to be **Serious**.

20.3.1.2.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as serious, the overall effect of adverse weather during decommissioning of Caledonia South is considered to be tolerable.

Assuming the implementation of the SEZ, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.3.2 Increased Third Party Vessel to Vessel Collision Risk

20.3.2.1 Qualification of Risk

This hazard is expected to be similar in nature to the equivalent construction phase hazard. As above, it is noted that in the case of subsea cables sections may be left *in situ* to avoid unnecessarily disturbing the seabed. This would be confirmed through consultation and assessment to ensure the most suitable approach was taken. But for the purposes of this assessment it has been assumed that all subsea cables will be removed during decommissioning with only cable protection left *in situ*.

The use of a buoyed decommissioning area analogous to the buoyed construction area is assumed and will result in a similar collision risk to that established for the equivalent construction phase hazard. The same assumptions in terms of frequency and consequence apply.

Relevant embedded mitigation measures would be as per the respective construction phase.

20.3.2.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between third party vessels during the decommissioning phase is **Extremely Unlikely**.

20.3.2.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between third party vessels during the decommissioning phase is considered **Serious**.

20.3.2.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of third party vessel to vessel collision risk during decommissioning of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.3.3 Increased Third Party Vessel to Project Vessel Collision Risk

The presence of vessels associated with decommissioning activities of Caledonia South may increase encounters and thus collision risk for vessels already operating in the area.

20.3.3.1 Qualification of Risk

Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, including the vessels involved, this hazard is expected to be similar in nature to the equivalent construction phase, including the number of vessel movements by decommissioning vessels. It is noted that in the case of subsea cables it is expected that they will be left *in situ* but for the purposes of this assessment (as a worst-case) it has been assumed that all cables will be removed during decommissioning, with only cable protection left *in situ*.

On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

20.3.3.2 Frequency of Occurrence

The frequency of occurrence in relation to encounters and collision risk between project vessels and third party vessels during the decommissioning phase is considered to be **Extremely Unlikely**.

20.3.3.3 Severity of Consequence

The severity of consequence in relation to encounters and collision risk between project vessels and third party vessels during the decommissioning phase is considered to be **Serious**.

20.3.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of encounters and collision risk between project vessels and third party vessels during decommissioning of Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.3.4 Vessel to Structure Allision Risk

Presence of structures (including partially removed) during decommissioning will lead to creation of powered, drifting and internal allision risk for vessels.

20.3.4.1 Powered Allision Risk

20.3.4.1.1 Qualification and Quantification of Risk

It is likely that powered allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

20.3.4.1.2 Frequency of Occurrence

The frequency of occurrence in relation to powered vessel to structure allision risk during the decommissioning phase is considered to be **Extremely Unlikely**.

20.3.4.1.3 Severity of Consequence

The severity of consequence in relation to powered vessel to structure allision risk during the decommissioning phase is considered to be **Moderate**.

20.3.4.2 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during decommissioning of Caledonia South is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

20.3.4.3 Drifting Allision Risk

20.3.4.3.1 Qualification and Quantification of Risk

It is likely that drifting allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

20.3.4.3.2 Frequency of Occurrence

The frequency of occurrence in relation to drifting vessel to structure allision risk during the decommissioning phase is considered to be **Extremely Unlikely**.

20.3.4.3.3 Severity of Consequence

The severity of consequence in relation to drifting vessel to structure allision risk during the decommissioning phase is considered to be **Moderate**.

20.3.4.3.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during decommissioning of Caledonia South is considered to be broadly acceptable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable and Not Significant in EIA terms.**

20.3.4.4 Internal Allision Risk

20.3.4.4.1 Qualification and Quantification of Risk

It is likely that internal allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

20.3.4.4.2 Frequency of Occurrence

The frequency of occurrence of internal vessel to structure allision risk during the decommissioning phase is considered to be **Remote.**

20.3.4.4.3 Severity of Consequence

The severity of consequence of internal vessel to structure allision risk during the decommissioning phase is considered to be **Moderate**.

20.3.4.4.4 Significance of Effect

Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during decommissioning of the Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

20.3.5 Reduced Access to Local Ports

20.3.5.1 Qualification of Risk

Decommissioning activities associated with the removal of structures and cables may displace existing routes/activity restricting access to ports/harbours.

Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, this hazard is expected to be similar in nature to the equivalent construction phase, including the number of vessel movements by decommissioning vessels. It is noted that in the case of subsea cables it is expected that they will be left *in situ* but for the purposes of this assessment (as a worst-case) it has been assumed that all cables will be removed during decommissioning, with only cable protection will be left *in situ*.

As with the construction stage, it is not yet known from which port(s) decommissioning activity will be based for the Caledonia South.

On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

20.3.5.2 Frequency of Occurrence

The frequency of the risk of reduced access to local ports during the decommissioning phase is considered to be **Reasonably Probable**.

20.3.5.3 Severity of Consequence

The severity of consequence of the risk of reduced access to local ports during the decommissioning phase is considered to be **Minor**.

20.3.5.4 Significance of Effect

Taking the frequency of occurrence as reasonably probable and the severity of consequence as minor, the overall effect of reduced port access during decommissioning of Caledonia South is considered to be tolerable.

Assuming liaison with the Whitehills, Banff, and Macduff harbour authorities in advance of and during decommissioning, the hazard is considered ALARP. The hazard is therefore **Tolerable and Not Significant in EIA terms**.

20.3.6 Loss of Station

As per the construction phase, the floating substructures may suffer loss of station in the event that the mooring system fails, or there is damage to tow during WTG towage during decommissioning. This may become a floating hazard to passing vessels. This hazard is only relevant to the floating WTGs within the Caledonia South Site, and thus there will be no risk of this hazard from the Caledonia South OECC.

20.3.6.1 Qualification of Risk

Given that the process of removing floating WTGs is likely to be similar to the reverse of WTG installation in terms of vessel numbers, vessel movements, and duration of the decommissioning phase, the risk of loss of station during the decommissioning phase is likely to be as described in the equivalent construction phase hazard. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

20.3.6.2 Frequency of Occurrence

The frequency of occurrence relating to loss of station during the decommissioning phase is considered to be **Extremely Unlikely**.

20.3.6.3 Severity of Consequence

The severity of consequence relating to loss of station during the decommissioning phase is considered to be **Moderate**.

20.3.6.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of loss of station during the decommissioning phase of Caledonia South is considered to be **Broadly Acceptable and ALARP, and therefore Not Significant in EIA terms.**

20.3.7 Reduction of SAR Capabilities

The removal of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the decommissioning phase of Caledonia South by increasing the number of incidents, increasing consequences or reducing access for the responders.

20.3.7.1 Qualification of Risk

Given that removal of structures is likely to be similar to installation in terms of vessel numbers and duration, the risk is likely to be as described in the equivalent construction phase hazard. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

20.3.7.2 Frequency of Occurrence

The frequency of occurrence relating to the risk of reduced emergency response capabilities during the decommissioning phase is considered to be **Extremely Unlikely**.

20.3.7.3 Severity of Consequence

The severity of consequence relating to the risk of reduced emergency response capabilities during the decommissioning phase is considered to be **Serious**.

20.3.7.4 Significance of Effect

Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during decommissioning of the Caledonia South is considered to be tolerable.

The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable and Not Significant in EIA terms.**

21 Cumulative Risk Assessment – Caledonia OWF

21.1 Vessel Displacement and Increased Third Party Vessel to Vessel Collision Risk

21.1.1 Vessel Displacement

Based on the cumulative assessment of vessel routeing undertaken, three routes are expected to deviate on a cumulative basis, namely Routes 1, 3 and 10.

It is anticipated that Routes 1 and 3 will pass further northeast of both Salamander OWF and the Caledonia OWF, leading to a distance increase of approximately 1.6nm. There is considered to be sufficient sea room available to safely accommodate these deviations if necessary, noting that Salamander OWF is located in excess of 43nm southeast of the Caledonia OWF.

Route 10 is expected to pass further west of Stromar OWF, closer to the Caledonia OWF, and lead to journey increases of approximately 0.6nm. In this case, there is also sufficient sea room to accommodate for a shift in traffic without the need to deviate around the Caledonia OWF. This aligns with input provided during the Hazard Workshop, which indicated that the sea room between the Caledonia OWF and other developments was considered sufficient, and is not expected to cause concern.

Taking the frequency of occurrence as **Frequent** and the severity of consequence as **Negligible**, the cumulative effect of vessel displacement is considered to be **Tolerable and ALARP and Not Significant in EIA terms.**

21.1.2 Increased Third Party Vessel to Vessel Collision Risk

In terms of collision risk, given the available sea room to accommodate the deviations and the proximity from the Caledonia OWF, there is not anticipated to be a large change in terms of third party to third party collision. This aligns with input from the Hazard Workshop, where sea room was considered sufficient and no concerns were raised.

Taking the frequency of occurrence as **Negligible** and the severity of consequence as **Serious**, the cumulative effect of third party vessel to vessel collision risk is considered to be **Broadly Acceptable and Not Significant in EIA terms**.

21.2 Increased Third Party Vessel to Project Vessel Collision Risk

There is the potential that the same ports or similarly located ports could be used by cumulative developments in terms of base ports for construction, maintenance vessels, and or decommissioning vessels. On this basis, there may be an overall cumulative increase in project vessel presence within the general area, and as such the potential for increased encounters and collision risk with third party traffic. However, all developers should be establishing appropriate vessel management systems including through marine coordination,

and as such any encounters will be managed, including by COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974).

Taking the frequency of occurrence as **Extremely Unlikely** and the severity of consequence as **Serious**, the cumulative effect of third party vessel to project vessel collision risk is considered to be **Tolerable and Not Significant in EIA terms.**

21.3 Vessel to Structure Allision Risk

The nearest screened in cumulative development is Stromar OWF, located in excess of 11nm northeast of the Caledonia OWF and 21nm northeast of the Caledonia OECC. As discussed in relation to collision risk, input from the Hazard Workshop indicated there was no concern over the sea room available for deviation within a cumulative context. Given this available sea space between the Caledonia OWF and the screened in developments, it is unlikely that vessels will experience increased allision risk beyond the localised risk when passing any given development.

All developments will be required to implement marine lighting and marking in agreement with NLB and in compliance with IALA G1162 (IALA, 2022), meaning the localised risk is managed. Further, all layouts will need to be agreed with the MCA and NLB, with these discussions including consideration of allision risk.

Taking the frequency of occurrence as **Negligible** and the severity of consequence as **Serious**, the cumulative effect of vessel to structure allision risk is considered to be **Broadly Acceptable and Not Significant in EIA terms**.

21.4 Reduced Access to Local Ports

As discussed in relation to collision risk, there is the potential that the same ports or similarly located ports could be used by cumulative developments in terms of base ports for construction, maintenance vessels, and or decommissioning vessels. This increases the number of vessels which may be RAM at any given time as well as generally increasing the number of vessels within an area.

Given the relative distance to ports in the area and the anticipated cumulative deviations for the main commercial routes, it is not anticipated that there will be any substantial effect due to activities associated with cumulative developments beyond the deviations already outlined for hazards relating to vessel displacement. This assumes that the duration and nature of such activities are analogous to that considered for the Proposed Development (Offshore), especially for the areas on approach to the Landfall Site.

In the event of temporal overlap in construction of cumulative developments, it is anticipated that the developments would coordinate activities in liaison with local ports so as to ensure that access constraints are minimised. As is the case for the assessment of the Proposed Development (Offshore) in isolation, promulgation of information to allow mariners to passage plan accordingly is key.

Taking the frequency of occurrence as **Frequent** and the severity of consequence as **Minor**, the cumulative effect of reduced access to ports is considered to be **Tolerable and Not Significant in EIA terms.**

21.5 Reduced SAR Capabilities

Given baseline incident rates, and noting the additional resources that would be available for the Proposed Development (Offshore) and other cumulative developments, 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 OWFs do not occur at a high frequency (see Section 9.6).

Additionally, other developments will also be expected to comply with MGN 654, and provide measures in liaison with the MCA to mitigate the risk of reduced SAR capabilities. This will include agreement of layouts, production of an ERCoP, and a SAR checklist.

Taking the frequency of occurrence as **Extremely Unlikely** and the severity of consequence as **Serious**, the cumulative effect of reduced emergency response capability is considered to be **Tolerable and ALARP and Not Significant in EIA terms**.

22 Cumulative Risk Assessment – Caledonia North

22.1 Vessel Displacement and Increased Third Party Vessel to Vessel Collision Risk

22.1.1 Vessel Displacement

Based on the cumulative assessment of vessel routeing undertaken, three routes are expected to deviate on a cumulative basis, namely Routes 1, 3 and 10.

It is anticipated that Routes 1 and 3 will pass further northeast of both Salamander OWF and the Caledonia North Site, leading to a distance increase of approximately 1.6nm. There is considered to be sufficient sea room available to safely accommodate these deviations if necessary, noting that Salamander OWF is located in excess of 49nm southeast of the Caledonia North Site.

Route 10 is expected to pass further west of Stromar OWF, closer to the Caledonia North Site, and lead to journey increases of approximately 0.6nm. In this case, there is also sufficient sea room to accommodate for a shift in traffic without the need to deviate around the Caledonia North Site. This aligns with input provided during the Hazard Workshop, which indicated that the sea room between the Caledonia North Site and other developments was considered sufficient, and is not expected to cause concern.

Taking the frequency of occurrence as **Frequent** and the severity of consequence as **Negligible**, the cumulative effect of vessel displacement is considered to be **Tolerable and ALARP and Not Significant in EIA terms**.

22.1.2 Increased Third Party Vessel to Vessel Collision Risk

In terms of collision risk, given the available sea room to accommodate the deviations and the proximity from the Caledonia North Site, there is not anticipated to be a large change in terms of third party to third party collision. This aligns with input from the Hazard Workshop, where sea room was considered sufficient and no concerns were raised.

Taking the frequency of occurrence as **Negligible** and the severity of consequence as **Serious**, the cumulative effect of third party vessel to vessel collision risk is considered to be **Broadly Acceptable and Not Significant in EIA terms.**

22.2 Increased Third Party Vessel to Project Vessel Collision Risk

There is the potential that the same ports or similarly located ports could be used by cumulative developments in terms of base ports for construction, maintenance vessels, and or decommissioning vessels. On this basis, there may be an overall cumulative increase in project vessel presence within the general area, and as such the potential for increased encounters and collision risk with third party traffic. However, all developers should be establishing appropriate vessel management systems including through marine coordination,

and as such any encounters will be managed, including by COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974).

Taking the frequency of occurrence as **Extremely Unlikely** and the severity of consequence as **Serious**, the cumulative effect of third party vessel to project vessel collision risk is considered to be **Tolerable and Not Significant in EIA terms.**

22.3 Vessel to Structure Allision Risk

The nearest screened in cumulative development is Stromar OWF, located in excess of 11nm northeast of the Caledonia North Site and the Caledonia North OECC. As discussed in relation to collision risk, input from the Hazard Workshop indicated there was no concern over the sea room available for deviation within a cumulative context. Given this available sea space between the Caledonia North Site and the screened in developments, it is unlikely that vessels will experience increased allision risk beyond the localised risk when passing any given development.

All developments will be required to implement marine lighting and marking in agreement with NLB and in compliance with IALA G1162 (IALA, 2022), meaning the localised risk is managed. Further, all layouts will need to be agreed with the MCA and NLB, with these discussions including consideration of allision risk.

Taking the frequency of occurrence as **Negligible** and the severity of consequence as **Serious**, the cumulative effect of vessel to structure allision risk is considered to be **Broadly Acceptable and Not Significant in EIA terms.**

22.4 Reduced Access to Local Ports

As discussed in relation to collision risk, there is the potential that the same ports or similarly located ports could be used by cumulative developments in terms of base ports for construction, maintenance vessels, and or decommissioning vessels. This increases the number of vessels which may be RAM at any given time as well as generally increasing the number of vessels within an area.

Given the relative distance to ports in the area and the anticipated cumulative deviations for the main commercial routes, it is not anticipated that there will be any substantial effect due to activities associated with cumulative developments beyond the deviations already outlined for hazards relating to vessel displacement. This assumes that the duration and nature of such activities are analogous to that considered for Caledonia North, especially for the areas on approach to the Landfall Site.

In the event of temporal overlap in construction of cumulative developments, it is anticipated that the developments would coordinate activities in liaison with local ports so as to ensure that access constraints are minimised. As is the case for the assessment of Caledonia North in isolation, promulgation of information to allow mariners to passage plan accordingly is key.

Taking the frequency of occurrence as **Frequent** and the severity of consequence as **Minor**, the cumulative effect of reduced access to ports is considered to be **Tolerable and Not Significant in EIA terms.**

22.5 Reduced SAR Capabilities

Given baseline incident rates, and noting the additional resources that would be available for Caledonia North and other cumulative developments, 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 OWFs do not occur at a high frequency (further details are provided in the NRA).

Additionally, other developments will also be expected to comply with MGN 654, and provide measures in liaison with the MCA to mitigate the risk of reduced SAR capabilities. This will include agreement of layouts, production of an ERCoP, and a SAR checklist.

Taking the frequency of occurrence as **Extremely Unlikely** and the severity of consequence as **Serious**, the cumulative effect of reduced emergency response capability is considered to be **Tolerable and ALARP and Not Significant in EIA terms**.

23 Cumulative Risk Assessment – Caledonia South

23.1 Vessel Displacement and Increased Third Party Vessel to Vessel Collision Risk

23.1.1 Vessel Displacement

Based on the cumulative assessment of vessel routeing undertaken, three routes are expected to deviate on a cumulative basis, namely Routes 1, 3 and 10.

It is anticipated that Routes 1 and 3 will pass further northeast of both Salamander OWF and the Caledonia South Site, leading to a distance increase of approximately 1.6nm. There is considered to be sufficient sea room available to safely accommodate these deviations if necessary, noting that Salamander OWF is located in excess of 43nm southeast of the Caledonia South Site.

Route 10 is expected to pass further west of Stromar OWF, closer to the Caledonia South Site, and lead to journey increases of approximately 0.6nm. In this case, there is also sufficient sea room to accommodate for a shift in traffic without the need to deviate around the Caledonia South Site. This aligns with input provided during the Hazard Workshop, which indicated that the sea room between the Caledonia South Site and other developments was considered sufficient, and is not expected to cause concern.

Taking the frequency of occurrence as **Frequent** and the severity of consequence as **Negligible**, the cumulative effect of vessel displacement is considered to be **Tolerable and ALARP and Not Significant in EIA terms.**

23.1.2 Increased Third Party Vessel to Vessel Collision Risk

In terms of collision risk, given the available sea room to accommodate the deviations and the proximity from the Caledonia South Site, there is not anticipated to be a large change in terms of third party to third party collision. This aligns with input from the Hazard Workshop, where sea room was considered sufficient and no concerns were raised.

Taking the frequency of occurrence as **Negligible** and the severity of consequence as **Serious**, the cumulative effect of third party vessel to vessel collision risk is considered to be **Broadly Acceptable and Not Significant in EIA terms.**

23.2 Increased Third Party Vessel to Project Vessel Collision Risk

There is the potential that the same ports or similarly located ports could be used by cumulative developments in terms of base ports for construction, maintenance vessels, and or decommissioning vessels. On this basis, there may be an overall cumulative increase in project vessel presence within the general area, and as such the potential for increased encounters and collision risk with third party traffic. However, all developers should be establishing appropriate vessel management systems including through marine coordination,

and as such any encounters will be managed, including by COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974).

Taking the frequency of occurrence as **Extremely Unlikely** and the severity of consequence as **Serious**, the cumulative effect of third party vessel to project vessel collision risk is considered to be **Tolerable and not significant in EIA terms**.

23.3 Vessel to Structure Allision Risk

The nearest screened in cumulative development is Stromar OWF, located in excess of 12nm northeast of the Caledonia South Site and 21nm northeast of the Caledonia South OECC. As discussed in relation to collision risk, input from the Hazard Workshop indicated there was no concern over the sea room available for deviation within a cumulative context. Given this available sea space between the Caledonia South Site and the screened in developments, it is unlikely that vessels will experience increased allision risk beyond the localised risk when passing any given development.

All developments will be required to implement marine lighting and marking in agreement with NLB and in compliance with IALA G1162 (IALA, 2022), meaning the localised risk is managed. Further, all layouts will need to be agreed with the MCA and NLB, with these discussions including consideration of allision risk.

Taking the frequency of occurrence as **Negligible** and the severity of consequence as **Serious**, the cumulative effect of vessel to structure allision risk is considered to be **Broadly Acceptable and Not Significant in EIA terms.**

23.4 Reduced Access to Local Ports

As discussed in relation to collision risk, there is the potential that the same ports or similarly located ports could be used by cumulative developments in terms of base ports for construction, maintenance vessels, and or decommissioning vessels. This increases the number of vessels which may be RAM at any given time as well as generally increasing the number of vessels within an area.

Given the relative distance to ports in the area and the anticipated cumulative deviations for the main commercial routes, it is not anticipated that there will be any substantial effect due to activities associated with cumulative developments beyond the deviations already outlined for hazards relating to vessel displacement. This assumes that the duration and nature of such activities are analogous to that considered for Caledonia South, especially for the areas on approach to the Landfall Site.

In the event of temporal overlap in construction of cumulative developments, it is anticipated that the developments would coordinate activities in liaison with local ports so as to ensure that access constraints are minimised. As is the case for the assessment of Caledonia South in isolation, promulgation of information to allow mariners to passage plan accordingly is key.

Taking the frequency of occurrence as **Frequent** and the severity of consequence as **Minor**, the cumulative effect of reduced access to ports is considered to be **Tolerable and Not Significant in EIA terms.**

23.5 Reduced SAR Capabilities

Given baseline incident rates, and noting the additional resources that would be available for Caledonia South and other cumulative developments, 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 OWFs do not occur at a high frequency (further details are provided in Section 9.6).

Additionally, other developments will also be expected to comply with MGN 654, and provide measures in liaison with the MCA to mitigate the risk of reduced SAR capabilities. This will include agreement of layouts, production of an ERCoP, and a SAR checklist.

Taking the frequency of occurrence as **Extremely Unlikely** and the severity of consequence as **Serious**, the cumulative effect of reduced emergency response capability is considered to be **Tolerable and ALARP and Not Significant in EIA terms.**

24 Risk Control Log

24.1 Caledonia OWF

Table 24.1 presents a summary of the risk assessment of shipping and navigation hazards associated with Caledonia OWF. This includes (per hazard) the proposed embedded mitigation measures, frequency of occurrence, severity of consequence, and resulting significance of risk.

Any additional mitigation measures proposed are then listed per hazard alongside the residual risk.

Table 24.1 Risk Control Log – Caledonia OWF

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel Displacement	Construction	DSLP approval, adherence to LMP and NSP, marking on nautical charts, promulgation of information.	Frequent	Negligible	Tolerable	N/A	Tolerable and ALARP
	O&M		Frequent	Negligible	Tolerable		Tolerable and ALARP
	Decommissioning		Frequent	Negligible	Tolerable		Tolerable and ALARP
	Cumulative		Frequent	Negligible	Tolerable		Tolerable and ALARP
Vessel Displacement During Adverse Weather	Construction	Adherence to LMP	Remote	Serious	Tolerable	Implementation of SEZ	Tolerable with mitigation, and ALARP
	O&M		Remote	Serious	Tolerable		Tolerable with mitigation, and ALARP
	Decommissioning		Remote	Serious	Tolerable		Tolerable with mitigation, and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Increased Third Party Vessel to Vessel Collision Risk	Construction	Marking on nautical charts, clear buoyage, promulgation of information, DSLP approval, adherence to LMP, MPCP, and ERCoP.	Extremely Unlikely	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Decommissioning		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Cumulative		Negligible	Serious	Broadly Acceptable		Broadly acceptable, not significant
Increased Third Party Vessel to Project Vessel Collision Risk	Construction	Application for safety zones, buoyed construction/decommissioning areas, guard vessels, DSLP approval, promulgation of information, marine coordination, marking on nautical charts, adherence to LMP, VMP, NSP, MPCP, and ERCoP.	Extremely Unlikely	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Decommissioning		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Cumulative		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Construction	Application for safety zones, buoyed	Remote	Moderate	Tolerable	Ensure locations of structures are made	Tolerable and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel to Structure Allision Risk	O&M	construction/decommissioning area, DSLP approval, marking on nautical charts, promulgation of information, appointment of FLO, adherence to LMP, ERCoP, MPCP, and FMMS.	Remote	Moderate	Tolerable	available to the fishing industry via weekly notice of operations, as secured by the FMMS	Tolerable and ALARP
	Decommissioning		Remote	Moderate	Tolerable		Tolerable and ALARP
	Cumulative		Negligible	Serious	Broadly Acceptable		Broadly acceptable, not significant
Reduced Access to Local Ports	Construction	Clear buoyage of construction/decommissioning area, marine coordination of project vessels, marking on nautical charts, promulgation of information, adherence to LMP and VMP.	Reasonably Probable	Minor	Tolerable	Liaison with Whitehills, Banff, and Macduff harbour authorities.	Tolerable with mitigation and ALARP
	O&M		Remote	Minor	Broadly Acceptable		Broadly acceptable, not significant
	Decommissioning		Reasonably Probable	Minor	Tolerable		Tolerable with mitigation and ALARP
	Cumulative		Frequent	Minor	Tolerable		Tolerable and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Reduction of Under Keel Clearance	Construction	Promulgation of information including via the FLO, marking of locations on nautical charts, adherence to MPCP and ERCoP.	Extremely Unlikely	Serious	Tolerable	Ensure locations of structures are made available to the fishing industry via weekly notice of operations, as secured by the FMMS	Tolerable with mitigation and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable with mitigation and ALARP
Loss of Station	Construction	Compliance with regulatory expectations on moorings for floating wind and marine devices (HSE and MCA, 2017) and MGN 654, promulgation of information, appropriate marking of structures, compliance with international regulations, adherence to DSLP and ERCoP.	Extremely Unlikely	Moderate	Broadly Acceptable	N/A	Broadly acceptable, not significant
	O&M		Extremely Unlikely	Moderate	Broadly Acceptable		Broadly acceptable, not significant
	Decommissioning		Extremely Unlikely	Moderate	Broadly Acceptable		Broadly acceptable, not significant
Reduction of SAR Capabilities	Construction	SAR checklist, DSLP approval, promulgation of information, marking on appropriate charts, marine coordination of project	Extremely Unlikely	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
	Decommissioning	vessels, compliance with MGN 654 and international marine regulations, adherence to LMP, ERCoP, MPCP, VMP, and NSP.	Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Cumulative		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
Anchor Interaction with Subsea Cables and Mooring Lines	O&M	Promulgation of information, marking on nautical charts, vessel compliance with MGN 654, adherence to CBRA and CaP.	Extremely Unlikely	Moderate	Broadly Acceptable	N/A	Broadly acceptable, not significant

24.2 Caledonia North

Table 24.2 presents a summary of the risk assessment of shipping and navigation hazards associated with Caledonia North. This includes (per hazard) the proposed embedded mitigation measures, frequency of occurrence, severity of consequence, and resulting significance of risk.

Any additional mitigation measures proposed are then listed per hazard alongside the residual risk.

Table 24.2 Risk Control Log – Caledonia North

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel Displacement	Construction	DSLP approval, adherence to LMP and NSP, marking on nautical charts, promulgation of information.	Frequent	Negligible	Tolerable	N/A	Tolerable and ALARP
	O&M		Frequent	Negligible	Tolerable		Tolerable and ALARP
	Decommissioning		Frequent	Negligible	Tolerable		Tolerable and ALARP
	Cumulative		Frequent	Negligible	Tolerable		Tolerable and ALARP
Vessel Displacement During Adverse Weather	Construction	Adherence to LMP	Remote	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Remote	Serious	Tolerable		Tolerable and ALARP
	Decommissioning		Remote	Serious	Tolerable		Tolerable and ALARP
Increased Third Party Vessel to Vessel Collision Risk	Construction	Marking on nautical charts, clear buoyage, promulgation of information, DSLP approval,	Extremely Unlikely	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
	Decommissioning	adherence to LMP, MPCP, and ERCoP.	Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Cumulative		Negligible	Serious	Broadly Acceptable		Broadly acceptable, not significant
Increased Third Party Vessel to Project Vessel Collision Risk	Construction	Application for safety zones, buoyed construction/decommissioning areas, guard vessels, DSLP approval, promulgation of information, marine coordination, marking on nautical charts, adherence to LMP, VMP, NSP, MPCP, and ERCoP.	Extremely Unlikely	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Decommissioning		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Cumulative		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
Vessel to Structure Allision Risk	Construction	Application for safety zones, buoyed construction/decommissioning area, DSLP approval, marking on nautical charts, promulgation of information,	Remote	Moderate	Tolerable	Ensure locations of structures are made available to the fishing industry via weekly notice of operations, as secured by the FMMS	Tolerable and ALARP
	O&M		Remote	Moderate	Tolerable		Tolerable and ALARP
	Decommissioning		Remote	Moderate	Tolerable		Tolerable and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
	Cumulative	appointment of FLO, adherence to LMP, ERCoP, MPCP, and FMMS.	Negligible	Serious	Broadly Acceptable		Broadly acceptable, not significant
Reduced Access to Local Ports	Construction	Clear buoyage of construction/decommissioning area, marine coordination of project vessels, marking on nautical charts, promulgation of information, adherence to LMP and VMP.	Reasonably Probable	Minor	Tolerable	Liaison with Whitehills, Banff, and Macduff harbour authorities.	Tolerable with mitigation and ALARP
	O&M		Remote	Minor	Broadly Acceptable		Broadly acceptable, not significant
	Decommissioning		Reasonably Probable	Minor	Tolerable		Tolerable with mitigation and ALARP
	Cumulative		Frequent	Minor	Tolerable		Tolerable and ALARP
Reduction of Under Keel Clearance	O&M	Promulgation of information including via the FLO, marking of locations on nautical charts, adherence to MPCP and ERCoP.	Extremely Unlikely	Moderate	Broadly Acceptable		Broadly acceptable, not significant

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Reduction of SAR Capabilities	Construction	SAR checklist, DSLP approval, promulgation of information, marking on appropriate charts, marine coordination of project vessels, compliance with MGN 654 and international marine regulations, adherence to LMP, ERCoP, MPCP, VMP, and NSP.	Extremely Unlikely	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Decommissioning		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Cumulative		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
Anchor Interaction with Subsea Cables	O&M	Promulgation of information, marking on nautical charts, vessel compliance with MGN 654, adherence to CBRA and CaP.	Extremely Unlikely	Moderate	Broadly Acceptable	N/A	Broadly acceptable, not significant

24.3 Caledonia South

Table 24.3 presents a summary of the risk assessment of shipping and navigation hazards associated with Caledonia South. This includes (per hazard) the proposed embedded mitigation measures, frequency of occurrence, severity of consequence, and resulting significance of risk.

Any additional mitigation measures proposed are then listed per hazard alongside the residual risk.

Table 24.3 Risk Control Log – Caledonia South

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel Displacement	Construction	DSLP approval, adherence to LMP and NSP, marking on nautical charts, promulgation of information.	Frequent	Negligible	Tolerable	N/A	Tolerable and ALARP
	O&M		Frequent	Negligible	Tolerable		Tolerable and ALARP
	Decommissioning		Frequent	Negligible	Tolerable		Tolerable and ALARP
	Cumulative		Frequent	Negligible	Tolerable		Tolerable and ALARP
Vessel Displacement During Adverse Weather	Construction	Adherence to LMP	Remote	Serious	Tolerable	Implementation of SEZ	Tolerable with mitigation, and ALARP
	O&M		Remote	Serious	Tolerable		Tolerable with mitigation, and ALARP
	Decommissioning		Remote	Serious	Tolerable		Tolerable with mitigation, and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Increased Third Party Vessel to Vessel Collision Risk	Construction	Marking on nautical charts, clear buoyage, promulgation of information, DSLP approval, adherence to LMP, MPCP, and ERCoP.	Extremely Unlikely	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Decommissioning		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Cumulative		Negligible	Serious	Broadly Acceptable		Broadly acceptable, not significant
Increased Third Party Vessel to Project Vessel Collision Risk	Construction	Application for safety zones, buoyed construction/decommissioning areas, guard vessels, DSLP approval, promulgation of information, marine coordination, marking on nautical charts, adherence to LMP, VMP, NSP, MPCP, and ERCoP.	Extremely Unlikely	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Decommissioning		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Cumulative		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Construction	Application for safety zones, buoyed	Remote	Moderate	Tolerable	Ensure locations of structures are made	Tolerable and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel to Structure Allision Risk	O&M	construction/decommissioning area, DSLP approval, marking on nautical charts, promulgation of information, appointment of FLO, adherence to LMP, ERCoP, MPCP, and FMMS.	Remote	Moderate	Tolerable	available to the fishing industry via weekly notice of operations, as secured by the FMMS	Tolerable and ALARP
	Decommissioning		Remote	Moderate	Tolerable		Tolerable and ALARP
	Cumulative		Negligible	Serious	Broadly Acceptable		Broadly acceptable, not significant
Reduced Access to Local Ports	Construction	Clear buoyage of construction/decommissioning area, marine coordination of project vessels, marking on nautical charts, promulgation of information, adherence to LMP and VMP.	Reasonably Probable	Minor	Tolerable	Liaison with Whitehills, Banff, and Macduff harbour authorities.	Tolerable with mitigation and ALARP
	O&M		Remote	Minor	Broadly Acceptable		Broadly acceptable, not significant
	Decommissioning		Reasonably Probable	Minor	Tolerable		Tolerable with mitigation and ALARP
	Cumulative		Frequent	Minor	Tolerable		Tolerable and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Reduction of Under Keel Clearance	Construction	Promulgation of information including via the FLO, marking of locations on nautical charts, adherence to MPCP and ERCoP.	Extremely Unlikely	Serious	Tolerable	Ensure locations of structures are made available to the fishing industry via weekly notice of operations, as secured by the FMMS	Tolerable with mitigation and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable with mitigation and ALARP
Loss of Station	Construction	WTG towage risk assessment, compliance with regulatory expectations on moorings for floating wind and marine devices (HSE and MCA, 2017) and MGN 654, promulgation of information, appropriate marking of structures, compliance with international regulations, adherence to DSLP and ERCoP.	Extremely Unlikely	Moderate	Broadly Acceptable	N/A	Broadly acceptable, not significant
	O&M		Extremely Unlikely	Moderate	Broadly Acceptable		Broadly acceptable, not significant
	Decommissioning		Extremely Unlikely	Moderate	Broadly Acceptable		Broadly acceptable, not significant
Reduction of SAR Capabilities	Construction	SAR checklist, DSLP approval, promulgation of information, marking on appropriate charts, marine coordination of project	Extremely Unlikely	Serious	Tolerable	N/A	Tolerable and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
	Decommissioning	vessels, compliance with MGN 654 and international marine regulations, adherence to LMP, ERCoP, MPCP, VMP, and NSP.	Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
	Cumulative		Extremely Unlikely	Serious	Tolerable		Tolerable and ALARP
Anchor Interaction with Subsea Cables and Mooring Lines	O&M	Promulgation of information, marking on nautical charts, vessel compliance with MGN 654, adherence to CBRA and CaP.	Extremely Unlikely	Moderate	Broadly Acceptable	N/A	Broadly acceptable, not significant

25 Through Life Safety Management

25.1 Quality, Health, Safety and Environment

Quality, Health, Safety and Environment (QHSE) processes and documentation including a Safety Management System (SMS) will be in place for the Proposed Development (Offshore) 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 QHSE 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.

25.2 Incident Reporting

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

The Proposed Development (Offshore) 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 Proposed Development (Offshore) 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.

25.3 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 development, 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.

25.4 Inspection of Resources

All vessels, facilities, and equipment necessary for marine operations 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 AtoNs to determine compliance with the performance standards specified by NLB.

25.5 Audit Performance

Auditing and performance review are the final steps in QHSE 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.

25.6 Safety Management System

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 AtoNs to ensure that if a light is faulty a quick fix can be instigated, which will allow IALA availability requirements to be met.

25.7 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.

25.8 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.

25.9 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 Proposed Development (Offshore) 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. The Decommissioning Plan will be based on good decommissioning OWF practices at the time of decommissioning.

26 Summary

26.1 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, and a Hazard Workshop. Key stakeholders consulted include:

- MCA;
- NLB;
- UKCoS;
- Nigg Energy Park;
- RYA Scotland;
- CA
- Scottish White Fish Producers;
- Scottish Fishermen's Federation;
- Green Marine;
- Smyril Line; and
- Serco NorthLink.

26.2 Existing Environment

26.2.1 Navigational Features

Key navigational features in the area include the surrounding OWFs, including Moray East OWF which lies adjacent to the Caledonia North Site over a distance of 10nm. The closest harbours are situated at Wick, approximately 13.2nm northwest the Caledonia North Site, and Macduff at approximately 19.7nm south of the Caledonia South Site. Two large military firing areas are within the vicinity of Caledonia OWF, one of which fully encompasses the Caledonia North Site and the Caledonia South Site. Numerous anchoring points are available along the northeast coast, with a designated anchorage located at Macduff. Several subsea cables are noted to intersect the Caledonia North Site and the Caledonia South Site.

26.2.2 Maritime Incidents

From DfT SAR helicopter taskings data recorded between April 2015 and March 2023, there was an average of one SAR tasking per year within the study area. There was 14 SAR taskings within the OECC study area, and one within the Caledonia OECC itself.

Within the study area there was an average of one unique RNLI incidents per year between 2010 and 2022 with "*machinery failure*" (36%) and "*vessel may be in trouble*" (21%) the most frequently recorded incident types. One incident was responded to by the RNLI within Caledonia OWF itself.

Within the OECC study area there was an average of four to five unique RNLI incident per year with "*machinery failure*" (37%) and "*person in danger*" (22%) the most frequently recorded incident types. Thirteen incidents were responded to by the RNLI within the Caledonia OECC itself.

Within the study area there was an average of one unique MAIB incident every two and a half years between 2012 and 2021 composed of two machinery failures, one accident to a person, and one hazardous incident. Two incidents were recorded by the MAIB within Caledonia OWF itself.

Within the OECC study area there was an average of one unique MAIB incident every two years, composed of three machinery failures, one grounding, and one collision.

26.2.3 Vessel Traffic Movements

26.2.3.1 Array Area

From the 28 days of vessel traffic survey data recorded in winter and summer 2023 the study area, there was an average of 17 unique vessels per day recorded within the study area during the winter survey period, with an average of six to seven unique vessels recorded within Caledonia OWF. During the summer survey period, an average of 29 to 30 unique vessels was recorded within the study area per day with an average of seven to eight within Caledonia OWF. Approximately 35% and 26% of vessel traffic intersected Caledonia OWF during the winter and summer periods respectively.

The main vessel types within the study area during the winter survey period were fishing vessels (28%) and cargo vessels (24%). The main vessel types within the study area during the summer survey period were cargo vessels (25%) and wind farm vessels (23%).

26.2.3.2 Offshore Export Cable Corridor

During the 28 days of AIS only vessel traffic data from winter and summer 2023 within the OECC study area, there was an average of 11 unique vessels recorded per day within the OECC study during the winter data period, with an average of nine unique vessels recorded within the Caledonia OECC itself. During the summer survey period, an average of 15 unique vessels was recorded within the OECC study area per day with an average of 11 to 12 within the Caledonia OECC itself. Approximately 80% and 77% of vessel traffic within the OECC study area were recorded to intersect the Caledonia OECC during the winter and summer periods respectively.

The main vessel types within the OECC study area during the winter data period were fishing vessels (26%), cargo vessels (18%) and oil and gas vessels (18%). The main vessel types within the OECC study area during the summer data period were recreational vessels (40%) and fishing vessels (22%).

26.2.3.3 Main Commercial Vessel Routes

A total of 10 main commercial routes were identified from the vessel traffic data. The highest use main commercial routes were between the Pentland Firth and Rotterdam; and between

Wick and Beatrice OWF; – each of these routes with an average of two and three unique vessels per day.

26.3 Future Case Vessel Traffic

Of the 10 main routes identified, it is anticipated that three will deviate as a result of Caledonia OWF. The largest percentage increase in terms of overall change in route length was to Route 6, with a 1% increase. The largest change on an absolute basis was also to Route 6, with a 0.7nm increase.

26.4 Collision and Allision Risk Modelling

The NRA process included quantitative modelling of the change in allision and collision frequency as a result of the Proposed Development (Offshore), with consideration given to future cases in terms of potential future traffic increases.

It was estimated that the return period of a vessel being involved in a collision post Caledonia OWF was one in 292 years assuming base case traffic levels. This represents a 78% increase in collision frequency compared to the pre wind farm base case result.

The powered allision return period post wind farm was estimated at one in 341 years assuming base case traffic levels. The corresponding drifting allision return period post wind farm was estimated at one in 4,054 years. The fishing vessel allision return period was estimated at one in 3.5 years. However, for the reasons detailed in Section 16.3.5, it is considered likely that the actual fishing allision return period will be notably lower than the quantitative modelled output, and that any allisions that do occur will be low to moderate consequence.

It was estimated that the return period of a vessel being involved in a collision post Caledonia North Site was one in 332 years assuming base case traffic levels. This represents a 57% increase in collision frequency compared to the pre wind farm base case result.

The powered allision return period post Caledonia North Site was estimated at one in 1,943 years assuming base case traffic levels. The corresponding drifting allision return period post Caledonia North Site was estimated at one in 10,897 years. The fishing vessel allision return period was estimated at one in 7.2 years. However, for the reasons detailed in Section 16.3.5, it is considered likely that the actual fishing allision return period will be notably lower than the quantitative modelled output, and that any allisions that do occur will be low to moderate consequence.

It was estimated that the return period of a vessel being involved in a collision post Caledonia South Site was one in 319 years assuming base case traffic levels. This represents a 63% increase in collision frequency compared to the pre wind farm base case result.

The powered allision return period post Caledonia South Site was estimated at one in 412 years assuming base case traffic levels. The corresponding drifting allision return period post Caledonia South Site was estimated at one in 7,018 years. The fishing vessel allision return period was estimated at one in 5.4 years. However, for the reasons detailed in Section 16.3.5, it is considered likely that the actual fishing allision return period will be notably lower than the quantitative modelled output, and that any allisions that do occur will be low to moderate consequence.

26.5 Risk Statement

Using the baseline data, quantitative modelling, expert opinion, outputs of the Hazard Workshop, and lessons learnt from existing offshore developments, shipping and navigation hazards have been identified and assessed in line with the FSA methodology for Caledonia OWF, Caledonia North, and Caledonia South. The full risk control logs including details of hazards, mitigation measures, and significant of risk are presented in Section 24.

The significance of risk has been determined as either Broadly Acceptable or Tolerable and ALARP for all shipping and navigation hazards assessed, assuming the embedded and additional mitigation identified is in place.

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Appendix A Marine Guidance Note 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	Reference and Notes
Site and Installation Co-ordinates. Developers are responsible for ensuring that formally agreed coordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (European Terrestrial Reference System 1989 (ETRS89)) datum.		
Traffic Survey. Includes:		
All vessel types	✓	**Section 10: Vessel Traffic Movements** All vessel types are considered with specific breakdowns by vessel type given for Caledonia OWF (see Section 10.1) and Caledonia OECC (see Section 10.2) study areas.
At least 28 days duration, within either 12 or 24 months prior to submission of the ES.	✓	**Section 5.2: Vessel Traffic Surveys** A total of 28 full days of vessel traffic survey data from January to February 2023 and from July to August 2023 has been assessed within Caledonia OWF and OECC study areas.
Multiple data sources	✓	**Section 5.2: Vessel Traffic Surveys** The vessel traffic survey data includes AIS, visual observations and radar for the summer and winter periods in order to ensure maximal coverage of vessels not broadcasting on AIS. **Section 5: Data Sources** Additional data sources including the long-term AIS data and consultations input have also been considered.
Seasonal variations	✓	**Section 5.2: Vessel Traffic Surveys** A total of 28 full days of vessel traffic survey data from January to February 2023 and from July to August 2023 has been assessed within Caledonia OWF and OECC study areas. **Section 5: Data Sources** Additional long term data sources including the long-term AIS data have also been considered.

Issue	Compliance	Reference and Notes
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.
UKCoS consultation	✓	**Section 4: Consultation** The UKCoS has been consulted as part of the NRA process including through the Hazard Workshop.
Recreational and fishing vessel consultation	✓	**Section 4: Consultation** The CA, RYA Scotland, the Scottish Fishermen's Federation, and the Scottish White Fish Production Association have been invited to consult as part of the NRA process including through the Hazard Workshop.
Port and navigation authorities consultation, as appropriate	✓	**Section 4: Consultation** Local ports were represented at 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 Proposed Development (Offshore) has been analysed.
ii. Numbers, types and sizes of vessels presently using such areas.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Proposed Development (Offshore) has been analysed and includes breakdowns of daily vessel count, vessel type and vessel size.
iii. Non-transit uses of the area, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, personal watercraft etc.	✓	**Section 7: Navigational Features** There are no marine aggregate dredging areas in proximity to the Proposed Development (Offshore). **Section 10: Vessel Traffic Movements** Non-transit users were identified in the vessel traffic survey data and included fishing vessels engaged in fishing activities.
iv. Whether these areas contain transit routes used by coastal or deep-draught or international scheduled vessels on passage.	✓	**Section 10: Vessel Traffic Movements** Main routes have been identified using the principles set out in MGN 654 in proximity to Caledonia OWF (see Section 11.2), with these routes taking into account coastal, deep-draught and internationally scheduled vessels.
v. Alignment and proximity of the site relative to adjacent shipping routes.	✓	**Section 7: Navigational Features** There are no IMO routeing measures in proximity to the Proposed Development (Offshore).
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓	**Section 7: Navigational Features** Section 7.6 identifies relevant areas such as military practice and exercise areas in proximity to the Proposed Development (Offshore).

Issue	Compliance	Reference and Notes
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** Section 7.1 identifies nearby ports. Section 7.7 identifies anchorage areas in proximity to the Proposed Development (Offshore).
viii. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	**Section 7: Navigational Features** Section 7.1 identifies nearby ports. The Proposed Development (Offshore) does not lie within any jurisdiction of a port and / or harbour authority.
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 and activities are considered within Caledonia OWF (Section 10.1.2.2) and Caledonia OECC (Section 10.2.2.2) study areas.
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	**Section 7: Navigational Features** Section 7.6 identifies military practice and exercise areas in proximity to the Proposed Development (Offshore).
xi. Proximity of the site to existing or proposed submarine cables or pipelines, offshore oil/gas platform, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Area or other exploration/exploitation sites.	✓	**Section 7: Navigational Features** There are no marine aggregate dredging areas in the region. Section 7.4 identifies charted wrecks in proximity to the Proposed Development (Offshore). Section 7.5 considers subsea cables. **Section 14: Cumulative and Transboundary Overview** Planned submarine cables are identified in Section 14.1.
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** Baseline OREIs are considered in Section 7.3. **Section 14: Cumulative and Transboundary Overview** Planned nearby OREIs presented are shown in Section 14.1.
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping grounds.	✓	**Section 7: Navigational Features** Section 7.8 considers spoil grounds in proximity to the Proposed Development (Offshore).
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** Section 7.2 identifies AtoNs in proximity to the Proposed Development (Offshore).
xv. Researched opinion using computer simulation	✓	**Section 16: Collision and Allision Risk Modelling**

Issue	Compliance	Reference and Notes
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.		Collision and allision risk modelling has been undertaken for Caledonia OWF.
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 the MAIB (Section 9.5), RNLI (Section 9.2) and DfT (Section 9.1) in proximity to the Proposed Development (Offshore) has been considered alongside historical OWF 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 limited recreational activity.
Predicted effect of OREI on traffic and interactive boundaries. Where appropriate, the following should be determined:		
a. The safe distance between a shipping route and OREI boundaries.	✓	**Section 15: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes a minimum distance of 1nm from offshore installations and WTG boundaries.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	There is not considered to be a corridor formed between the Array Area and other cumulative developments (both Stromar and Broadshore are in excess of 10nm from the Array Area).
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 16: Collision and Allision Risk Modelling** Collision and allision risk modelling has been undertaken for Caledonia OWF.
b. Clearances of fixed or floating WTG blades above the sea surface are not less	✓	**Section 17: Mitigation Measures** The minimum blade tip height is included in the WCS for WTGs (see Table 17.1).

Issue	Compliance	Reference and Notes
than 22 m (above Mean High Water Springs (MHWS) for fixed). 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 6.7: Worst Case Scenario** Inter array, interconnector and export cable specifications are included in the WCS for cables (see Section 6.7).
d. Whether structure block or hinder the view of other vessels or other navigational features.	✓	**Section 18: Risk Assessment – In Isolation** The hazards due to the Proposed Development (Offshore) have been assessed for each phase and include consideration of the potential for vessels navigating in proximity to structures to be visually obscured
The effects of tides, tidal streams and weather. It should be determined whether:		
a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide, i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.	✓	**Section 6.7: Worst Case Scenario** The range of water depths within Caledonia OWF is provided in the WCS for the site boundary. **Section 8: Meteorological Ocean Data** Various states of the tide local to the Proposed Development (Offshore) are provided. **Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Proposed Development (Offshore) has been analysed. **Section 16: Collision and Allision Risk Modelling** Collision and allision risk models take into account 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** Various states of the tide local to the Proposed Development (Offshore) are provided. **Section 16: Collision and Allision Risk Modelling** The collision and allision risk models take into account 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	✓	**Section 8: Meteorological Ocean Data** Various states of the tide local to the Proposed Development (Offshore) are provided and it is noted that hazards are not anticipated at high or low water only.

Issue	Compliance	Reference and Notes
stream, including unpowered vessels and small, low speed craft.		**Section 16: Collision and Allision Risk Modelling** The drifting allision risk model takes into account tidal conditions and assesses whether machinery failure could cause vessels to be set into danger.
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 Proposed Development (Offshore) 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 Proposed Development (Offshore) relating to various states of the tide.
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** Weather and visibility data local to the Proposed Development (Offshore) is provided. **Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Proposed Development (Offshore) has been analysed including recreational vessels. **Section 12: Adverse Weather Vessel Traffic Movements** Alternative routeing used by Regular Operators during periods of adverse weather have been identified.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	**Section 8: Meteorological Ocean Data** The hazards due to the Proposed Development (Offshore) have been assessed for each phase and include consideration of internal allision risk for vessels under sail.
j. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above.	✓	**Section 16: Collision and Allision Risk Modelling** The drifting allision risk model takes into account weather and tidal conditions and assesses whether machinery failure could cause vessels to be set into danger.
Assessment of access to and navigation within, or close to, an OREI. To determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:		
a. Navigation within or close to the site would be safe:		
i. For all vessels.	✓	**Section 4: Consultation**

<table>
<tr><th>Issue</th><th>Compliance</th><th>Reference and Notes</th></tr>
<tr><td>ii. For specified vessel types, operations and/or sizes.</td><td>✓</td><td rowspan="4">Section 4.1 outlines Regular Operator consultation undertaken following the vessel traffic surveys.

Section 12: Adverse Weather Vessel Traffic Movements
Alternative routeing used by Regular Operators during periods of adverse weather are discussed.

Section 16: Collision and Allision Risk Modelling
Collision and allision risk modelling has been undertaken and includes use of post wind farm routeing, as well as taking account of tidal and weather conditions.</td></tr>
<tr><td>iii. In all directions or areas.</td><td>✓</td></tr>
<tr><td>iv. In specified directions or areas.</td><td>✓</td></tr>
<tr><td>v. In specified tidal, weather or other conditions.</td><td>✓</td></tr>
<tr><td colspan="3">b. Navigation in and/or near the site should be prohibited or restricted:</td></tr>
<tr><td>i. For specified vessel types, operations and/or sizes.</td><td>✓</td><td rowspan="5">Section 13: Navigation, Communication and Position Fixing Equipment
Potential hazards on navigation of the different communications and position fixing devices used in and around OWFs are assessed.

Section 16: Collision and Allision Risk Modelling
Collision and allision risk modelling has been undertaken for Caledonia OWF and includes use of post wind farm routeing which assumes commercial vessel traffic avoids Caledonia OWF.

Section 17: Mitigation Measures
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.</td></tr>
<tr><td>ii. In respect of specific activities.</td><td>✓</td></tr>
<tr><td>iii. In all areas or directions.</td><td>✓</td></tr>
<tr><td>iv. Prohibited in specified areas or directions.</td><td>✓</td></tr>
<tr><td>v. In specified tidal or whether conditions.</td><td>✓</td></tr>
<tr><td>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.</td><td>✓</td><td>Section 16: Collision and Allision Risk Modelling
Collision and allision risk modelling has been undertaken for Caledonia OWF and includes use of post wind farm routeing which assumes commercial vessel traffic avoids the array.</td></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 15: Future Case Vessel Traffic
The methodology applied when considering the safe distance at which main routes should be deviated around offshore installations has been described and includes consideration of the Shipping Route Template (see Section 15.4.1).</td></tr>
</table>

Issue	Compliance	Reference and Notes
SAR, maritime assistance service, counter pollution and salvage incident response.		
The MCA, through HMCG, 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.		
a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including compliance with MGN 654, which requires the creation of an ERCoP.
b. The MCA's guidance document *Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response* (MCA, 2021) for the design, equipment and operation requirements will be followed.	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including compliance with MGN 654, which requires the fulfilment of requirements in the stated guidance document.
c. A SAR checklist will be completed to record discussions regarding the requirements, recommendations and considerations outlined in Annex 5 (to be agreed with MCA).	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including compliance with MGN 654, which requires the SAR checklist to be completed.
Hydrography. In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
i. Pre-construction: The proposed generating assets area and proposed cable route.	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including compliance with MGN 654, which requires the specified hydrographic surveys to be completed.
ii. On a pre-established periodicity during the life of the development.	✓	
iii. Post construction: Cable route(s).	✓	
iv. Post decommissioning of all or part of the development: the installed generating assets area and cable route.	✓	

Issue	Compliance	Reference and Notes
Communications, Radar and positioning systems. To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:		
a. The structures could produce radio interference such as shadowing, reflections or phase changes, and emissions with respect to any frequencies used for marine positioning, navigation and timing (PNT) or communications, including GMDSS and AIS, whether ship borne ashore or fitted to any of the proposed structures, to:		
i. Vessels operating at a safe navigational distance.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Potential hazards on navigation of the different communications and position fixing devices used in and around OWFs are assessed.
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.	✓	
iii. Vessels by the nature of their work necessarily operating within the OREI.	✓	
b. The structures could produce radar reflections, blind spots, shadow areas or other adverse effects:		
i. Vessel to vessel	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Potential hazards on navigation of the different communications and position fixing devices used in and around OWFs are assessed.
ii. Vessel to shore	✓	
iii. VTS radar to vessel	✓	
iv. Racon to/from vessel	✓	
c. The structures and generators might produce SONAR interference affecting fishing, industrial or military systems used in the area.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Section 13.8 assesses the potential risk of SONAR interference due to the Proposed Development (Offshore).
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Section 13.9 assesses the potential risk of noise due to the Proposed Development (Offshore).
e. Generators and the seabed cabling within the site onshore might produce EMFs affecting compasses and other navigation systems.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Section 13.6 assesses the potential risk of electromagnetic interference due to the Proposed Development (Offshore).

Issue	Compliance	Reference and Notes
Risk mitigation measures recommended for OREI during construction, operation and decommissioning.		
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the EIA. The specific measures to be employed will be selected in consultation with the MCA and will be listed in the developer's EIAR. These will be consistent with international standards contained in, for example, Chapter V of SOLAS (IMO, 1974), and could include any or all of the following:		
i. Promulgation of information and warnings through notices to mariners and other appropriate MSI dissemination methods.	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including the promulgation of information.
ii. Continuous watch by multi-channel VHF, including DSC.	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including marine coordination.
iii. Safety Zones of appropriate configuration, extent and application to specified vessels[6].	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including use of Safety Zones.
iv. Designation of the site as an ATBA	✓	**Section 6: Project Design Envelope Relevant to Shipping and Navigation** It is not planned to designate Caledonia OWF as an ATBA (see Section 6).
v. Provision of aids to navigation as determined by the GLA.	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including the provision of AtoNs in accordance with NLB and MCA requirements.
vi. Implementation of routeing measures within or near to the development.	✓	It is not planned to implement any new routeing measures within or near to the Proposed Development (Offshore).
vii. Monitoring by Radar, AIS, Closed Circuit Television (CCTV) or other agreed means.	✓	**Section 17: Mitigation Measures** As required under MGN 654 (MCA, 2021) the Proposed Development (Offshore) will agree suitable site mitigation with the MCA via the SAR checklist.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of Safety Zones.	✓	Means for notifying and providing evidence of the infringement of Safety Zones will be provided in the Safety Zone Application, submitted post consent.
ix. Creation of an ERCoP with the MCA's SAR branch for the construction phase onwards.	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including compliance with MGN 654, which requires the creation of an ERCoP.

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

Issue	Compliance	Reference and Notes
x. Use of guard vessels, where appropriate.	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including the use of guard vessels where appropriate.
xi. Update NRAs every two years, e.g. at testing sites.	✓	Not applicable to the Proposed Development (Offshore).
xii. Device-specific or array-specific NRAs.	✓	**Section 6.7: Worst Case Scenario** All offshore elements of the Proposed Development have been considered in this NRA including the Caledonia OECC (surface and subsea) infrastructure. **Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17 including a cable burial risk assessment undertaken prior to construction which will serve as additional assessment relating to shipping and navigation.
xiii. Design of OREI structures to minimise risk to contacting vessels or craft.	✓	There is no additional risk posed to craft compared to previous OWFs and so no additional measures are identified.
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	**Section 17: Mitigation Measures** Embedded mitigation measures have been proposed and are summarised in Section 17.

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 18: Risk Assessment – In Isolation** The risk assessment provides a risk claim for a range of hazards based on a number of inputs including baseline data, expert opinion, stakeholder concerns and lessons learnt from existing offshore developments.
Description of the marine environment.	✓	**Section 7: Navigational Features** Navigational features in proximity to the Proposed Development (Offshore) have been described including (but not limited to) other OWF developments, key AtoNs, and charted wrecks. **Section 14: Cumulative and Transboundary Overview** Potential future offshore developments have been screened into the cumulative risk assessment where a cumulative or in combination activity has been identified based upon the location and distance from the Proposed Development (Offshore). Developments screened include other OWFs, oil and gas infrastructure, and sub-sea cables.

Item	Compliance	Comments
SAR overview and assessment.	✓	**Section 9: Emergency Response and Incident Overview** Existing SAR resources in proximity to the Proposed Development (Offshore) are summarised including the UK SAR operations contract, RNLI stations, and HMCG stations.
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 Proposed Development (Offshore) for which any shipping and navigation hazards are assessed is provided including a description of the Proposed Development (Offshore) associated infrastructure, construction phase programme, and indicative vessel and helicopter numbers during the construction and O&M phases.
Analysis of the vessel traffic, including base case and future traffic densities and types.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to Caledonia OWF has been analysed and includes vessel density and breakdowns of vessel type. **Section 15: Future Case Vessel Traffic** Future vessel traffic levels have been considered, with consideration of increases in commercial vessel activity, commercial fishing vessel and recreational vessel activity, and traffic associated with the Proposed Development (Offshore) operations. Additionally, worst case alternative routeing for commercial traffic has been considered.
Status of the hazard log: ▪ Hazard identification; ▪ Risk assessment; ▪ Influences on level of risk; ▪ Tolerability of risk; and ▪ Risk matrix.	✓	**Section 3: Navigational Risk Assessment Methodology** A tolerability matrix has been defined to determine the tolerability (significance) of risks. **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 IMOs FSA guidelines are the primary guidance documents used for the assessment. **Section 16: 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 24: Risk Control Log**

Item	Compliance	Comments
		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

The complete hazard log, created following the Hazard Workshop, is presented in Table B.1. Definitions of the rankings used in the Hazard Log are detailed in Section 3.

Table B.1 Hazard Log

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
								Consequences								Consequences							
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Vessels Displacement																							
Commercial vessels	Isolation	Array area	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction area Construction vessels which are RAM	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	5	1	1	1	2	1.3	**Tolerable with Mitigation**	Increased journey time/distance which impacts on schedules or compliance with COLREGs	3	1	2	1	3	1.8	**Broadly Acceptable**		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	5	1	1	1	2	1.3	**Tolerable with Mitigation**	Increased journey time/distance which impacts on schedules or compliance with COLREGs	3	1	2	1	3	1.8	**Broadly Acceptable**		
		Offshore export cable corridor	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Construction vessels which are RAM	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	4	1	1	1	2	1.3	**Broadly Acceptable**	Increased journey time/distance which impacts on schedules or compliance with COLREGs	2	1	1	1	2	1.3	**Broadly Acceptable**		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	2	1	1	1	2	1.3	**Broadly Acceptable**	Increased journey time/distance which impacts on schedules or compliance with COLREGs	1	1	1	1	2	1.3	**Broadly Acceptable**		
	Cumulative	Array area	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction areas Construction vessels which are RAM	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	5	1	1	1	2	1.3	**Tolerable with Mitigation**	Increased journey time/distance which impacts on schedules or compliance with COLREGs	3	1	2	1	3	1.8	**Broadly Acceptable**		General consensus was that the space between Caledonia and Stromar, and Caledonia and Broadshore was sufficient to

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
								Consequences								Consequences							
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of other Relevant Projects Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	5	1	1	1	2	1.3	Tolerable with Mitigation	Increased journey time/distance which impacts on schedules or compliance with COLREGs	3	1	2	1	3	1.8	Broadly Acceptable		safely accommodate likely users (in excess of 10nm).
		Offshore export cable corridor	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Construction vessels which are RAM	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	4	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on schedules or compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	3	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on schedules or compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		
Commercial fishing vessels in transit	Isolation	Array area	C/D	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSPGuard vessel (s) (via risk assessment)Promulgation of informationCompliance with MGN 654 Lighting and markingMarking on Admiralty charts	Presence of buoyed construction areaConstruction vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	3	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	3	1.5	Broadly Acceptable		
			O	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	3	1.5	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation if Required	Additional Comments
		Offshore export cable corridor	C/D	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Construction vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	2	1	1	1	2	1.3	**Broadly Acceptable**	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	2	1.3	**Broadly Acceptable**		
			O	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	1	1	1	1	2	1.3	**Broadly Acceptable**	Increased journey time/distance which impacts on transits or compliance with COLREGs	1	1	1	1	2	1.3	**Broadly Acceptable**		
	Cumulative	Array area	C/D	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction area Construction vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	4	1	1	1	2	1.3	**Broadly Acceptable**	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	3	1.5	**Broadly Acceptable**		
			O	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	4	1	1	1	2	1.3	**Broadly Acceptable**	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	3	1.5	**Broadly Acceptable**		
		Offshore export cable corridor	C/D	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654	Construction vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	3	1	1	1	2	1.3	**Broadly Acceptable**	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	2	1.3	**Broadly Acceptable**		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation if Required	Additional Comments
				Lighting and marking Marking on Admiralty charts																			
			O	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on transits or compliance with COLREGs	1	1	1	1	2	1.3	Broadly Acceptable		
Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	Development of and adherence to an NSPGuard vessel (s) (via risk assessment)Promulgation of informationCompliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction areaConstruction vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable		
		Offshore export cable corridor	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Construction vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance which impacts on transits or compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654	Maintenance vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance which impacts on transits or compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	Further Mitigation if Required	Additional Comments
				Lighting and marking Marking on Admiralty charts																			
	Cumulative	Array area	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction area Construction vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	2	1	1	1	1	1.0	**Broadly Acceptable**	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	1	1.0	**Broadly Acceptable**		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	2	1	1	1	1	1.0	**Broadly Acceptable**	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	1	1	1	1.0	**Broadly Acceptable**		
		Offshore export cable corridor	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Construction vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	2	1	1	1	1	1.0	**Broadly Acceptable**	Increased journey time/distance which impacts on transits or compliance with COLREGs	1	1	1	1	1	1.0	**Broadly Acceptable**		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Maintenance vessels which are RAM	Increased journey time/distance but does not impact on transits or impact compliance with COLREGs	1	1	1	1	1	1.0	**Broadly Acceptable**	Increased journey time/distance which impacts on transits or compliance with COLREGs	1	1	1	1	1	1.0	**Broadly Acceptable**		
Displacement of Commercial Vessel Adverse Weather Routeing																							
Commercial vessels	Isolation	Array Area	O	Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts Commercial agreement in place with relevant parties	Maintenance vessels which are RAM Presence of WTGs (Array Area)	Increase in journey times/distances with limited impact on schedules or compliance with COLREGs	5	1	1	1	3	1.5	**Tolerable with Mitigation**	Large scale inshore deviation required or cancellation of sailing	4	2	2	2	5	2.8	**Tolerable with Mitigation**		NorthLink noted the project will impact their adverse weather routeing. This would be an infrequent occurrence, but could lead to a

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
																							large deviation inshore or a cancelled sailing. A cancellation would not have a navigtational safety impact but could have an operational and reputational impact.
	Cumulative	Array Area	O	Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts Commercial agreement in place with relevant parties	Presence of other relevant Projects Maintenance vessels which are RAM Presence of WTGs (Array Area)	Increase in journey times/distances with limited impact on schedules or compliance with COLREGs	5	1	1	1	3	1.5	**Tolerable with Mitigation**	Large scale inshore deviation required or cancellation of sailing	4	2	2	2	5	2.8	**Tolerable with Mitigation**		NorthLink noted the project will impact their adverse weather routeing. This would be an infrequent occurrence, but could lead to a large deviation inshore or a cancelled sailing. A cancellation would not have a navigational safety impact but could have an operational and reputational impact.
Increased Vessel to Vessel Collision Risk Between Third-Party Vessels																							
Commercial vessels	Isolation	Array area	C/D	Development of and adherence to an NSPGuard vessel (s) (via risk assessment)Promulgation of informationCompliance with MGN 654 Lighting and markingMarking on Admiralty charts	Presence of buoyed construction areaAdverse weatherConstruction vessels which are RAM	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	**Broadly Acceptable**	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	2	4	4	4	4	4.0	**Tolerable with Mitigation**		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	**Broadly Acceptable**	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	2	4	4	4	4	4.0	**Tolerable with Mitigation**		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk		
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence			
		Offshore export cable corridor	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	2	2	3	2	2.3	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	4	4	4	4.0	Tolerable with Mitigation		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	2	2	3	2	2.3	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	4	4	4	4.0	Tolerable with Mitigation		
	Cumulative	Array area	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction areas Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	3	4	4	4	4	4.0	Tolerable with Mitigation		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of other Relevant Projects Adverse weather Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	3	4	4	4	4	4.0	Tolerable with Mitigation		General consensus was that the space between Caledonia and Stromar, and Caledonia and Broadshore was sufficient to safely accommodate likely users (in excess of 10nm).
		Offshore export cable corridor	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	2	2	3	2	2.3	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	2	4	4	4	4	4.0	Tolerable with Mitigation		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654	Adverse weather Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	2	2	3	2	2.3	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	2	4	4	4	4	4.0	Tolerable with Mitigation		

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User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation if Required	Additional Comments
				Lighting and marking Marking on Admiralty charts																			
Commercial fishing vessels in transit	Isolation	Array area	C/D	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction area Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable		
Commercial fishing vessels in transit	Isolation	Array area	O	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable		
Commercial fishing vessels in transit	Isolation	Offshore export cable corridor	C/D	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSPGuard vessel (s) (via risk assessment)Promulgation of informationCompliance with MGN 654 Lighting and markingMarking on Admiralty charts	Adverse weatherConstruction vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable		
Commercial fishing vessels in transit	Isolation	Offshore export cable corridor	O	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
								Consequences								Consequences							
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
	Cumulative	Array area	C/D	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction area Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	3	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable		
			O	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased encounters resulting in a low impact collision event	3	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable		
		Offshore export cable corridor	C/D	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable		
			O	Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable		
Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction area Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation if Required	Additional Comments
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable		
		Offshore export cable corridor	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable		
			O	Development of and adherence to an NSPGuard vessel (s) (via risk assessment)Promulgation of informationCompliance with MGN 654 Lighting and markingMarking on Admiralty charts	Adverse weatherMaintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable		
	Cumulative	Array area	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of buoyed construction area Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable		
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Maintenance vessels which are RAM Visual interference associated with a third-party vessel exiting the array	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable		
		Offshore export cable corridor	C/D	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation if Required	Additional Comments
							Frequency	Consequences					Risk			Frequency	Consequences					Risk			
								People	Environment	Property	Business	Average Consequence					People	Environment	Property	Business	Average Consequence				
			O	Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Adverse weather Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	**Broadly Acceptable**		Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	**Broadly Acceptable**		
Increased Vessel to Vessel Collision Risk Between a Third-Party Vessel and a Project Vessel																									
Commercial vessels	Isolation	Array area	C/D	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit including towage operation Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	**Broadly Acceptable**		Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	4	4	4	4.0	**Tolerable with Mitigation**		
Commercial vessels	Isolation	Array area	O	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit including towage operation Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	**Broadly Acceptable**		Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	4	4	4	4.0	**Tolerable with Mitigation**		
Commercial vessels	Isolation	Offshore export cable corridor	C/D	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	2	2	3	2	2.3	**Broadly Acceptable**		Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	4	4	4	4.0	**Tolerable with Mitigation**		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation if Required	Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk			Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk			
			O	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	2	2	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution		1	4	4	4	4	4.0	**Tolerable with Mitigation**			
	Cumulative	Array area	C/D	Buoyed construction areaDevelopment of and adherence to a VMPDevelopment of and adherence to an NSPApplication for safety zonesGuard vessel (s) (via risk assessment)Promulgation of informationProject vessel compliance with international marine regulations	Project vessels in transit including towage operationLack of third-party awarenessConstruction vessels which are RAM	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution		1	4	4	4	4	4.0	**Tolerable with Mitigation**			
			O	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit including towage operation Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution		1	4	4	4	4	4.0	**Tolerable with Mitigation**			
		Offshore export cable corridor	C/D	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	2	2	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution		1	4	4	4	4	4.0	**Tolerable with Mitigation**			

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences – Frequency	Consequences – People	Consequences – Environment	Consequences – Property	Consequences – Business	Consequences – Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences – Frequency	Consequences – People	Consequences – Environment	Consequences – Property	Consequences – Business	Consequences – Average Consequence	Risk	Further Mitigation if Required	Additional Comments
			O	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	2	2	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	4	4	4	4.0	**Tolerable with Mitigation**		
Commercial fishing vessels in transit	Isolation	Array area	C/D	Buoyed construction area Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit including towage operation Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	**Broadly Acceptable**		Noted importance of VMP for this hazard.
			O	Buoyed construction area Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit or within array including towage operation Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	**Broadly Acceptable**		Noted importance of VMP for this hazard.

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation if Required	Additional Comments
		Offshore export cable corridor	C/D	Buoyed construction area Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	**Broadly Acceptable**		Noted importance of VMP for this hazard.
			O	Buoyed construction areaDevelopment of and adherence to a VMPFisheries liaison and Fishing Industry Representative Development of and adherence to an NSPApplication for safety zonesGuard vessel (s) (via risk assessment)Promulgation of informationProject vessel compliance with international marine regulations	Project vessels in transitLack of third-party awarenessMaintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	**Broadly Acceptable**		Noted importance of VMP for this hazard.
	Cumulative	Array area	C/D	Buoyed construction area Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit including towage operation Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	3	3	1	3	2	2.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	**Broadly Acceptable**		Noted importance of VMP for this hazard.

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
								Consequences								Consequences							
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
			O	Buoyed construction area Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit or within array including towage operation Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	3	3	1	3	2	2.3	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable		Noted importance of VMP for this hazard.
		Offshore export cable corridor	C/D	Buoyed construction area Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	2	2.3	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	2	4	2	4	4	3.5	Broadly Acceptable		Noted importance of VMP for this hazard.
			O	Buoyed construction area Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	2	2.3	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	2	4	2	4	4	3.5	Broadly Acceptable		Noted importance of VMP for this hazard.
Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information	Project vessels in transit including towage operation Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage,	1	4	2	4	2	3.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation if Required	Additional Comments
								Consequences									Consequences							
							Frequency	People	Environment	Property	Business	Average Consequence	Risk			Frequency	People	Environment	Property	Business	Average Consequence	Risk		
				Project vessel compliance with international marine regulations											PLL, and/or pollution									
			O	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit or within array including towage operation Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable		
		Offshore export cable corridor	C/D	Buoyed construction areaDevelopment of and adherence to a VMPDevelopment of and adherence to an NSPApplication for safety zonesGuard vessel (s) (via risk assessment)Promulgation of informationProject vessel compliance with international marine regulations	Project vessels in transitLack of third-party awarenessConstruction vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable		
			O	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation if Required	Additional Comments
							Frequency	Consequences					Risk		Frequency	Consequences					Risk		
								People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence			
	Cumulative	Array area	C/D	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit including towage operation Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable		
	Cumulative	Array area	O	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit or within array including towage operation Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable		
	Cumulative	Offshore export cable corridor	C/D	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Construction vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable		
	Cumulative	Offshore export cable corridor	O	Buoyed construction area Development of and adherence to a VMP Development of and adherence to an NSP Application for safety zones Guard vessel (s) (via risk assessment) Promulgation of information Project vessel compliance with international marine regulations	Project vessels in transit Lack of third-party awareness Maintenance vessels which are RAM	Increased encounters resulting in a low impact collision event	1	3	1	3	1	2.0	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable		
Reduced Access to Local Ports, Harbours and Marinas																								

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
Commercial vessels	Isolation	Array area	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on schedules, berth times, or compliance with COLREGs	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on schedules, berth times, and/or compliance with COLREGs	2	1	1	1	3	1.5	Broadly Acceptable		
			O	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on schedules, berth times, or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on schedules, berth times, and/or compliance with COLREGs	1	1	1	1	3	1.5	Broadly Acceptable		
		Offshore export cable corridor	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on schedules, berth times, or compliance with COLREGs	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on schedules, berth times, and/or compliance with COLREGs	2	1	2	1	2	1.5	Broadly Acceptable		
			O	Development of and adherence to an EMPDevelopment of and adherence to a VMPPromulgation of informationProject vessel compliance with international marine regulations	Project vessel use of local portsProject vessels which are RAM	Increased journey time/distance but does not impact on schedules, berth times, or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on schedules, berth times, and/or compliance with COLREGs	1	1	2	1	2	1.5	Broadly Acceptable		
	Cumulative	Array area	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on schedules, berth times, or compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on schedules, berth times, and/or compliance with COLREGs	2	1	1	1	4	1.8	Broadly Acceptable		
			O	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance	Project vessel use of local ports	Increased journey time/distance but does not impact on schedules, berth times, or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on schedules, berth times, and/or compliance with COLREGs	2	1	1	1	4	1.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation if Required	Additional Comments
				with international marine regulations																			
		Offshore export cable corridor	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on schedules, berth times, or compliance with COLREGs	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on schedules, berth times, and/or compliance with COLREGs	2	1	2	1	3	1.8	Broadly Acceptable		
		Offshore export cable corridor	O	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on schedules, berth times, or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on schedules, berth times, and/or compliance with COLREGs	1	1	2	1	3	1.8	Broadly Acceptable		
Commercial fishing vessels in transit	Isolation	Array area	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on transits or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	1	2	2	3	2	2.3	Broadly Acceptable		
Commercial fishing vessels in transit	Isolation	Array area	O	Development of and adherence to an EMP Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on transits or compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	1	2	2	3	2	2.3	Broadly Acceptable		
Commercial fishing vessels in transit	Isolation	Offshore export cable corridor	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Promulgation of information Project vessel compliance	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on transits or compliance with COLREGs	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	3	2	2	3	2	2.3	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation if Required	Additional Comments
				with international marine regulations																			
			O	Development of and adherence to an EMP Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on transits or compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	2	2	3	2	2.3	Broadly Acceptable		
	Cumulative	Array area	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on transits or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	2	2	3	2	2.3	Broadly Acceptable		
			O	Development of and adherence to an EMPDevelopment of and adherence to a VMPFisheries liaison and Fishing Industry Representative Promulgation of informationProject vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on transits or compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	2	2	3	2	2.3	Broadly Acceptable		
		Offshore export cable corridor	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on transits or compliance with COLREGs	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	3	2	2	3	4	2.8	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
			O	Development of and adherence to an EMP Development of and adherence to a VMP Fisheries liaison and Fishing Industry Representative Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on transits or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	2	2	3	4	2.8	Broadly Acceptable		
Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on transits or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		
			O	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on transits or compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		
		Offshore export cable corridor	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on transits or compliance with COLREGs	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		
			O	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on transits or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	1	1	1	1	2	1.3	Broadly Acceptable		
	Cumulative	Array area	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance	Project vessel use of local ports	Increased journey time/distance but does not impact on transits or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
							Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
				with international marine regulations																			
			O	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports	Increased journey time/distance but does not impact on transits or compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		
		Offshore export cable corridor	C/D	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on transits or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		
			O	Development of and adherence to an EMP Development of and adherence to a VMP Promulgation of information Project vessel compliance with international marine regulations	Project vessel use of local ports Project vessels which are RAM	Increased journey time/distance but does not impact on transits or compliance with COLREGs	1	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits and/or compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		
Creation of Vessel to Structure Allision Risk (Including Powered, Drifting and Internal)																							
Commercial vessels	Isolation	Array area	O	Development of and adherence to a DSLPApplication for safety zones Promulgation of information Compliance with MGN 654 Lighting and markingMarking on Admiralty charts	Presence of surface structuresHuman/navigational errorMechanical/technical failureAdverse weatherAid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	2	1.3	Broadly Acceptable	Allision event occurs involving vessel damage, PLL and/or pollution	2	4	4	4	4	4.0	Tolerable with Mitigation	Inclusion of contingency plans for navigational lights as part of LMP process.	CoS noted that the preference is for the substations to be internal as opposed to peripheral, and that allision with a substation is more significant than an allision with a WTG.NLB noted consideration would need to be made for cases of a WTG with a key navigational light
	Cumulative	Array area	O	Development of and adherence to a DSLP Application for safety zones Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of surface structures Human/navigational error Mechanical/technical failure Adverse weather Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	2	1.3	Broadly Acceptable	Allision event occurs involving vessel damage, PLL and/or pollution	3	4	4	4	4	4.0	Tolerable with Mitigation	Inclusion of contingency plans for navigational lights as part of LMP process.	

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
							Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		
					Navigation between adjacent arrays																		being towed from site.MCA noted that a drifting vessel may not be able to adjust its course and speed.
Commercial fishing vessels in transit	Isolation	Array area	O	Development of and adherence to a DSLP Fisheries liaison and Fishing Industry Representative Application for safety zones Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of surface structures Human/navigational error Mechanical/technical failure Adverse weather Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	2	1.3	**Broadly Acceptable**	Allision event occurs potentially internally within the array involving vessel damage, PLL and/or pollution	3	5	4	4	4	4.3	**Tolerable with Mitigation**	Inclusion of contingency plans for navigational lights as part of LMP process.	
	Cumulative	Array area	O	Development of and adherence to a DSLP Fisheries liaison and Fishing Industry Representative Application for safety zones Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts	Presence of surface structures Human/navigational error Mechanical/technical failure Adverse weather Aid to navigation failure Navigation between adjacent arrays	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	2	1.3	**Broadly Acceptable**	Allision event occurs potentially internally within the array involving vessel damage, PLL and/or pollution	3	5	4	4	4	4.3	**Tolerable with Mitigation**	Inclusion of contingency plans for navigational lights as part of LMP process.	
Recreational vessels (2.5 to 24m length)	Isolation	Array area	O	Development of and adherence to a DSLP Fisheries liaison and Fishing Industry Representative Application for safety zones Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts Minimum blade tip clearance	Presence of surface structures Human/navigational error Mechanical/technical failure Adverse weather Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	2	1	1	1	2	1.3	**Broadly Acceptable**	Allision event occurs potentially internally within the array involving vessel damage, PLL and/or pollution	2	4	4	4	4	4.0	**Tolerable with Mitigation**	Inclusion of contingency plans for navigational lights as part of LMP process.	

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst Case Consequences	Realistic Worst Case Consequences								Further Mitigation if Required	Additional Comments
							Frequency	Consequences					Risk			Frequency	Consequences					Risk			
								People	Environment	Property	Business	Average Consequence					People	Environment	Property	Business	Average Consequence				
	Cumulative	Array area	O	Development of and adherence to a DSLP Fisheries liaison and Fishing Industry Representative Application for safety zones Promulgation of information Compliance with MGN 654 Lighting and marking Marking on Admiralty charts Minimum blade tip clearance	Presence of surface structures Human/navigational error Mechanical/technical failure Adverse weather Aid to navigation failure Navigation between adjacent arrays	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	2	1	1	1	2	1.3	**Broadly Acceptable**		Allision event occurs potentially internally within the array involving vessel damage, PLL and/or pollution	2	4	4	4	4	4.0	**Tolerable with Mitigation**		Inclusion of contingency plans for navigational lights as part of LMP process.	
Reduction of Under Keel Clearance as a Result of Cable Protection, Dynamic Cables, and Mooring Lines																									
All vessels	Isolation	All subsea cables	O	Development of and adherence to a CaP Compliance with MGN 654 Compliance with regulatory floating guidance Notification of damage or decay of cables Marking on Admiralty charts Cable Burial Risk Assessment	Presence of cable protection, dynamic cables, and mooring lines which reduces water depth Human/navigational error	Vessel transits over an area of reduced clearance but does not make contact	5	1	1	1	1	1.0	**Tolerable with Mitigation**		Interaction with dynamic cable, mooring line, or cable protection resulting in vessel damage, grounding (cable protection only) injury to person and/or pollution (including spillage of potential hazardous cargo)	2	3	4	4	4	3.8	**Broadly Acceptable**		MCA and NLB consultation on design	
Anchor Interaction with Mooring Lines and Subsea Cables																									
All vessels	Isolation	All subsea cables	O	Development of and adherence to a CaPDevelopment of and adherence to an NSPCompliance with regulatory floating guidanceGuard vessel (s) via risk assessmentPromulgation of informationNotification of damage or decay of cablesMarking on Admiralty chartsCompliance with regulatory floating guidanceCable Burial Risk Assessment	Presence of mooring linesPresence of subsea cablesMooring line designInsufficient cable burial/protectionHuman/navigational errorMechanical/technical failure	Vessel anchors on or drags anchor over a subsea cable or mooring line but no interaction occurs	3	1	1	1	1	1.0	**Broadly Acceptable**		Vessel anchors on or drags anchor over a subsea cable or mooring line with interaction occurring resulting in damage to the cable, protection, mooring line, and/or anchor	2	3	2	3	3	2.8	**Broadly Acceptable**			
Interference with Communications and Position Fixing Equipment from the Development																									
All vessels	Isolation	Array area	O	Compliance with MGN 654 Lighting and marking Marking on Admiralty charts Cable Burial Risk Assessment	Human error relating to adjustment of Radar controls Presence of surface structures	Structures have no effect upon the Radar, communication and position fixing	4	1	1	1	1	1.0	**Broadly Acceptable**		Structures have minor but manageable levels of Radar	3	1	1	1	1	1.0	**Broadly Acceptable**			

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Further Mitigation if Required	Additional Comments
						equipment on a vessel								interference on a vessel									
All vessels	Isolation	Offshore export cable corridor	O	Compliance with MGN 654 Marking on Admiralty charts Cable Burial Risk Assessment	EMF from cables	Cables have no effect upon the Radar, communication and position fixing equipment on a vessel	4	1	1	1	1	1.0	Broadly Acceptable	Cables have minor but manageable levels of EMF interference on a vessel	3	1	1	1	1	1.0	Broadly Acceptable		
Reduction of Emergency Response Capability including SAR Access																							
Emergency responders	Isolation	Proposed Development	O	Development of and adherence to a DSLP ERCoP Development of adherence to a VMP Compliance with MGN 654 Project vessel compliance with international marine regulations Lighting and marking	Array does not facilitate emergency responder access Adverse weather Limited resource capability	Delay to emergency response request	2	1	1	1	2	1.3	Broadly Acceptable	Delay to emergency response request leading to vessel damage, PLL and/or pollution	1	5	5	5	5	5.0	Tolerable with Mitigation		Assumes MGN 654 compliant layout
Emergency responders	Cumulative	Proposed Development	O	Development of and adherence to a DSLP ERCoP Development of adherence to a VMP Compliance with MGN 654 Project vessel compliance with international marine regulations Lighting and marking	Array does not facilitate emergency responder access Adverse weather Limited resource capability	Delay to emergency response request	3	1	1	1	2	1.3	Broadly Acceptable	Delay to emergency response request leading to vessel damage, PLL and/or pollution	2	5	5	5	5	5.0	Tolerable with Mitigation		Assumes MGN 654 compliant layout
Loss of Station																							
All Vessels	Isolation	Array Area (WTGs)	C/D	Fisheries Liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Lighting and marking Compliance with regulatory floating guidance	Damage to or failure of mooring line(s) Damage to or failure of tow during WTG towage operation	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	1	1.8	Broadly Acceptable	Total failure of mooring system leads to drifting of floating structure with risk of collision with vessels	2	4	4	4	4	4.0	Tolerable with Mitigation		

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation if Required	Additional Comments
								Consequences								Consequences							
							Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
			O	Fisheries Liaison and Fishing Industry Representative Development of and adherence to an NSP Guard vessel (s) (via risk assessment) Promulgation of information Lighting and marking Compliance with regulatory floating guidance	Damage to or failure of mooring line(s) Damage to or failure of tow during WTG towage operation	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	1	1.8	**Broadly Acceptable**	Total failure of mooring system leads to drifting of floating structure with risk of collision with vessels	2	4	4	4	4	4.0	**Tolerable with Mitigation**		

Appendix C Consequences Assessment

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 Proposed Development (Offshore).

The significance of the impact due to the presence of the Proposed Development (Offshore) is also assessed based on risk evaluation criteria and comparison with historical incident data in UK waters[7].

C.1 Risk Evaluation Criteria

C.1.1 Risk to People

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

- Individual risk; and
- Societal risk.

C.1.1.1 Individual Risk

Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of the Proposed Development (Offshore). 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 Proposed Development (Offshore) 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 Proposed Development (Offshore) 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 MSC 72/16 (IMO, 2001). The annual individual risk level to crew falls within the ALARP region for each of the vessel types presented.

[7] For the purposes of this assessment, UK waters is defined as the UK Exclusive Economic Zone (EEZ) and UK territorial waters refers to the 12nm limit from the British Isles, excluding the Republic of Ireland.

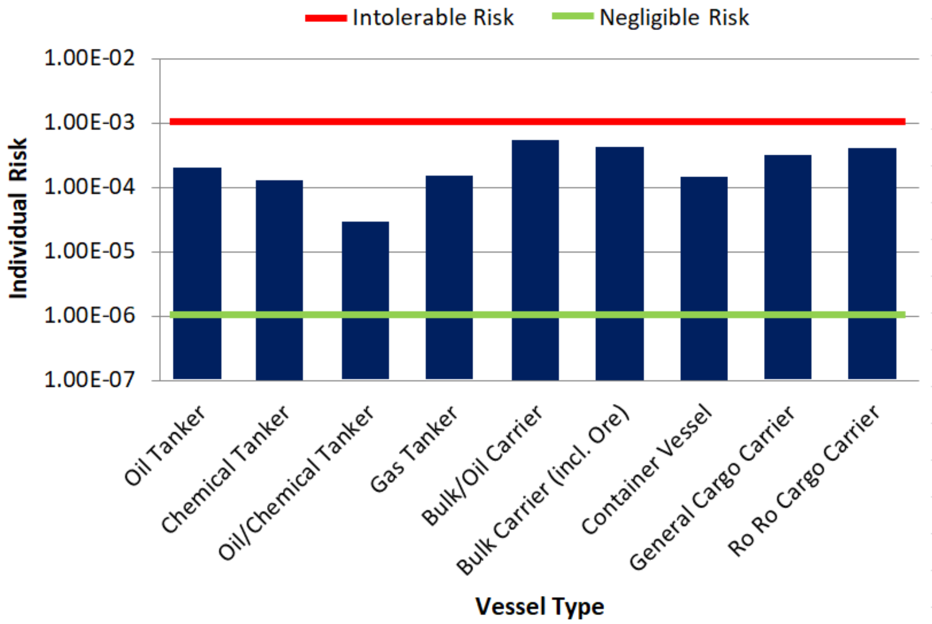

Figure C.1 Individual Risk Levels and Acceptance Criteria per Vessel Type

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.

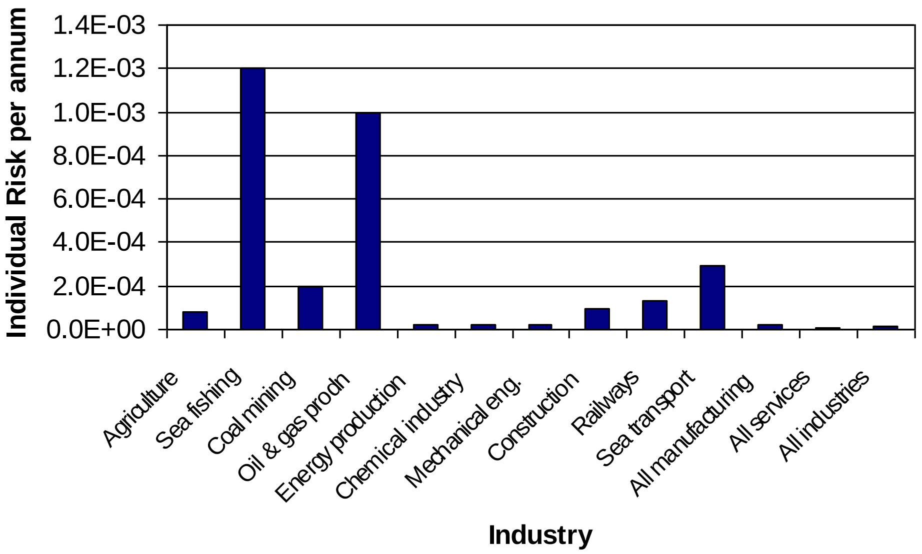

Figure C.2 Individual Risk per Year for Various UK Industries

The individual risk for sea transport of 2.9×10^{-4} per year is consistent with the worldwide data presented in Figure C.1, whilst the individual risk for sea fishing of 1.2×10^{-3} per year is the highest across all of the industries included.

C.1.1.2 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 Proposed Development (Offshore), giving account to the change in risk associated with each incident scenario caused by the introduction of the wind farm structures. Societal risk may be expressed as:

- Annual fatality rate where frequency and fatality are combined into a convenient one-dimensional measure of societal risk (also known as potential loss of life (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.1.2 Risk to Environment

For risk to the environment the key criteria considered in terms of the risk due to the Proposed Development (Offshore) 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 Proposed Development (Offshore) compared to UK background pollution risk levels.

C.2 Marine Accident Investigation Branch Incident Data

C.2.1 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 12nm 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 Proposed Development (Offshore).

Accounting for these criteria, a total of 11,773 accidents, injuries and hazardous incidents were reported to the MAIB in the 20-year period between 2002 and 2021 involving 13,415 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. The majority of incidents occur in coastal waters.

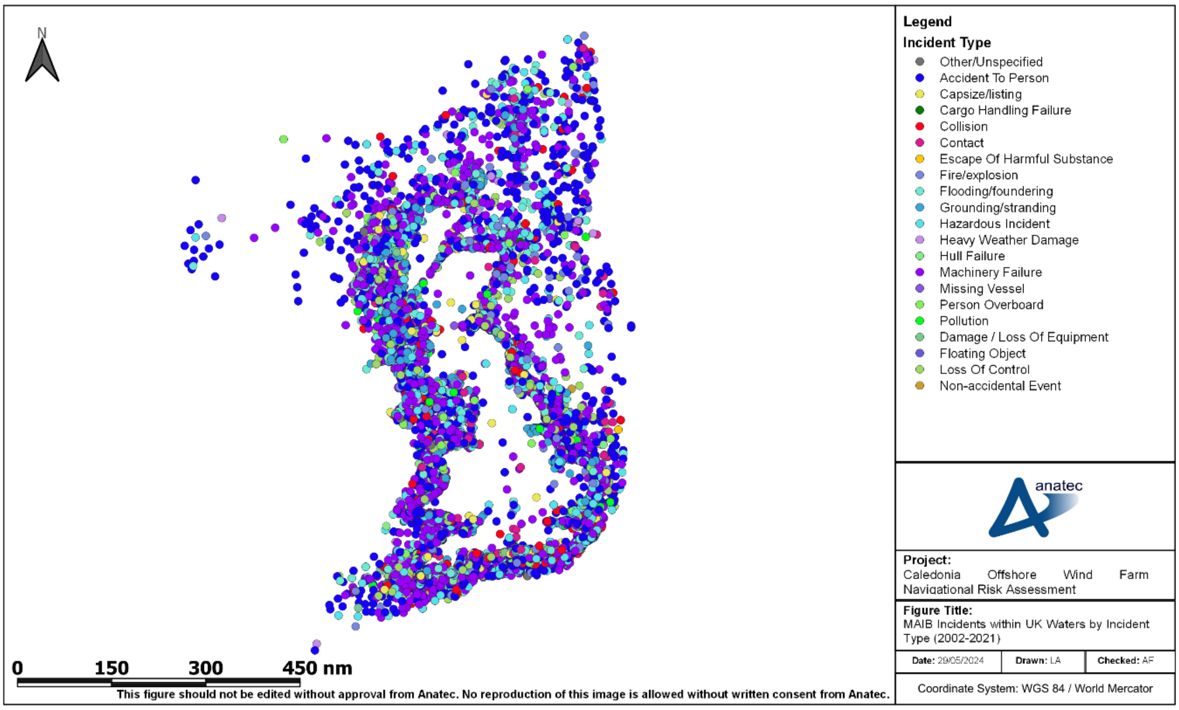

Figure C.3 MAIB Incident Locations by Incident Type within UK Waters (2002 to 2021)

The distribution of incidents by year in UK waters is presented in Figure C.4.

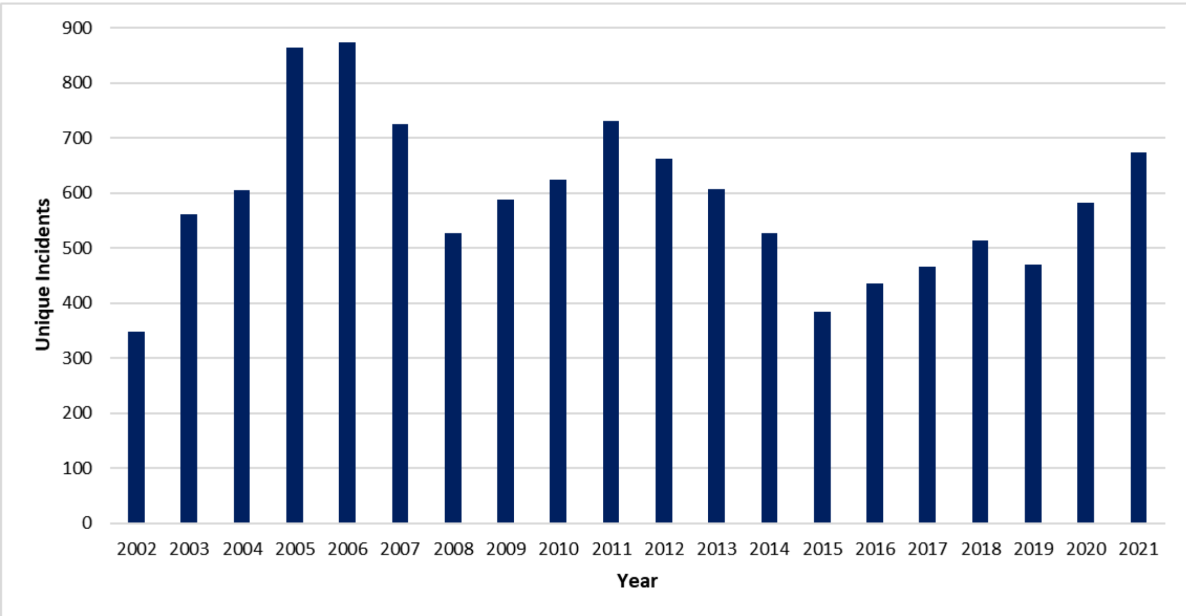

Figure C.4 MAIB Unique Incidents per Year within UK Waters (2002 to 2021)

The average number of unique incidents per year was 589. 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.

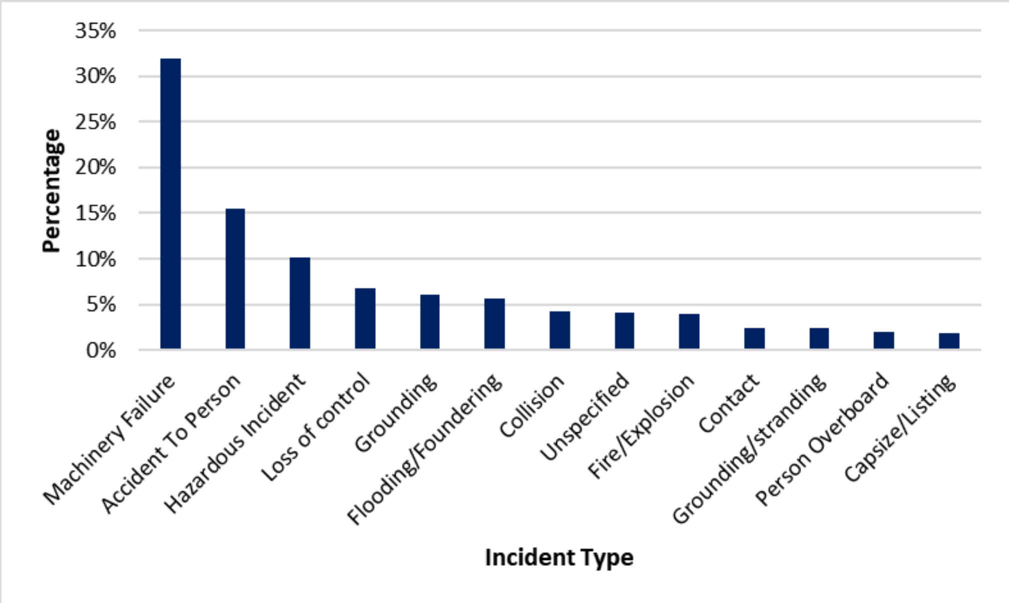

Figure C.5 MAIB Incident Types Breakdown within UK Waters (2002 to 2021)

The most frequent incident types were "*machinery failure*" (32%), "*accident to person*" (16%) and "*hazardous incident*" (10%). "*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.

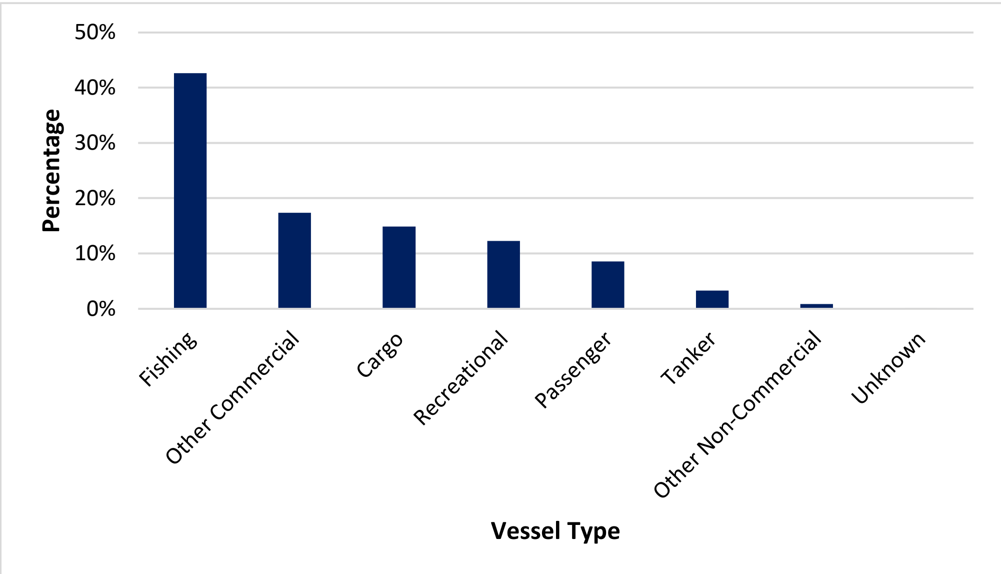

Figure C.6 MAIB Vessel Types Breakdown within UK Waters (2002 to 2021)

The most frequent vessel types involved in incidents were fishing vessels (43%), other commercial vessels (17%) (including offshore industry vessels, tugs, workboats and pilot vessels) and cargo vessels (15%).

A total of 414 fatalities were reported in the MAIB incidents within UK waters between 2002 and 2021, corresponding to an average of 21 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.

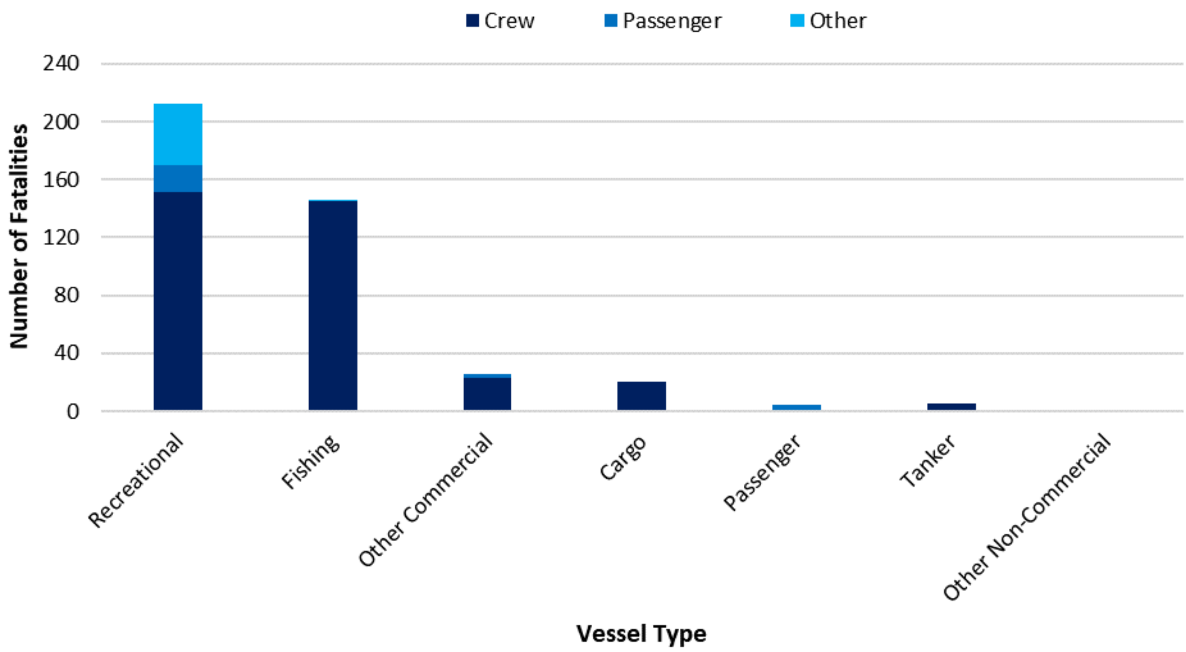

Figure C.7 MAIB Fatalities by Vessel Type within UK Waters (2002 to 2021)

The majority of fatalities occurred to recreational vessels (51%) and fishing vessels (35%), with crew members the main people involved (83%).

C.2.2 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 504 collision incidents were reported to the MAIB in UK waters between 2002 and 2021 involving 1,068 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.

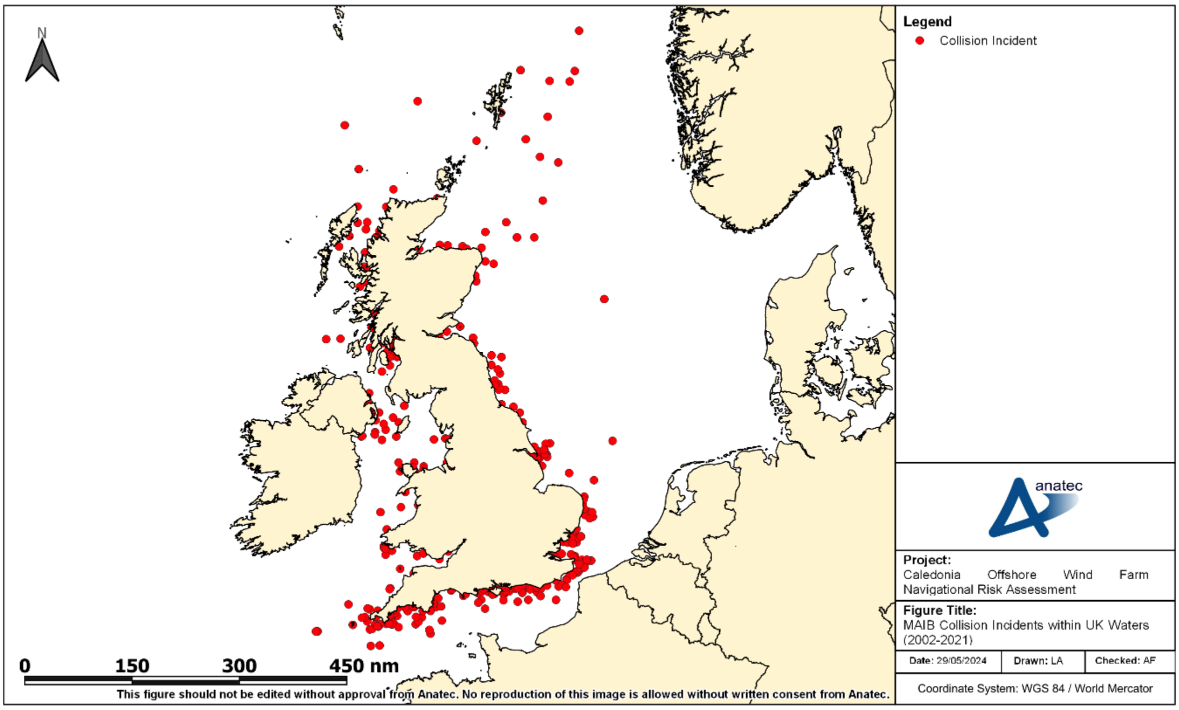

Figure C.8 MAIB Collision Incident Locations within UK Waters (2002 to 2021)

The distribution of collision incidents per year is presented in Figure C.9.

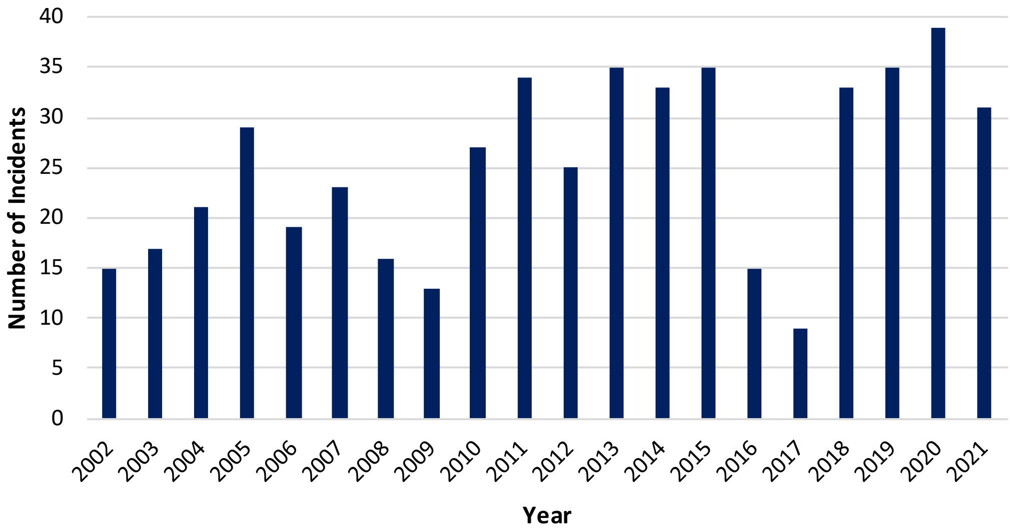

Figure C.9 MAIB Annual Collision Incidents within UK Waters (2002 to 2021)

The average number of collision incidents per year was 25. There has been an overall slight increasing trend in collision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

The distribution of vessel types involved in collision incidents is presented in Figure C.10.

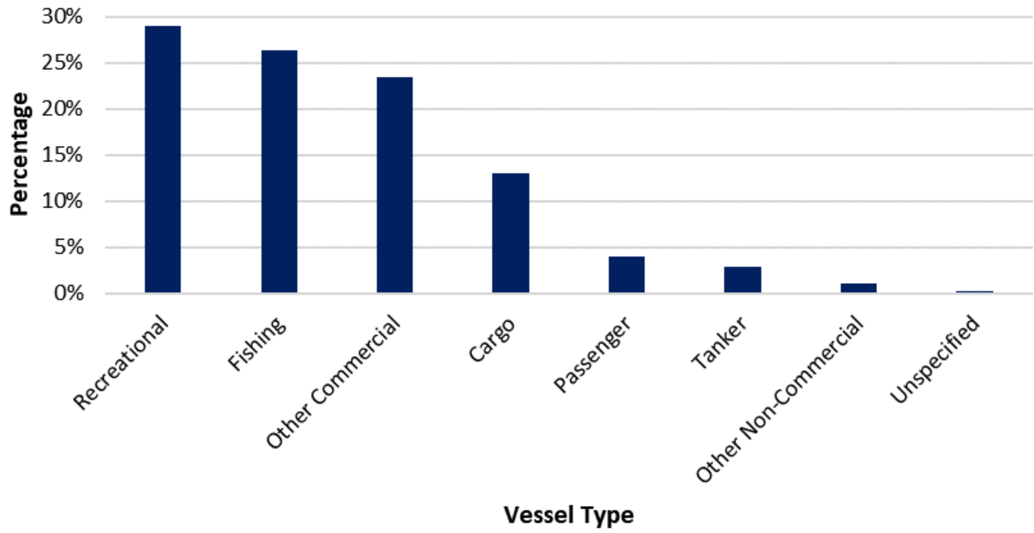

Figure C.10 MAIB Collision Incidents by Vessel Type within UK Waters (2002 to 2021)

The most frequent vessel types involved in collision incidents were recreational vessels (29%), fishing vessels (26%), other commercial vessels (24%) and cargo vessels (13%).

A total of five fatalities were reported in MAIB collision incidents within UK waters between 2002 and 2021. 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 (2002 to 2021)

Date	Description	Fatalities
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

Date	Description	Fatalities
June 2018	Collision between power boats during a race. One of the vessels overturned with the pilot pronounced dead at the scene.	1

C.2.3 Allision 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). In line with the NRA as a whole, an allision is considered to involve a moving object and a stationary object at sea, with port infrastructure excluded from consideration; the MAIB contact incidents have been individually inspected and filtered in line with the NRA definition.

A total of 119 allision incidents were reported to the MAIB within UK waters between 2002 and 2021 involving 119 vessels.

The locations of allision incidents reported in proximity to the UK are presented in Figure C.11.

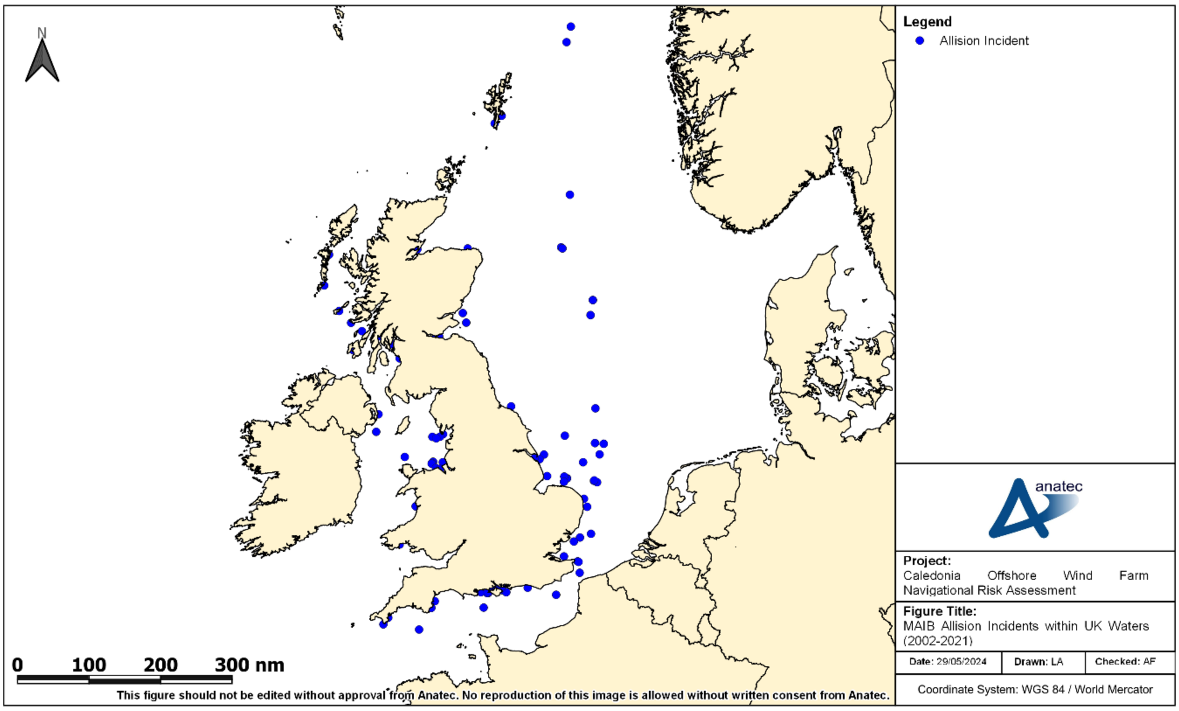

Figure C.11 MAIB Allision Incident Locations within UK waters (2002 to 2021)

The distribution of allision incidents per year is presented in Figure C.12.

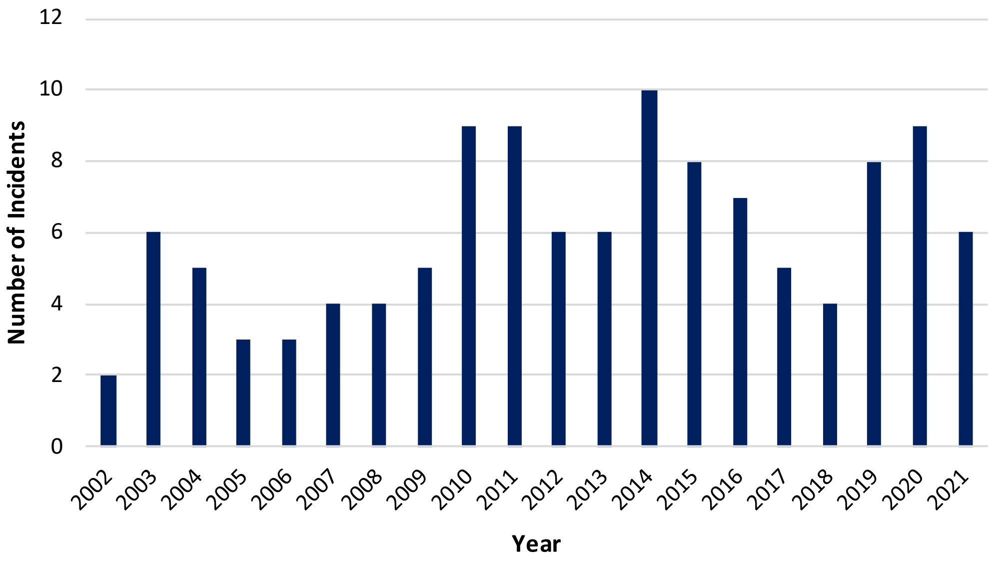

Figure C.12 MAIB Allision Incidents per Year within UK Waters (2002 to 2021)

The average number of allision incidents per year was six. As with collision incidents, there has been an overall slight increasing trend in allision incidents 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 allision incidents is presented in Figure C.13.

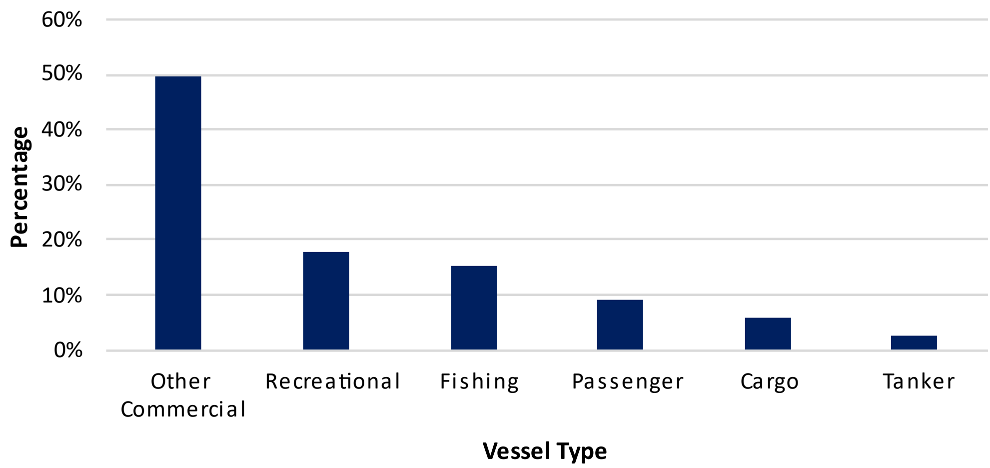

Figure C.13 MAIB Allision Incidents by Vessel Type within UK Waters (2002 to 2021)

The most frequent vessel types involved in allision incidents were other commercial vessels (50%), recreational vessels (18%) and fishing vessels (15%).

No fatalities were reported in MAIB allision incidents within offshore UK waters between 2002 and 2021.

C.3 Fatality Risk – Caledonia OWF

C.3.1 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 Caledonia OWF.

Caledonia OWF 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.2.2 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 not clearly represented by the MAIB data (as discussed in Section C.2.3). Additionally, none of the allision incidents reported by the MAIB between 2002 and 2021 resulted in a fatality.

Therefore, the MAIB collision fatality risk rate has also been conservatively applied for the allision incident types.

C.3.2 Fatality Probability

Five of the 504 collision incidents reported by the MAIB within UK waters between 2002 and 2021 resulted in one or more fatalities. This gives a 0.99% 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.3 presents the average number of people on board (POB) estimated for each category of vessel navigating in proximity to Caledonia OWF For passenger vessels this is based upon information available for the specific vessels recorded in the vessel traffic survey data. For other vessel categories, this is based upon information available from the MAIB incident data.

Table C.3 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	23
Passenger	RoRo passenger, cruise liner, etc.	Vessel traffic survey data / online information	1,257
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3
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.2.2), there was an estimated 57,524 POB the vessels involved in the collision incidents.

Based upon five fatalities during the period 2002 to 2021, the overall fatality probability in a collision for any individual onboard is approximately 8.69×10^{-5} 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.4. In addition, due to zero fatalities resulting from commercial vessel collisions between 2002 and 2021, the time period used to assess the fatality probability for commercial vessels has been extended by five years to ensure a meaningful probability is captured.

Table C.4 Collision Incident Fatality Probability by Vessel Category

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability	Time Period
Commercial	Dry cargo, passenger, tanker, etc.	1	55,573	$1.80\text{x}10^{-5}$	1997 to 2021 (25 years)
Fishing	Trawler, potter, dredger, etc.	2	927	2.2×10^{-3}	2002 to 2021 (20 years)
Recreational	Yacht, small commercial motor yacht, etc.	3	1,023	2.9×10^{-3}	2002 to 2021 (20 years)

C.3.3 Fatality Risk due to Caledonia OWF

The base case and future case annual collision frequency levels pre and post wind farm for Caledonia OWF are summarised in Table C.5.

Table C.5 Summary of Annual Collision and Allision Risk Results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	$1.92\text{x}10^{-3}$ (1 in 520 years)	$3.42\text{x}10^{-3}$ (1 in 292 years)	$1.50\text{x}10^{-3}$ (1 in 667 years)
	Future case (10%)	$2.42\text{x}10^{-3}$ (1 in 413 years)	$4.29\text{x}10^{-3}$ (1 in 232 years)	$1.87\text{x}10^{-3}$ (1 in 533 years)
	Future case (20%)	$2.86\text{x}10^{-3}$ (1 in 350 years)	$5.07\text{x}10^{-3}$ (1 in 197 years)	$2.21\text{x}10^{-3}$ (1 in 451 years)
Powered vessel to structure allision	Base case	-	$2.93\text{x}10^{-3}$ (1 in 341 years)	$2.93\text{x}10^{-3}$ (1 in 341 years)
	Future case (10%)	-	$3.25\text{x}10^{-3}$ (1 in 307 years)	$3.25\text{x}10^{-3}$ (1 in 307 years)
	Future case (20%)	-	$3.55\text{x}10^{-3}$ (1 in 282 years)	$3.55\text{x}10^{-3}$ (1 in 282 years)
Drifting vessel to structure allision	Base case	-	$2.47\text{x}10^{-4}$ (1 in 4,054 years)	$2.47\text{x}10^{-4}$ (1 in 4,054 years)
	Future case (10%)	-	$2.71\text{x}10^{-4}$ (1 in 3,685 years)	$2.71\text{x}10^{-4}$ (1 in 3,685 years)
	Future case (20%)	-	$2.96\text{x}10^{-4}$ (1 in 3,377 years)	$2.96\text{x}10^{-4}$ (1 in 3,377 years)
Fishing vessel to structure allision	Base case	-	$2.89\text{x}10^{-1}$ (1 in 3.5 years)	$2.89\text{x}10^{-4}$ (1 in 3.5 years)
	Future case (10%)	-	$3.17\text{x}10^{-1}$ (1 in 3.2 years)	$3.17\text{x}10^{-1}$ (1 in 3.2 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
	Future case (20%)	-	3.45×10^{-1} (1 in 2.9 years)	3.45×10^{-1} (1 in 2.9 years)
Total	**Base case**	**1.92×10^{-3} (1 in 520 years)**	**2.95×10^{-1} (1 in 3.4 years)**	**2.94×10^{-1} (1 in 3.4 years)**
	Future case (10%)	**2.42×10^{-3} (1 in 413 years)**	**3.25×10^{-1} (1 in 3.1 years)**	**3.22×10^{-1} (1 in 3.1 years)**
	Future case (20%)	**2.86×10^{-3} (1 in 350 years)**	**3.54×10^{-1} (1 in 2.8 years)**	**3.51×10^{-1} (1 in 2.8 years)**

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 Caledonia OWF for the base case and future case are presented in Figure C.14.

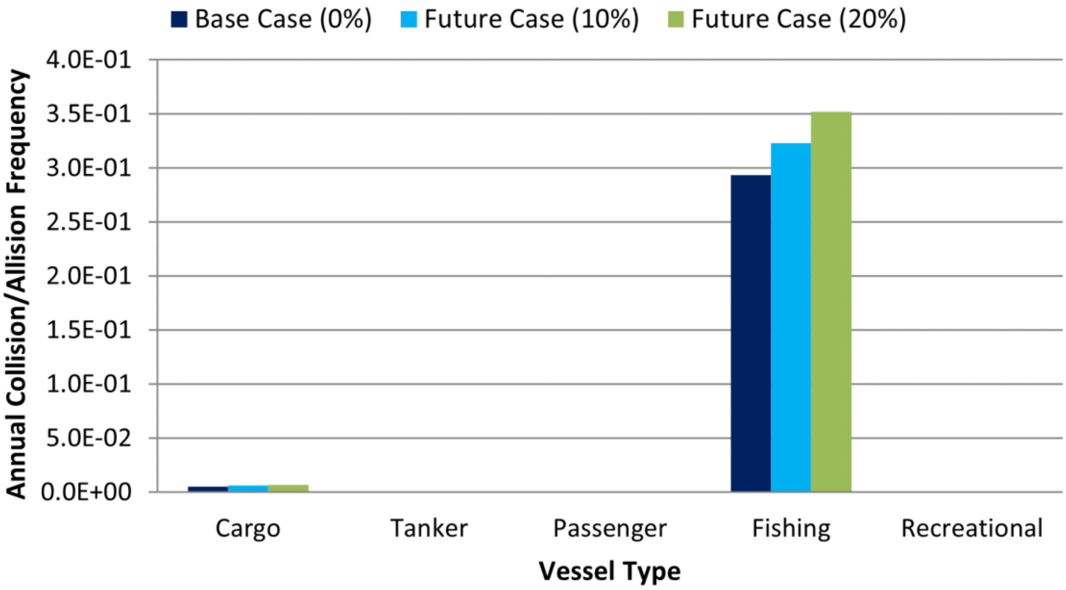

Figure C.14 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

It is seen that the majority of change in collision and allision frequency is associated with fishing vessels, owing to the greater duration spent in proximity to Caledonia OWF by fishing vessels engaged in fishing activities as well as the possibility of fishing occurring internally within Caledonia OWF itself.

Combining the annual collision and allision frequency (see Table C.5), estimated number of POB for each vessel type (see Table C.3) and the estimated fatality probability for each vessel type category (see Table C.4), the annual increase in PLL due to the presence of Caledonia

OWF the base case is estimated to be 2.01×10^{-3}, equating to one additional fatality every 497 years. As discussed below the vast majority of the PLL is associated with fishing vessels, and the conservative assumptions made in relation to fishing vessels should therefore be considered (see Section 16.3.5).

The estimated incremental increases in PLL due to Caledonia OWF, distributed by vessel type and for the base case and future case, are presented in Figure C.15.

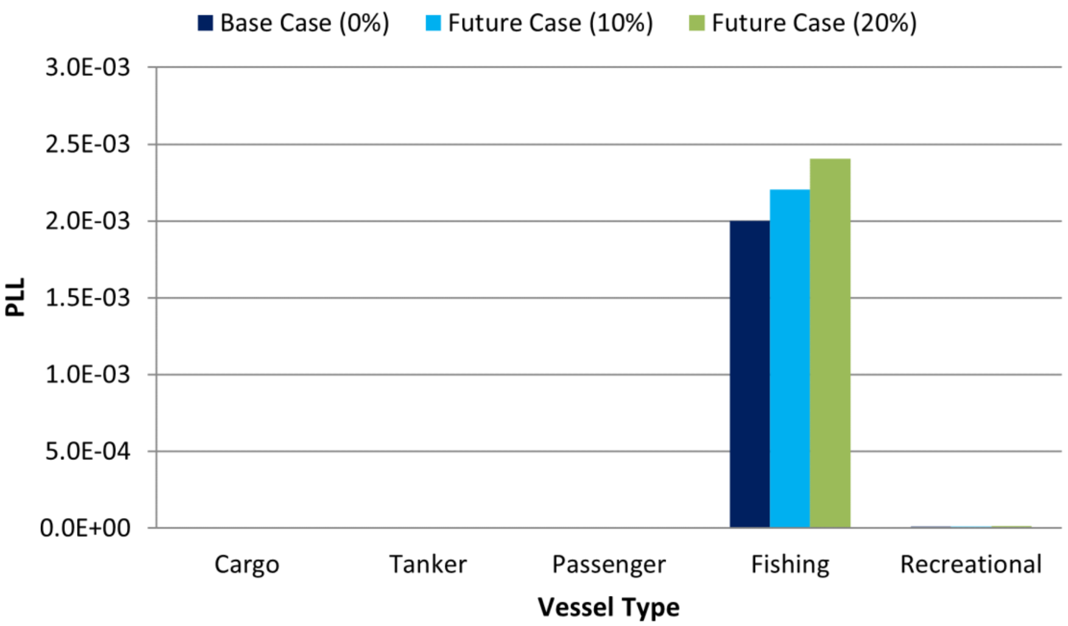

Figure C.15 Estimated Change in Annual PLL by Vessel Type

As with the change in annual collision and allision frequency, it can be seen that the majority of the change in annual PLL is associated with fishing vessels, which historically have a higher fatality probability than commercial vessels. The conservative assumptions made in relation to fishing vessels should therefore be considered (see Section 16.3.5) when viewing these results, in particular that baseline activity will not change. Based on consultation (Section 4), it is likely that in reality at least a proportion of fishing vessels will deviate.

Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in Figure C.16.

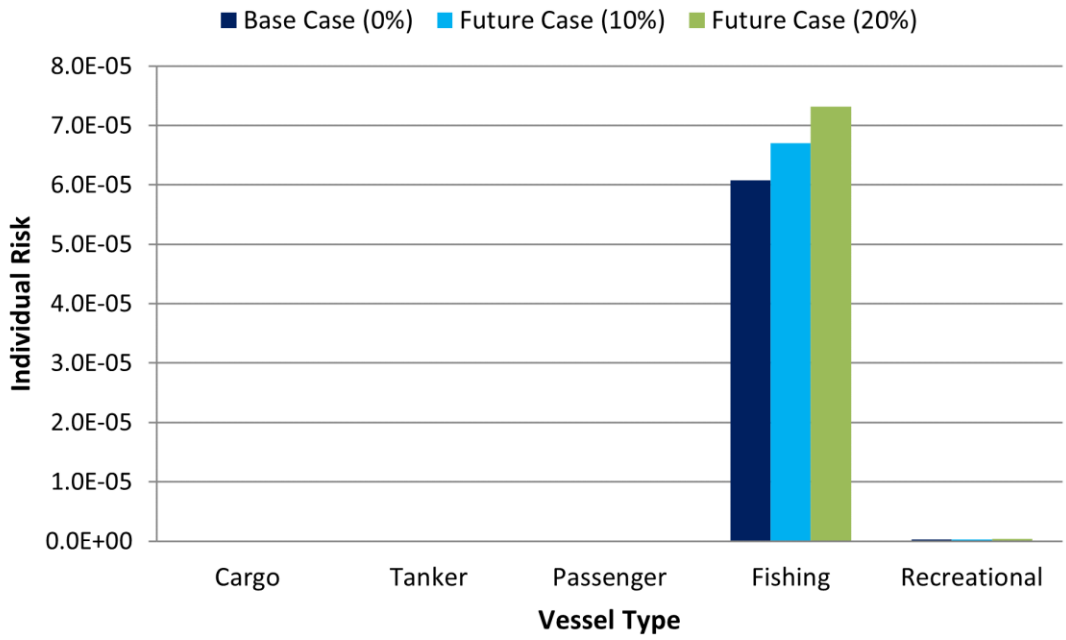

Figure C.16 Estimated Change in Individual Risk by Vessel Type

It can be seen that the individual risk is highest for people on fishing vessels, which reflects the higher probability of a fatality occurring in the event of an incident involving a fishing vessel.

C.3.4 Significance of Increase in Fatality Risk

In comparison to MAIB statistics, which indicate an average of 18 to 19 fatalities per year in UK territorial waters during the 20-year period between 2002 and 2021, the overall increase for the base case in PLL of one additional fatality per 497 years represents a low change.

In terms of individual risk to people, the change for commercial vessels attributed to Caledonia OWF (approximately 1.49×10^{-8} for the base case) is very low 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 Caledonia OWF (approximately 6.08×10^{-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.4 Pollution Risk – Caledonia OWF

C.4.1 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 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.17.

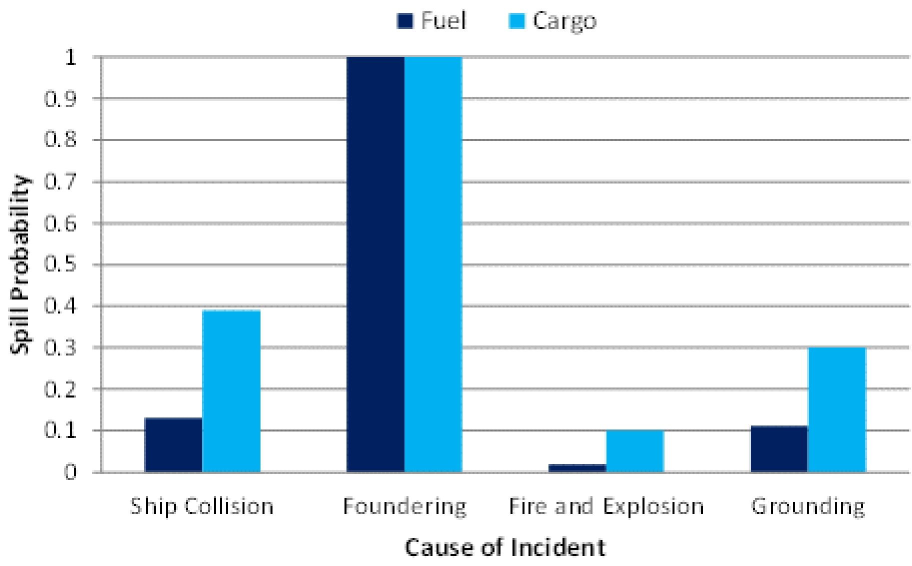

Figure C.17 Probability of an Oil Spill Resulting from an Accident

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 vessels 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 Caledonia OWF, 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 Caledonia OWF, 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.4.2 Pollution Risk due to Caledonia OWF

Applying the above probabilities to the annual collision and allision frequency by vessel type presented in Table C.5 and the average spill size per vessel, the amount of oil spilled per year due to the impact of Caledonia OWF is estimated to be 0.90 tonnes per year for the base case and 1.01 tonnes and 1.10 tonnes per year for the future cases of 10% and 20% vessel traffic increases respectively.

The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future case are presented in Figure C.18.

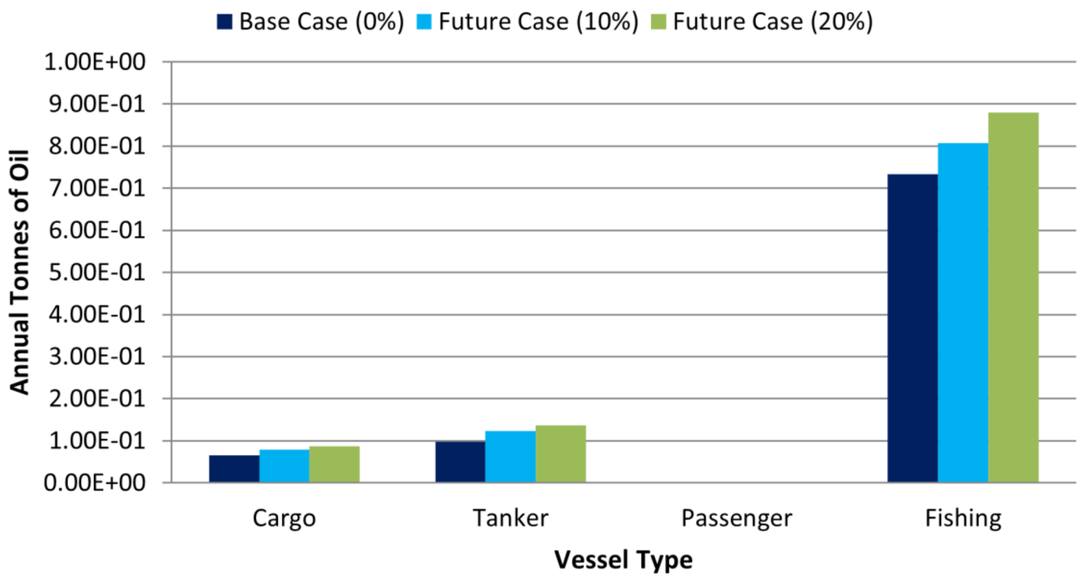

Figure C.18 Estimated Change in Pollution by Vessel Type

The majority of annual oil spill results are associated with fishing vessels due to the high annual allision frequency associated with fishing vessels. Tankers and cargo vessels also contribute to the annual oil spill estimate, which reflects the greater spillage size anticipated in associated incidents.

C.4.3 Significance of Increase in Pollution Risk

To assess the significance of the increased pollution risk from vessels caused by Caledonia OWF 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 Caledonia OWF of 0.9 tonnes for the base case represents a less than 0.01% increase compared to the historical average pollution quantities from maritime incidents in UK waters.

C.5 Fatality Risk – Caledonia North Site

C.5.1 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 Caledonia North Site.

The Caledonia North Site 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.2.2 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 not clearly represented by the MAIB data (as discussed in Section C.2.3). Additionally, none of the allision incidents reported by the MAIB between 2002 and 2021 resulted in a fatality.

Therefore, the MAIB collision fatality risk rate has also been conservatively applied for the allision incident types.

C.5.2 Fatality Probability

Five of the 504 collision incidents reported by the MAIB within UK waters between 2002 and 2021 resulted in one or more fatalities. This gives a 0.99% 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.6 presents the average number of people on board (POB) estimated for each category of vessel navigating in proximity to the Caledonia North Site. For passenger vessels this is based upon information available for the specific vessels recorded in the vessel traffic survey data. For other vessel categories, this is based upon information available from the MAIB incident data.

Table C.6 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	23
Passenger	RoRo passenger, cruise liner, etc.	Vessel traffic survey data / online information	1,257
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3
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.2.2), there was an estimated 57,524 POB the vessels involved in the collision incidents.

Based upon five fatalities during the period 2002 to 2021, the overall fatality probability in a collision for any individual onboard is approximately 8.69×10^{-5} 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.7. In addition, due to zero fatalities resulting from commercial vessel collisions between 2002 and 2021, the time period used to assess the fatality probability for commercial vessels has been extended by five years to ensure a meaningful probability is captured.

Table C.7 Collision Incident Fatality Probability by Vessel Category

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability	Time Period
Commercial	Dry cargo, passenger, tanker, etc.	1	55,573	1.80×10^{-5}	1997 to 2021 (25 years)
Fishing	Trawler, potter, dredger, etc.	2	927	2.2×10^{-3}	2002 to 2021 (20 years)
Recreational	Yacht, small commercial motor yacht, etc.	3	1,023	2.9×10^{-3}	2002 to 2021 (20 years)

C.5.3 Fatality Risk due to the Caledonia North Site

The base case and future case annual collision frequency levels pre and post wind farm for the Caledonia North Site are summarised in Table C.8.

Table C.8 Summary of Annual Collision and Allision Risk Results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.92×10^{-3} (1 in 520 years)	3.01×10^{-3} (1 in 332 years)	1.09×10^{-3} (1 in 919 years)
	Future case (10%)	2.42×10^{-3} (1 in 413 years)	3.77×10^{-3} (1 in 265 years)	1.35×10^{-3} (1 in 740 years)
	Future case (20%)	2.86×10^{-3} (1 in 350 years)	4.45×10^{-3} (1 in 224 years)	1.60×10^{-3} (1 in 625 years)
Powered vessel to structure allision	Base case	-	5.15×10^{-4} (1 in 1,943 years)	5.15×10^{-4} (1 in 1,943 years)
	Future case (10%)	-	5.73×10^{-4} (1 in 1,744 years)	5.73×10^{-4} (1 in 1,744 years)
	Future case (20%)	-	6.23×10^{-4} (1 in 1,603 years)	6.23×10^{-4} (1 in 1,603 years)
Drifting vessel to structure allision	Base case	-	9.18×10^{-5} (1 in 10,897 years)	9.18×10^{-5} (1 in 10,897 years)
	Future case (10%)	-	1.01×10^{-4} (1 in 9,906 years)	1.01×10^{-4} (1 in 9,906 years)
	Future case (20%)	-	1.10×10^{-4} (1 in 9,080)	1.10×10^{-4} (1 in 9,080)
Fishing vessel to structure allision	Base case	-	1.38×10^{-1} (1 in 7.2 years)	1.38×10^{-1} (1 in 7.2 years)
	Future case (10%)	-	1.52×10^{-1} (1 in 6.6 years)	1.52×10^{-1} (1 in 6.6 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
	Future case (20%)	-	1.65x10^{-1} (1 in 6.1 years)	1.65x10^{-1} (1 in 6.1 years)
Total	**Base case**	**1.92x10^{-3} (1 in 520 years)**	**1.42x10^{-1} (1 in 7.1 years)**	**1.40x10^{-1} (1 in 7.1 years)**
	Future case (10%)	**2.42x10^{-3} (1 in 413 years)**	**1.56x10^{-1} (1 in 6.4 years)**	**1.54x10^{-1} (1 in 6.5 years)**
	Future case (20%)	**2.86x10^{-3} (1 in 350 years)**	**1.70x10^{-1} (1 in 5.9 years)**	**1.68x10^{-1} (1 in 6 years)**

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 Caledonia North Site for the base case and future case are presented in Figure C.19.

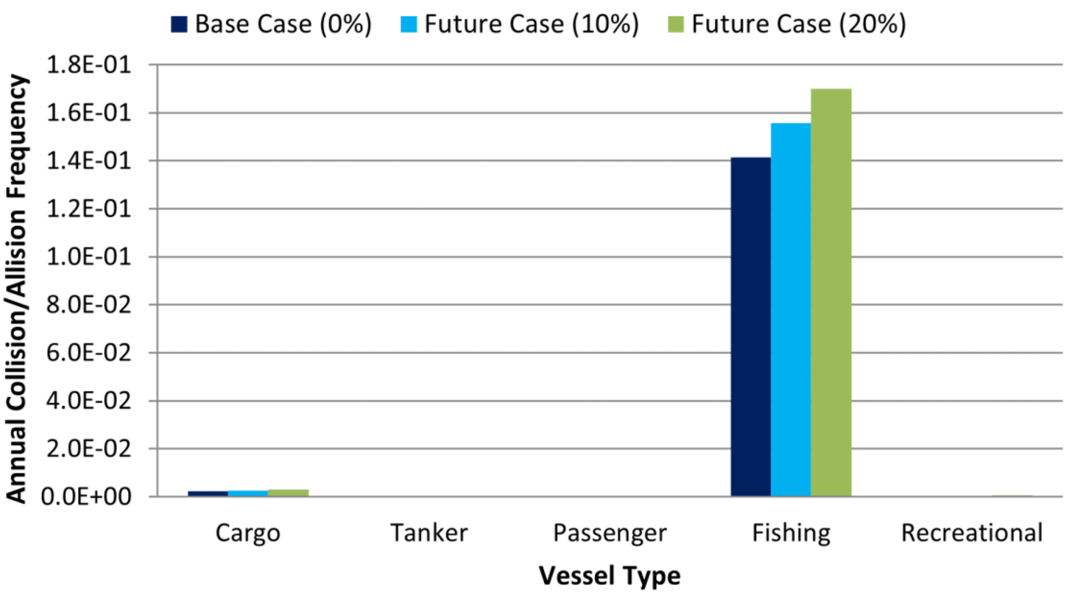

Figure C.19 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

It is seen that the majority of change in collision and allision frequency is associated with fishing vessels, owing to the greater duration spent in proximity to the Caledonia North Site by fishing vessels engaged in fishing activities as well as the possibility of fishing occurring internally within the Caledonia North Site itself.

Combining the annual collision and allision frequency (see Table C.8), estimated number of POB for each vessel type (see Table C.6) and the estimated fatality probability for each vessel type category (see Table C.7), the annual increase in PLL due to the presence of the Caledonia

North Site for the base case is estimated to be 9.80×10^{-4}, equating to one additional fatality every 1,021 years.

The estimated incremental increases in PLL due to the Caledonia North Site, distributed by vessel type and for the base case and future case, are presented in Figure C.20.

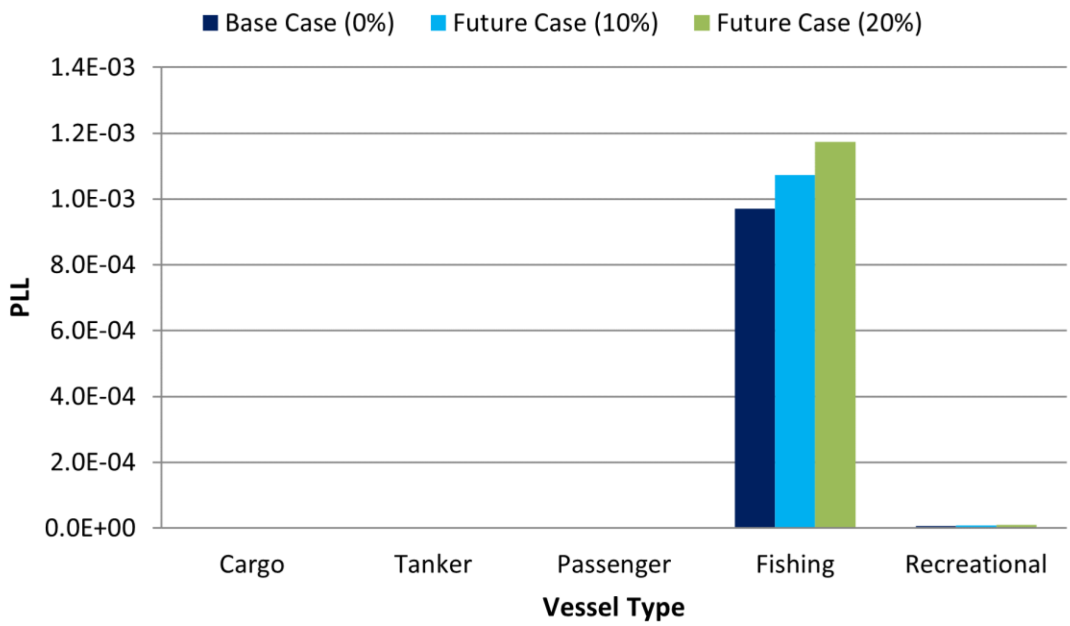

Figure C.20 Estimated Change in Annual PLL by Vessel Type

As with the change in annual collision and allision frequency, it can be seen that the majority of the change in annual PLL is associated with fishing vessels, which historically have a higher fatality probability than commercial vessels. The conservative assumptions made in relation to fishing vessels should therefore be considered (see Section 16.3.5) when viewing these results, in particular that baseline activity will not change. Based on consultation (Section 4), it is likely that in reality at least a proportion of fishing vessels will deviate.

Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in Figure C.21.

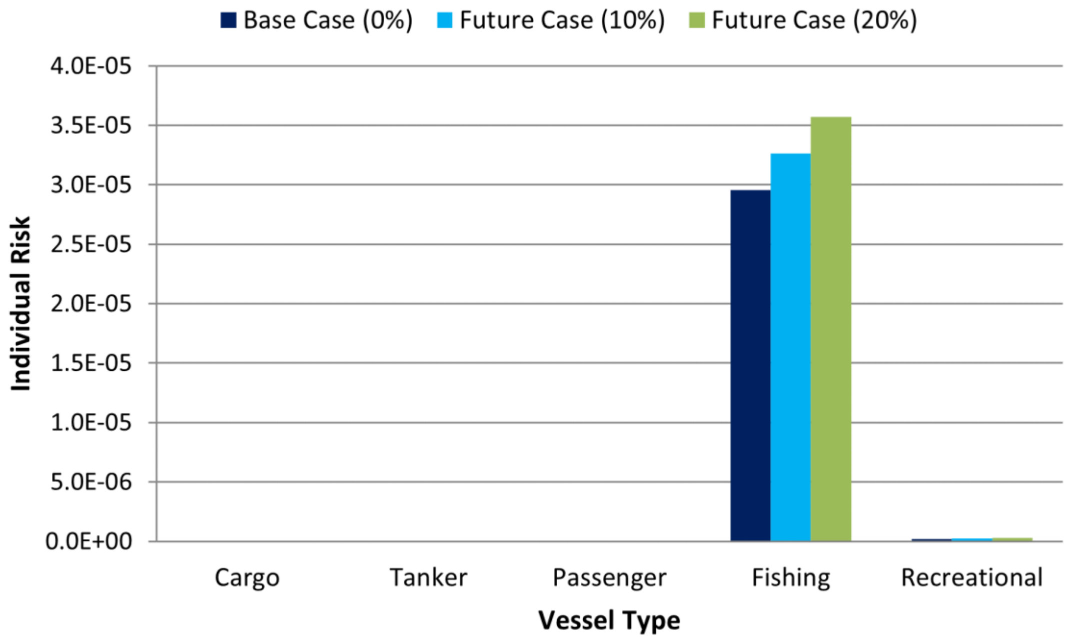

Figure C.21 Estimated Change in Individual Risk by Vessel Type

It can be seen that the individual risk is highest for people on fishing vessels, which reflects the higher probability of a fatality occurring in the event of an incident involving a fishing vessel.

C.5.4 Significance of Increase in Fatality Risk

In comparison to MAIB statistics, which indicate an average of 18 to 19 fatalities per year in UK territorial waters during the 20-year period between 2002 and 2021, the overall increase for the base case in PLL of one additional fatality per 1,021 years represents a small change.

In terms of individual risk to people, the change for commercial vessels attributed to the Caledonia North Site (approximately 7.78×10^{-9} for the base case) is very low 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 Caledonia North Site (approximately 2.95×10^{-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.6 Pollution Risk – Caledonia North Site

C.6.1 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 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.22.

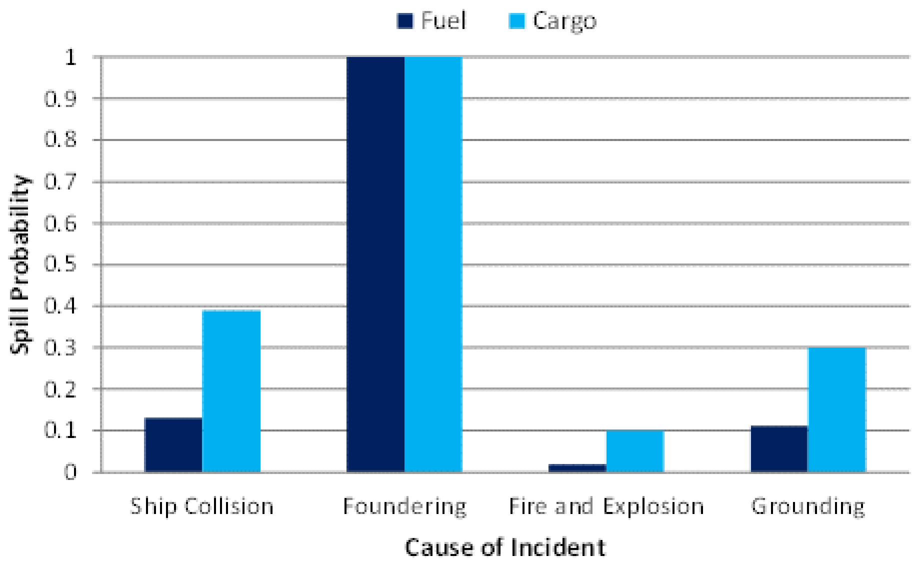

Figure C.22 Probability of an Oil Spill Resulting from an Accident

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 vessels 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 Caledonia North Site, 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 Caledonia North Site, 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.6.2 Pollution Risk due to the Caledonia North Site

Applying the above probabilities to the annual collision and allision frequency by vessel type presented in Table C.8 and the average spill size per vessel, the amount of oil spilled per year due to the impact of the Caledonia North Site is estimated to be 0.43 per year for the base case and 0.48 tonnes and 0.53 tonnes per year for the future cases of 10% and 20% vessel traffic increases respectively.

The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future case are presented in Figure C.23.

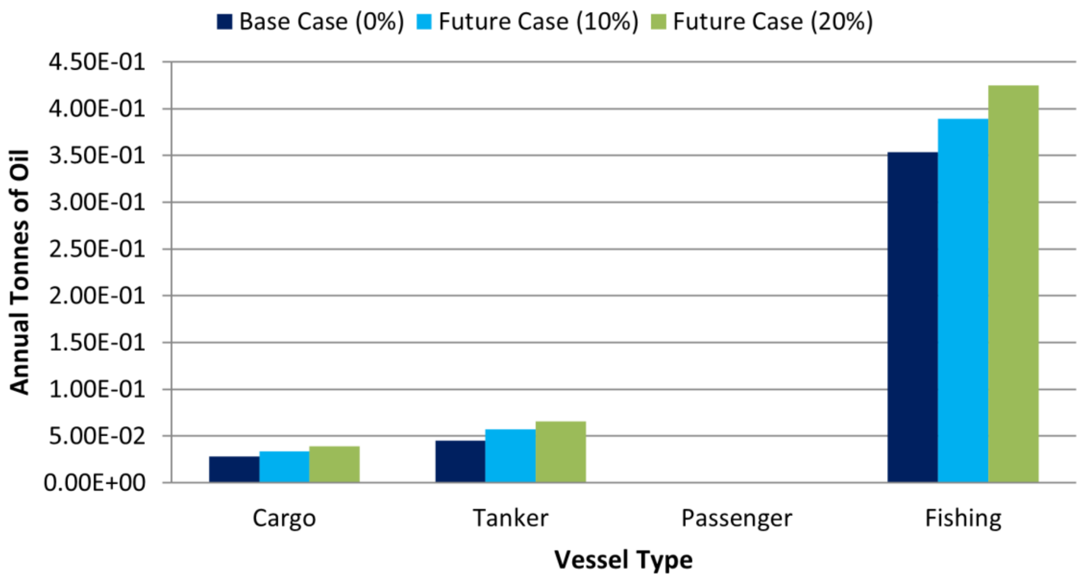

Figure C.23 Estimated Change in Pollution by Vessel Type

The majority of annual oil spill results are associated with fishing vessels due to the high annual allision frequency associated with fishing vessels. Tankers and cargo vessels also contribute to the annual oil spill estimate, which reflects the greater spillage size anticipated in associated incidents.

C.6.3 Significance of Increase in Pollution Risk

To assess the significance of the increased pollution risk from vessels caused by the Caledonia North Site, 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 Caledonia North Site of 0.43 tonnes for the base case represents a 0.003% increase compared to the historical average pollution quantities from maritime incidents in UK waters.

C.7 Fatality Risk – Caledonia South Site

C.7.1 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 Caledonia South Site.

The Caledonia South Site 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.2.2 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 not clearly represented by the MAIB data (as discussed in Section C.2.3). Additionally, none of the allision incidents reported by the MAIB between 2002 and 2021 resulted in a fatality.

Therefore, the MAIB collision fatality risk rate has also been conservatively applied for the allision incident types.

C.7.2 Fatality Probability

Five of the 504 collision incidents reported by the MAIB within UK waters between 2002 and 2021 resulted in one or more fatalities. This gives a 0.99% 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.9 presents the average number of people on board (POB) estimated for each category of vessel navigating in proximity to the Caledonia South Site. For passenger vessels this is based upon information available for the specific vessels recorded in the vessel traffic survey data. For other vessel categories, this is based upon information available from the MAIB incident data.

Table C.9 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	23
Passenger	RoRo passenger, cruise liner, etc.	Vessel traffic survey data / online information	1,257
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3
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.2.2), there was an estimated 57,524 POB the vessels involved in the collision incidents.

Based upon five fatalities during the period 2002 to 2021, the overall fatality probability in a collision for any individual onboard is approximately 8.69×10^{-5} 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.10. In addition, due to zero fatalities resulting from commercial vessel collisions between 2002 and 2021, the time period used to assess the fatality probability for commercial vessels has been extended by five years to ensure a meaningful probability is captured.

Table C.10 Collision Incident Fatality Probability by Vessel Category

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability	Time Period
Commercial	Dry cargo, passenger, tanker, etc.	1	55,573	1.80×10^{-5}	1997 to 2021 (25 years)
Fishing	Trawler, potter, dredger, etc.	2	927	2.2×10^{-3}	2002 to 2021 (20 years)
Recreational	Yacht, small commercial motor yacht, etc.	3	1,023	2.9×10^{-3}	2002 to 2021 (20 years)

C.7.3 Fatality Risk due to the Caledonia South Site

The base case and future case annual collision frequency levels pre and post wind farm for the Caledonia South Site are summarised in Table C.11.

Table C.11 Summary of Annual Collision and Allision Risk Results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.92×10^{-3} (1 in 520 years)	3.13×10^{-3} (1 in 319 years)	1.21×10^{-3} (1 in 827 years)
	Future case (10%)	2.42×10^{-3} (1 in 413 years)	3.93×10^{-3} (1 in 254 years)	1.51×10^{-3} (1 in 663 years)
	Future case (20%)	2.86×10^{-3} (1 in 350 years)	4.64×10^{-3} (1 in 215 years)	1.78×10^{-3} (1 in 561 years)
Powered vessel to structure allision	Base case	-	2.43×10^{-3} (1 in 412 years)	2.43×10^{-3} (1 in 412 years)
	Future case (10%)	-	2.70×10^{-3} (1 in 370 years)	2.70×10^{-3} (1 in 370 years)
	Future case (20%)	-	2.94×10^{-3} (1 in 340 years)	2.94×10^{-3} (1 in 340 years)
Drifting vessel to structure allision	Base case	-	1.42×10^{-4} (1 in 7,018 years)	1.42×10^{-4} (1 in 7,018 years)
	Future case (10%)	-	1.57×10^{-4} (1 in 6,380 years)	1.57×10^{-4} (1 in 6,380 years)
	Future case (20%)	-	1.71×10^{-4} (1 in 5,848 years)	1.71×10^{-4} (1 in 5,848 years)
Fishing vessel to structure allision	Base case	-	1.85×10^{-1} (1 in 5.4 years)	1.85×10^{-1} (1 in 5.4 years)
	Future case (10%)	-	2.03×10^{-1} (1 in 4.9 years)	2.03×10^{-1} (1 in 4.9 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
	Future case (20%)	-	2.21×10^{-1} (1 in 4.5 years)	2.21×10^{-1} (1 in 4.5 years)
Total	**Base case**	**1.92×10^{-3} (1 in 520 years)**	**1.91×10^{-1} (1 in 5.2 years)**	**1.90×10^{-1} (1 in 5.3 years)**
	Future case (10%)	**2.42×10^{-3} (1 in 413 years)**	**2.10×10^{-1} (1 in 4.8 years)**	**2.10×10^{-1} (1 in 4.8 years)**
	Future case (20%)	**2.86×10^{-3} (1 in 350 years)**	**2.29×10^{-1} (1 in 4.4 years)**	**2.26×10^{-1} (1 in 4.4 years)**

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 Caledonia South Site for the base case and future case are presented in Figure C.24.

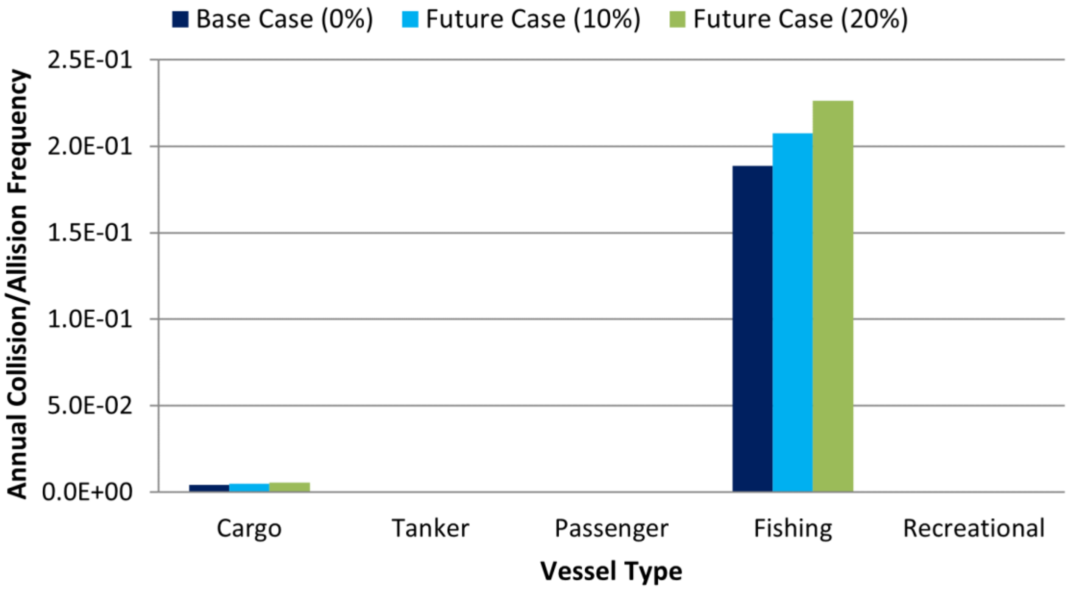

Figure C.24 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

It is seen that the majority of change in collision and allision frequency is associated with fishing vessels, owing to the greater duration spent in proximity to the Caledonia South Site by fishing vessels engaged in fishing activities as well as the possibility of fishing occurring internally within the Caledonia South Site itself.

Combining the annual collision and allision frequency (see Table C.11), estimated number of POB for each vessel type (see Table C.9) and the estimated fatality probability for each vessel type category (see Table C.10), the annual increase in PLL due to the presence of the

Caledonia South Site for the base case is estimated to be 1.30×10^{-3}, equating to one additional fatality every 769 years.

The estimated incremental increases in PLL due to the Caledonia South Site, distributed by vessel type and for the base case and future case, are presented in Figure C.25.

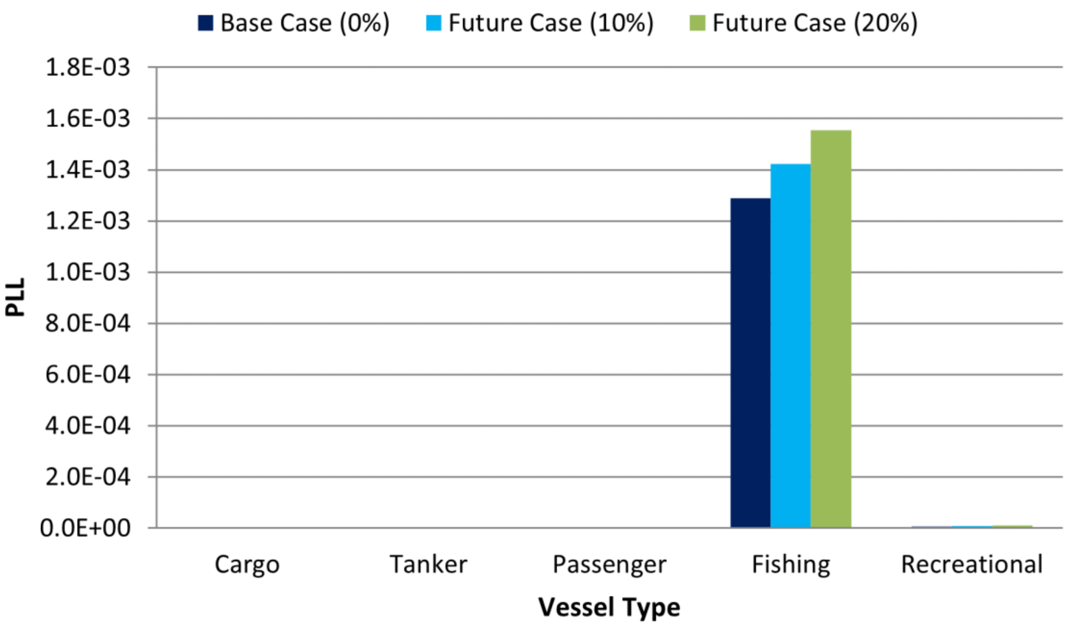

Figure C.25 Estimated Change in Annual PLL by Vessel Type

As with the change in annual collision and allision frequency, it can be seen that the majority of the change in annual PLL is associated with fishing vessels, which historically have a higher fatality probability than commercial vessels. The conservative assumptions made in relation to fishing vessels should therefore be considered (see Section 16.3.5) when viewing these results, in particular that baseline activity will not change. Based on consultation (Section 4), it is likely that in reality at least a proportion of fishing vessels will deviate.

Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in Figure C.26.

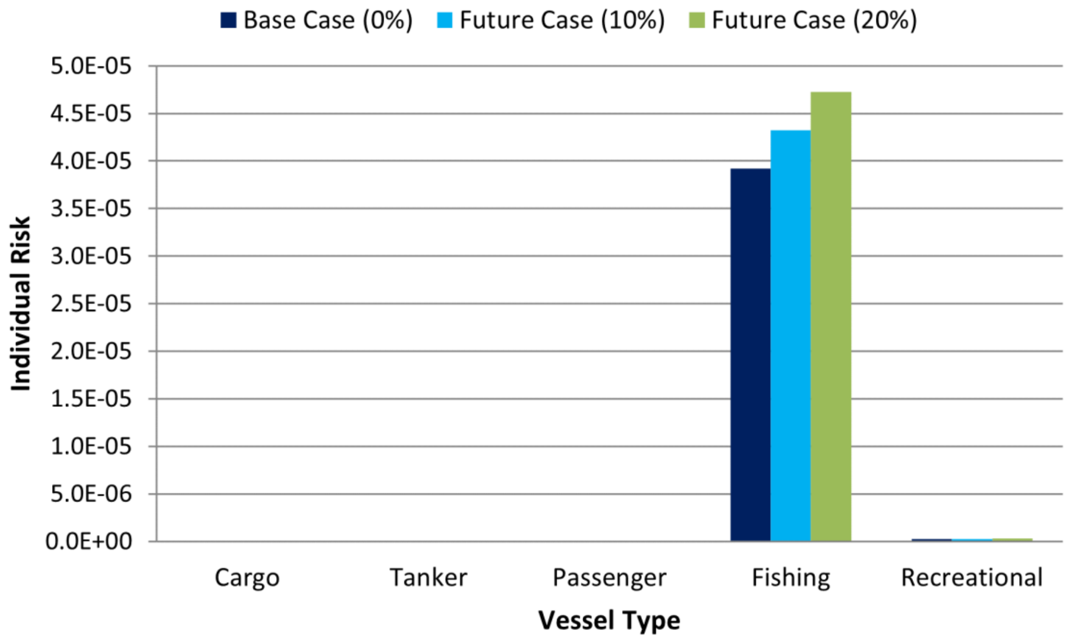

Figure C.26 Estimated Change in Individual Risk by Vessel Type

It can be seen that the individual risk is highest for people on fishing vessels, which reflects the higher probability of a fatality occurring in the event of an incident involving a fishing vessel.

C.7.4 Significance of Increase in Fatality Risk

In comparison to MAIB statistics, which indicate an average of 18 to 19 fatalities per year in UK territorial waters during the 20-year period between 2002 and 2021, the overall increase for the base case in PLL of one additional fatality per 769 years represents a low change.

In terms of individual risk to people, the change for commercial vessels attributed to the Caledonia South Site (approximately 1.21×10^{-8} for the base case) is very low 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 Caledonia South Site (approximately 3.92×10^{-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.8 Pollution Risk – Caledonia South Site

C.8.1 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 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.27.

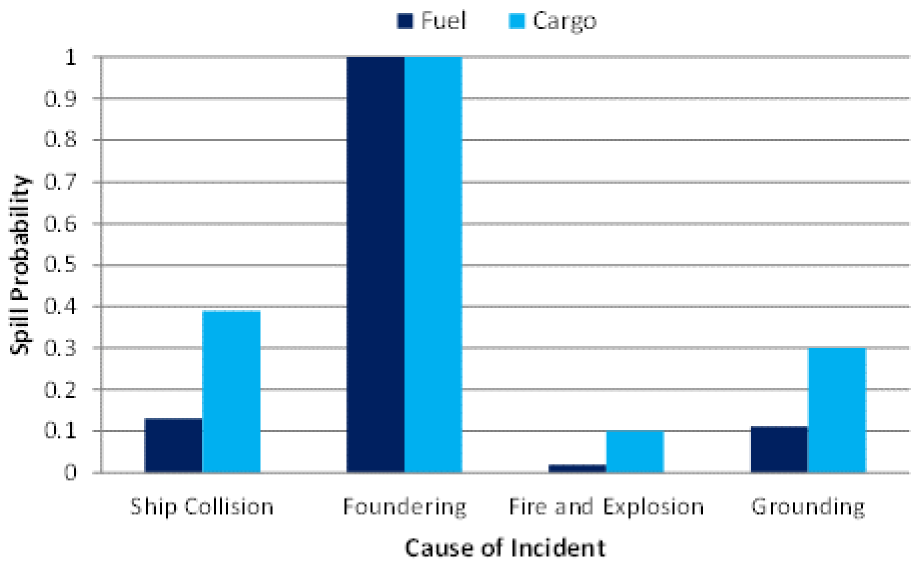

Figure C.27 Probability of an Oil Spill Resulting from an Accident

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 vessels 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 Caledonia South Site, 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 Caledonia South Site, 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.8.2 Pollution Risk due to the Caledonia South Site

Applying the above probabilities to the annual collision and allision frequency by vessel type presented in Table C.11 and the average spill size per vessel, the amount of oil spilled per year due to the impact of the Caledonia South Site is estimated to be 0.60 tonnes per year for the base case and 0.67 tonnes and 0.74 tonnes per year for the future cases of 10% and 20% vessel traffic increases respectively.

The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future case are presented in Figure C.28.

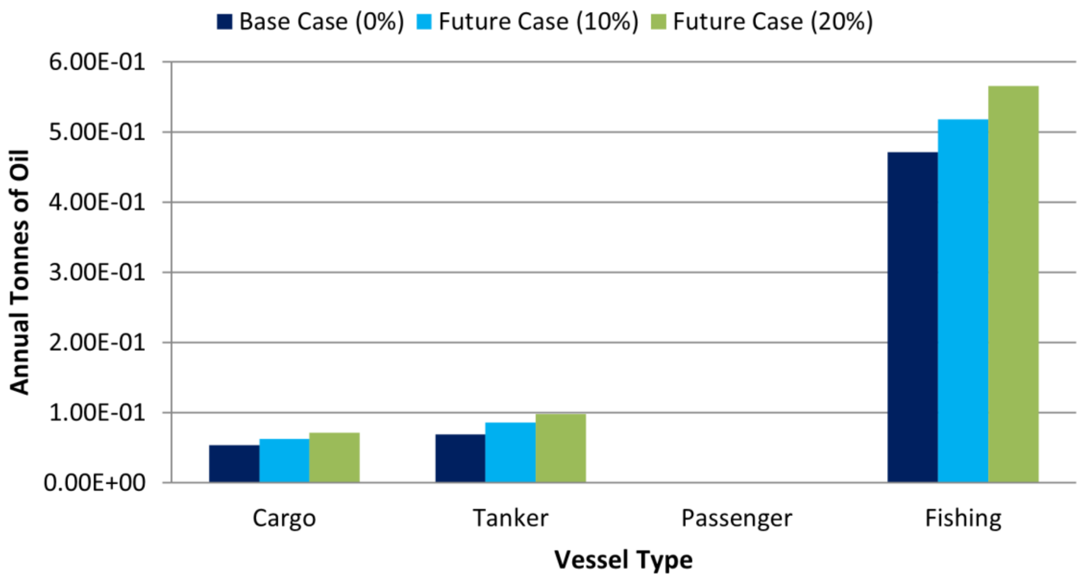

Figure C.28 Estimated Change in Pollution by Vessel Type

The majority of annual oil spill results are associated with fishing vessels due to the high annual allision frequency associated with fishing vessels. Tankers and cargo vessels also contribute to the annual oil spill estimate, which reflects the greater spillage size anticipated in associated incidents.

C.8.3 Significance of Increase in Pollution Risk

To assess the significance of the increased pollution risk from vessels caused by the Caledonia South Site 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 Caledonia South Site of 0.60 tonnes for the base case represents a 0.004% increase compared to the historical average pollution quantities from maritime incidents in UK waters.

C.9 Conclusion

This appendix has quantitively assessed the fatality and pollution risk associated with the Proposed Development (Offshore) in the event of a collision or allision incident occurring. The assessment indicates that the fatality and pollution risk associated with Caledonia OWF is greatest.

Overall, the impact of the Proposed Development (Offshore) 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 OWF development and there will be additional maritime risks associated with other OWF developments.

Discussion of relevant mitigation measures and monitoring is provided in Section 17 of the NRA.

Appendix D Regular Operator Consultation

As part of the consultation process for the Proposed Development (Offshore), Regular Operators identified (from the vessel traffic surveys and long-term vessel traffic data) that would be required to deviate their routes due to the presence of Caledonia OWF were consulted via email. An example of the correspondence sent to the Regular Operators (which shows the extent of Caledonia OWF and the Caledonia OECC at that time) is presented below.

Address: Anatec Ltd.
10 Exchange Street
Aberdeen AB11 6PH
Tel: 01224 253700

Email: aberdeen@anatec.com
Website: www.anatec.com

Date: 29/02/2024
Ref: A4787-OW-RO-1

Opportunity to Participate in Consultation Relating to Shipping and Navigation for the Proposed Caledonia Offshore Wind Farm

Dear Stakeholder,

As you may be aware, Ocean Winds (OW) is the developer of the Caledonia Offshore Wind Farm ('the Project'). The Project is to be located within the Moray Firth, approximately 13 nautical miles southeast of Wick. The project is currently considering both fixed-bottom foundations and floating substructures for the wind turbines which, when constructed, will generate an approximate capacity of 2 gigawatts (GW) (capable of powering the equivalent of around two million homes). Further information relating to the Project is available on the Project website here.

Following a Scoping Report for the Project submitted to Scottish Ministers in September 2022 (see here), OW 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, OW would like to ensure that comprehensive consultation is undertaken to identify any potential impacts that the Project may have upon shipping and navigation users. To analyse shipping movements within and in the vicinity of the Project, Automatic Identification System (AIS) data covering 12 months from November 2022 to October 2023 has been collected and assessed and will feed into the NRA. 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 Project. 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 Project is provided in Figure 1 for your reference. Also included are the boundaries of three adjacent wind farms, two of which (Beatrice and Moray East) are operational, with the third (Moray West) currently under construction.

We would be grateful if you could provide us with any comments or feedback that you may have, including any impact it may have upon the navigation of vessels, by the 15th March 2024. 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 other vessel operators/owners you feel may be interested in commenting.

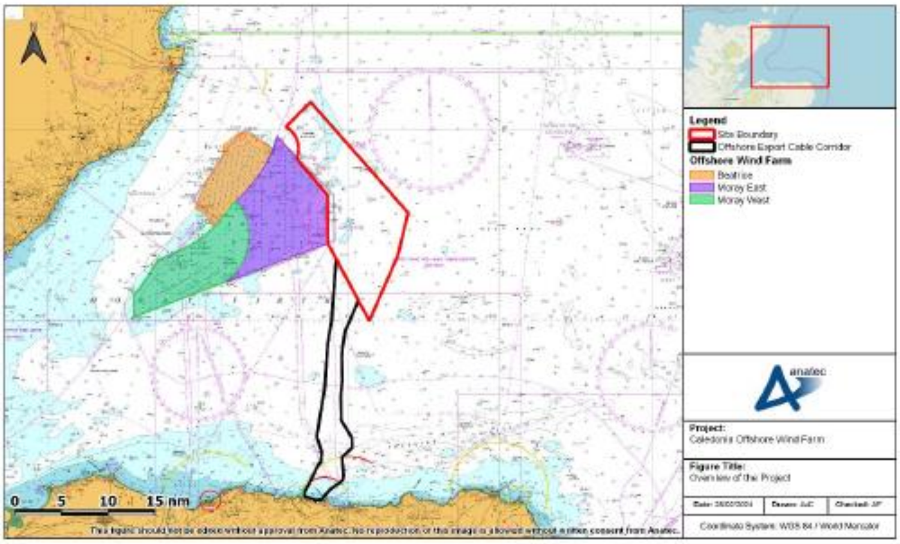

Figure 1 Overview of the Project

Whilst we welcome all feedback, we are particularly interested in any comments or feedback on 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;
4. Whether you would view floating turbines any differently from fixed turbines from a passing vessel perspective; and
5. Whether you wish to be retained on our list of marine stakeholders and consulted throughout the NRA process.

Additionally, we would like to invite you to attend a Hazard Workshop planned to take place on the 25th March 2024 in Edinburgh, noting a dial in option will also be available for anyone unable to attend in person. Full details are to be confirmed imminently.

Please provide your responses via email to [redacted] as well as an indication of whether you are interested in attending the Hazard Workshop noted above.

Yours sincerely,

[redacted]
Risk Analyst
Anatec Ltd

Appendix E Long-Term Vessel Traffic Movements

E.1 Introduction

This appendix assessed the additional long-term vessel traffic data for the Proposed Development (Offshore).

As required under MGN 654 (MCA, 2021), the NRA and Volumes 2, 3, and 4, Chapter 9: Shipping and Navigation of the EIAR consider 28-days of AIS, Radar, and visual observation data as the primary vessel traffic data source. However, it should be considered that studying a 28-day period in isolation may exclude certain activities or periods of pertinence to shipping and navigation. Therefore, in line with good practice assessment procedures, this NRA will also consider a long-term dataset covering the period between November 2022 to October 2023 to ensure comprehensive characterisation of vessel traffic movements can be established, including the capture of any seasonal variation.

This approach (i.e., the use of both 28 days and longer-term data) have been agreed with the MCA and NLB.

E.1.1 Aims and Objectives

The key aims and objectives of this appendix are as follows:

- Identify seasonal variations in vessel traffic via assessment of the long-term vessel traffic data;
- Determine which variations are not reflected within the short-term vessel traffic survey data (and therefore should be fed into the NRA baseline); and
- Assess which dataset (long-term, survey, or a combination of both) should be utilised for each key NRA element that requires vessel traffic data input.

E.2 Methodology

E.2.1 Study Area

This appendix has assessed the long-term vessel traffic data within a study area surrounding Caledonia OWF. The study area was defined in order to capture relevant routeing within the vicinity of Caledonia OWF and so a buffer of a minimum[8] of 10nm was considered for Caledonia OWF boundary.

E.2.2 Data Period and Temporary Vessel Traffic

The long-term AIS dataset was collected from coastal and satellites receivers between the 1st November 2022 and 31st October 2023 (the "data period"). Any traffic deemed to be

[8] The 12-month analysis was undertaken prior to minor site refinement and therefore the study area used is slightly larger than that shown in the main NRA analysis. Given the minor nature of the change, this is not considered as impacting the findings of the 12-month analysis. Volume 1, Chapter 6: Site Selection and Alternatives discusses the site refinement further.

temporary and/or non-routine in nature based on the information transmitted via AIS (i.e. vessels indicating they were engaged in surveys, guard work, or construction) has been excluded from the dataset for further analysis. This ensures the analysis focuses on routine traffic only.

Moray West OWF is located approximately 9 nm to the southwest of Caledonia OWF boundary, and was under construction at the time of data collection, thus vessels involved in the construction operations at Moray West OWF have been removed. An overview of all vessel tracks removed from the analysis is presented in Figure E.1.

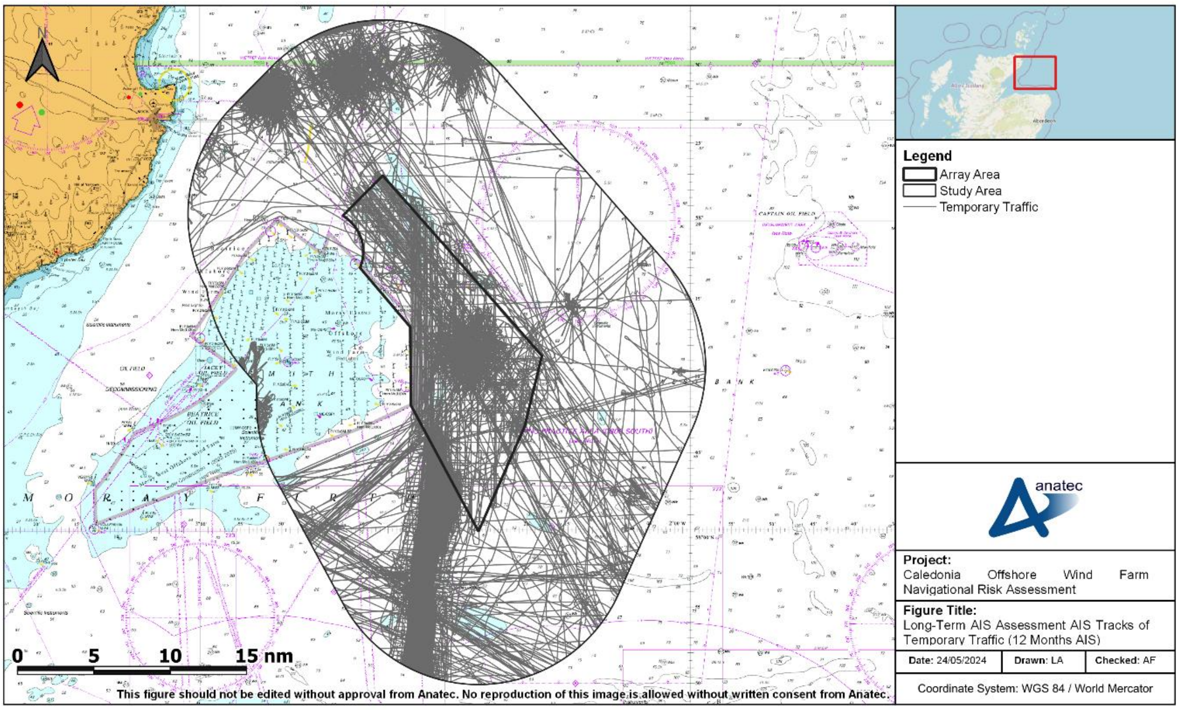

Figure E.1 Long-Term AIS Assessment AIS Tracks of Temporary Traffic (12 Months AIS)

E.2.3 AIS Carriage

General limitations associated with the use of AIS data (for example, carriage requirements) are discussed within Section 5.4.

E.3 Long-Term Vessel Traffic Movements

A plot of the vessel tracks recorded within the study area during the data period, colour-coded by vessel type and excluding temporary traffic is presented in Figure E.2. The vessel density within the study area is then presented in Figure E.3.

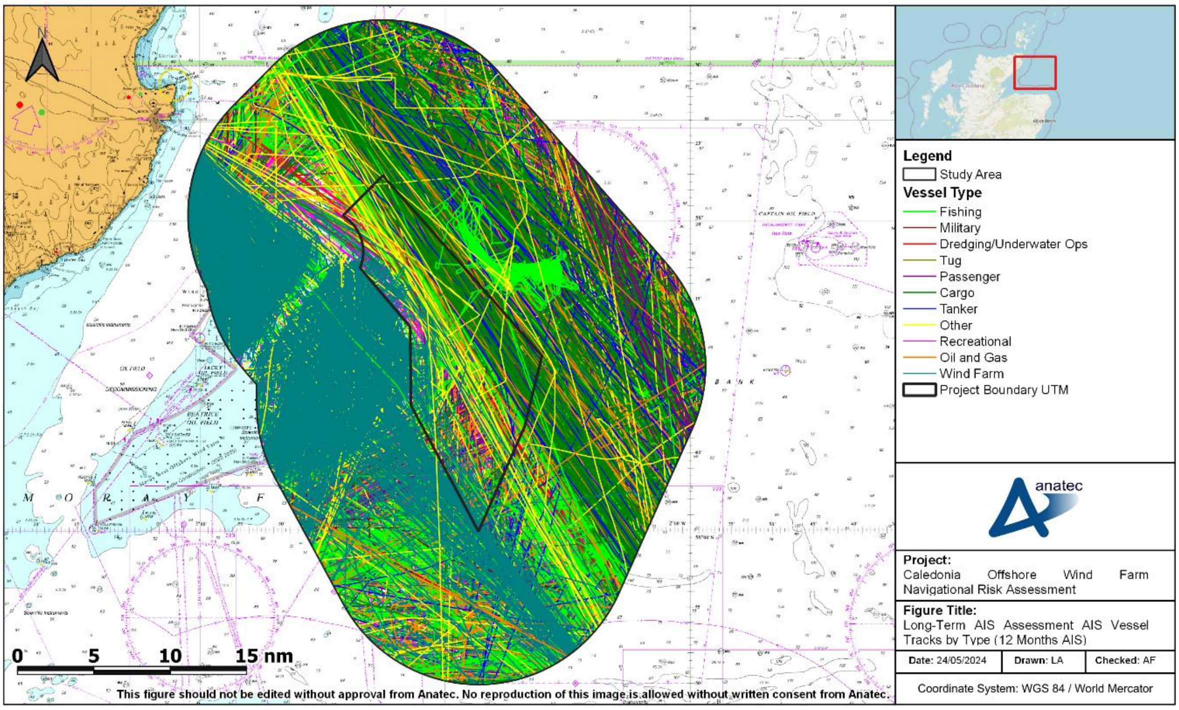

Figure E.2 Long-Term AIS Data by Vessel Type (12 Months AIS)

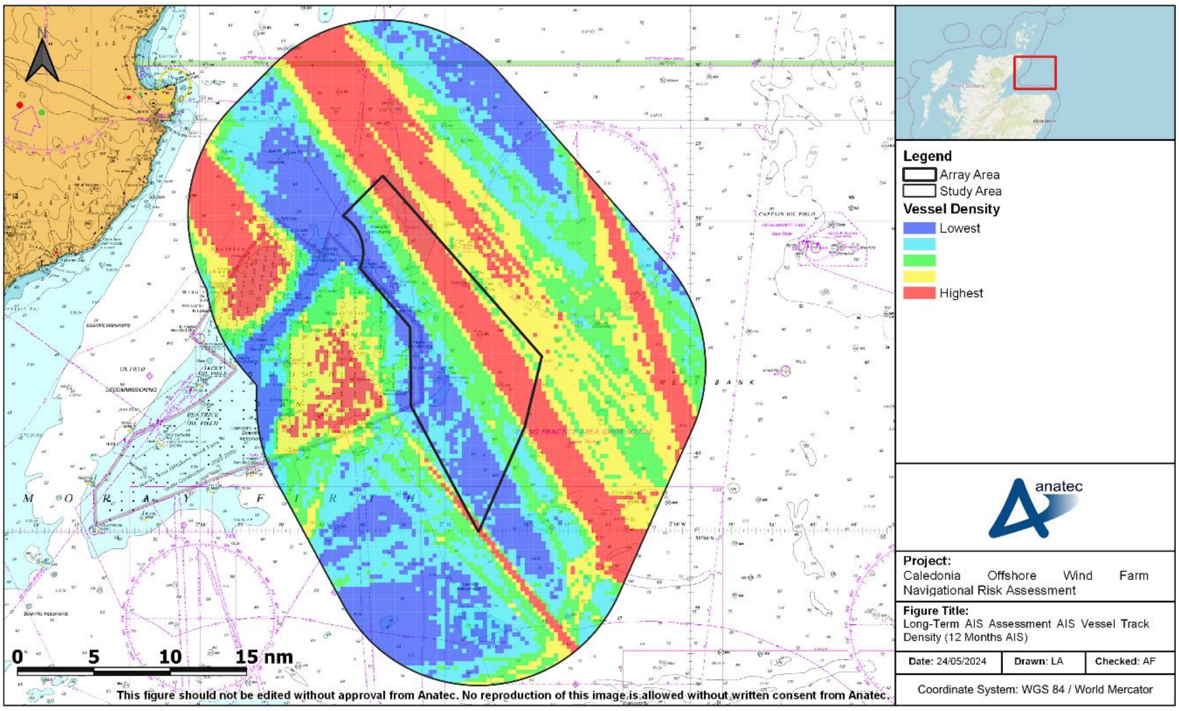

Figure E.3 Vessel Density Heat-Map of Long-Term AIS Data (12 Months AIS)

E.3.2 Vessel Count

The average daily number of vessels within the study area and Caledonia OWF are presented in Figure E.4.

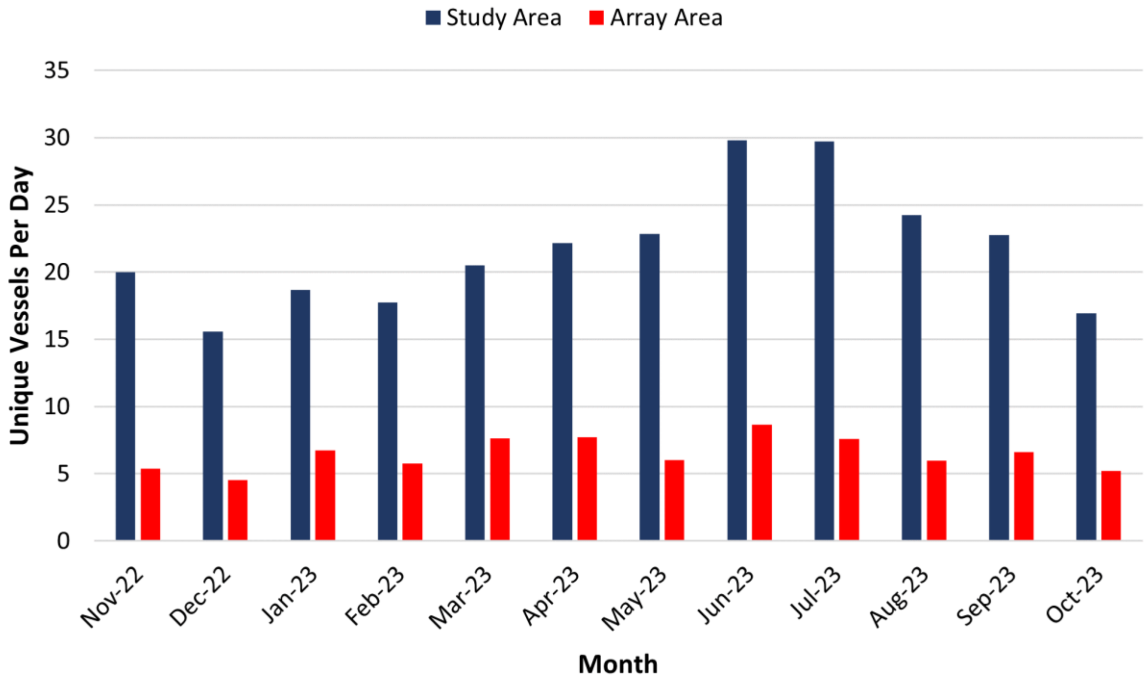

Figure E.4 Long-Term Daily Vessel Counts by Month within Array Area and Study Area (12 Months AIS)

The busiest month recorded within the study area was June and July 2023 which both recorded an average of 30 vessels per day within the study area, whilst the quietest month was December 2022 during which an average of 16 vessels were recorded per day.

Within Caledonia OWF, June 2023 was the busiest month, recording an average of nine unique vessels per day, whilst the quietest month was December 2022 which recorded an average of five unique vessels per day.

E.3.3 Vessel Type

Figure E.5 presents the distribution of vessel types recorded within the study area during the data period. It was noted that no vessels were classed as unspecified. Vessels classed as ‘Other’ included less predominant vessel types such as military vessels, dredgers, tugs, search and rescue vessels as well as those involved in research or survey work.

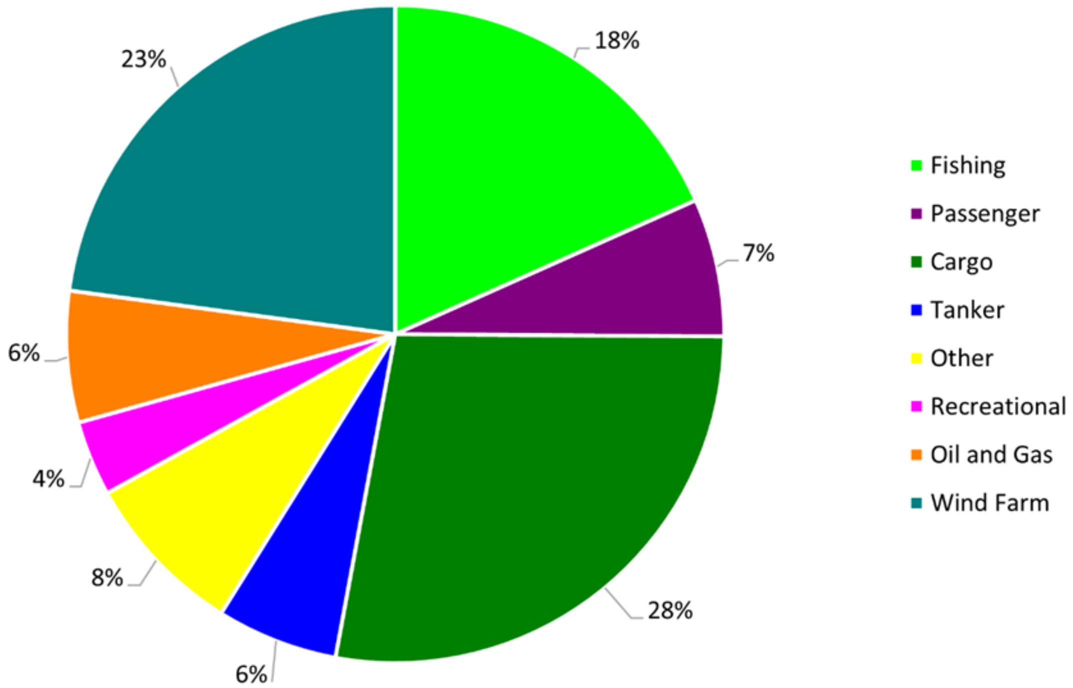

Figure E.5 Main Vessel Type Distribution (12 Months AIS)

The most common vessel types recorded were cargo vessels which accounted for 28% of all traffic recorded. Other common vessel types included wind farm vessels (23%) and commercial fishing vessels (18%).

E.3.4 Commercial Vessels

Figure E.6 presents the commercial vessels recorded within the study area during the data period, colour-coded by vessel type. Commercial traffic in this scenario includes cargo vessels, passenger vessels, and tankers.

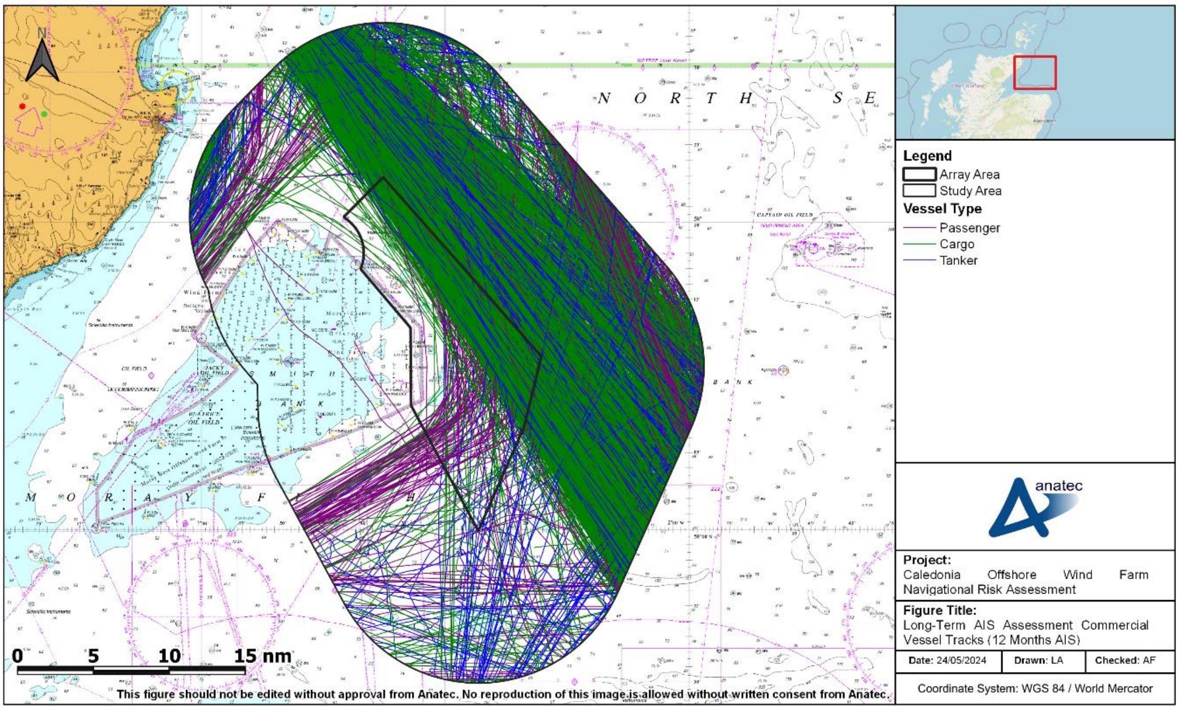

Figure E.6 Commercial Vessels by Vessel Type (12 Months AIS)

A high density of commercial traffic was noted within the study area, accounting for approximately 41% of all activity within the study area. The majority of commercial traffic were observed on well-defined shipping routes. Routeing was predominantly in southeast/northwest to and from the Pentland Firth. Regular RoRo routeing included the Smyril Line-operated route between the Netherlands and Faroe Islands, with approximately one transit every one to two days, as well as the Serco NorthLink Ferries RoRo route between Aberdeen and Kirkwall also with a transit approximately one to two days. Passenger vessels were noted throughout the study area, with passenger vessels observed to operate out of Inverness, and to route between Aberdeen and Kirkwall. Tankers were noted routeing to and from Macduff.

Figure E.7 presents the average number of unique commercial vessels for each vessel type per month within the study area.

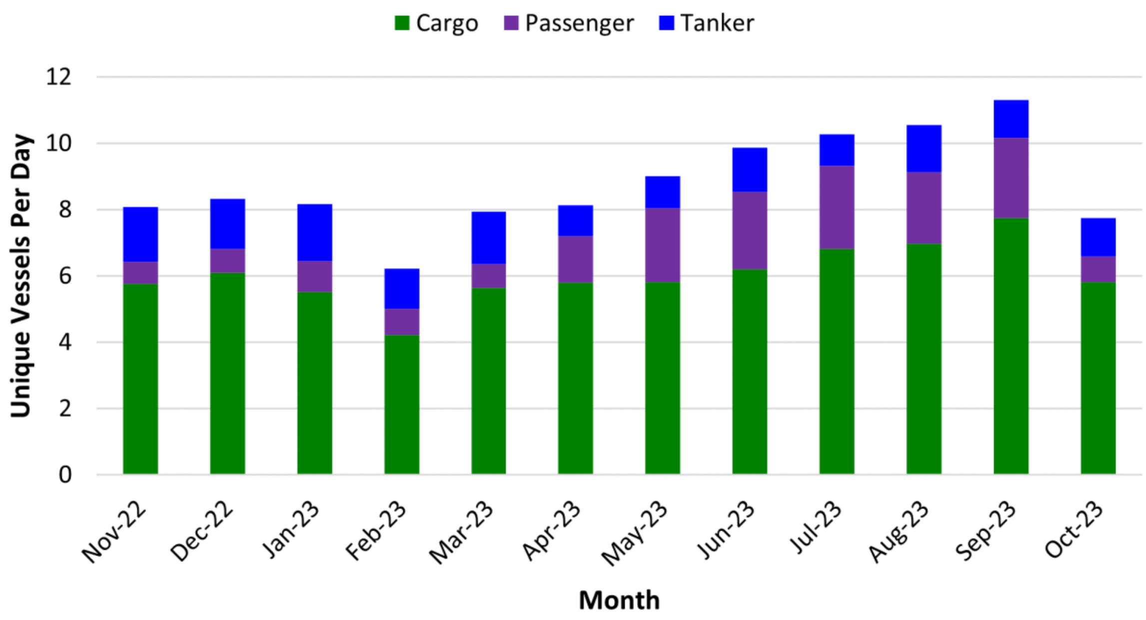

Figure E.7 Average Number of Daily Commercial Vessels per Month within the Study Area (12 Months AIS)

Cargo vessels showed minimal seasonal variation with vessel numbers peaking in September 2023 with 232 vessels recorded. The quietest month was December 2022 with 118 vessels recorded. Overall, there was an average of approximately six unique cargo vessels recorded within the study area per day of the data period, contributing the most to commercial activity.

Passenger vessels highlighted the seasonal variation within the study area, as higher counts of vessels were recorded between May and September 2023 when compared with the winter months. The busiest month was July when 78 vessels were recorded, whereas the quietest month was November 2022 when only 20 vessels were recorded. Overall, between one and two passenger vessels were recorded per day of the 12-month period, with between two and three per day during the busier months.

Tankers, similar to cargo, showed minimal seasonal variation. The busiest month for tankers was January 2023 when 53 vessels were recorded, and the quietest month was April 2023 when 28 vessels were recorded. Overall, there was an average of between one and two unique tankers recorded within the study area during the data period.

E.3.5 Other Commercial Users

Other commercial vessel types recorded within the study area are presented in Figure E.8. These vessels are not deemed to be on distinct commercial routes and timetables but more involved in commercial operations.

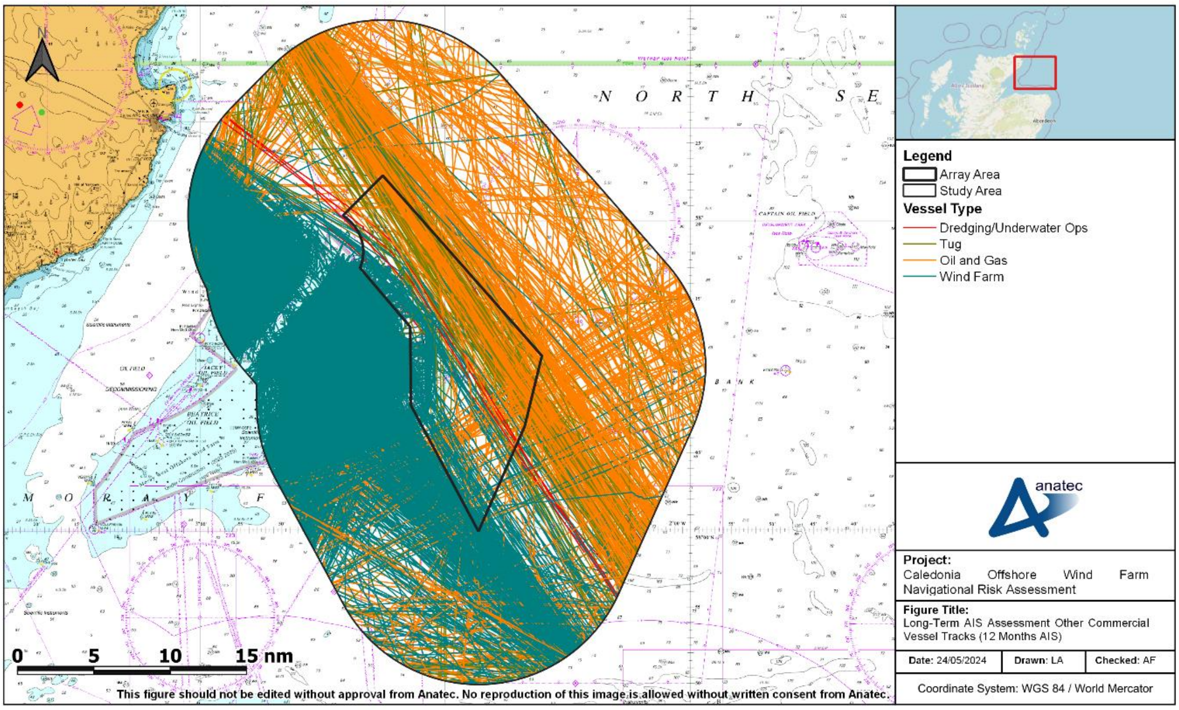

Figure E.8 Other Commercial Vessel Tracks (12 Months AIS)

Other commercial traffic including oil and gas vessels, wind farm vessels, tugs, and marine aggregate dredgers and sub-sea operation vessels were recorded within the study area. As can be seen, oil and gas vessels followed similar routeing patterns to that of cargo vessels, with high activity within the east of Caledonia OWF. Wind farm vessels were very prominent within the study area due to the presence of the neighbouring Beatrice and Moray East OWFs, and can be seen operating out of Wick and Fraserburgh.

On average, between one and two oil and gas vessels were recorded within the study area per day of the data period, with the busiest month being October 2023 which recorded between two and three unique vessels on average per day. Overall there was approximately five unique wind farm vessels recorded within the study area per day of the data period. The busiest month for wind farm vessels was June 2023 when between eight and nine unique wind farm vessels were recorded within the study area per day.

Tugs and dredgers were recorded less often, approximately on average once every two to three days and once every 46 days respectively. These vessels were mostly notable on a northwest/southeast course through Caledonia OWF.

E.3.6 Commercial Fishing Vessels

Commercial fishing vessels made up 18% of all vessels recorded on AIS during the data period. Figure E.9 presents all fishing vessels recorded within the study area during the data period colour-coded by likely fishing activity. Fishing activity was determined by vessel speed, destination, track behaviour, and navigational status information transmitted via AIS. It is considered that a proportion of vessels were recorded on transit before and after being identified in active fishing activity.

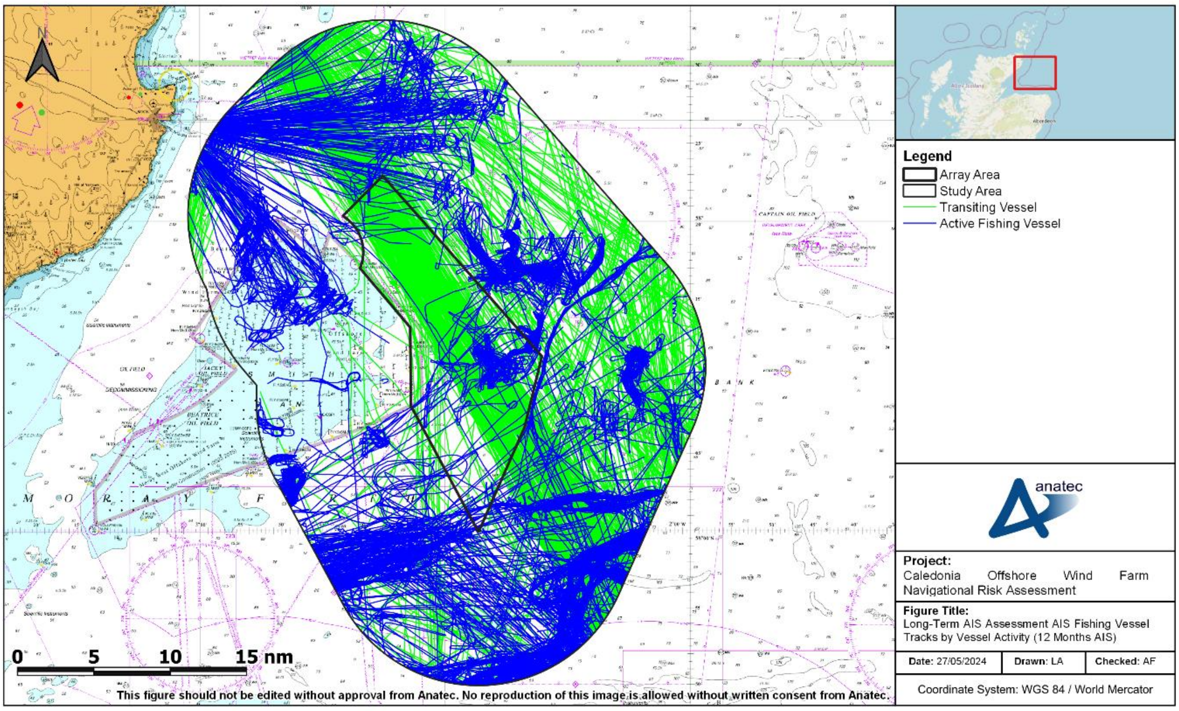

Figure E.9 Commercial Fishing Vessels by Vessel Activity (12 Months AIS)

A prominent route for transiting vessels can be seen intersecting Caledonia OWF from northwest to southeast. Additionally, vessels were seen transiting within the northeast of the study area. In general, fishing vessels were noted to avoid transiting through Moray West and Beatrice OWFs.

Potential active fishing behaviour was recorded throughout the study area with the most heavily fished areas being towards the south of Caledonia OWF as well as to the north and northeast of Caledonia OWF . Fishing within Beatrice OWF was also noted. Several instances of active fishing was recorded within Caledonia OWF. Overall, approximately half of recorded fishing vessels were estimated to be actively fishing, with the most common gear types being demersal trawlers (59%), potters (16%), and pelagic trawlers (12%).

The distribution of daily unique commercial fishing vessels recorded per month within the study area is presented in Figure E.10.

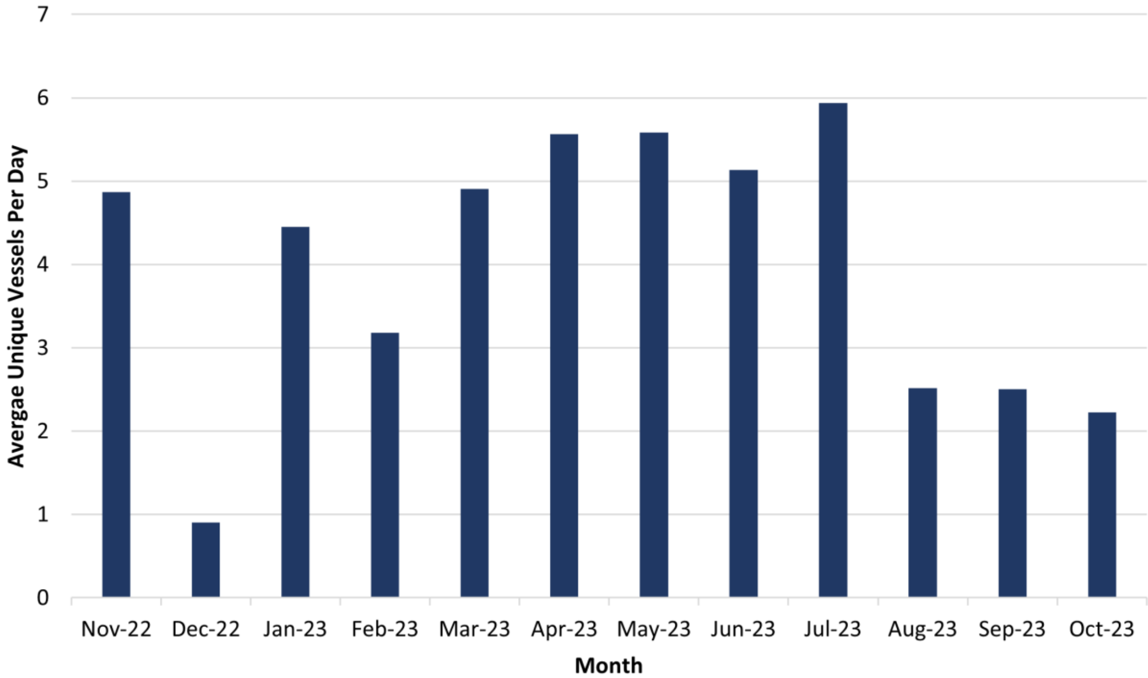

Figure E.10 Average Daily Commercial Fishing Vessel Count per Month within Study Area (12 Months AIS)

Fishing in the area showed slight seasonality, with higher numbers of vessels generally recorded during spring and summer months. The busiest month was July 2023, during which 184 vessels were recorded. The quietest month was December 2022 when 28 vessels were recorded within the study area. Overall, there was an average of between three and four unique fishing vessels recorded within the study area per day.

E.3.7 Recreational Vessels

Figure E.11 presents the commercial vessels recorded within the study area during the data period.

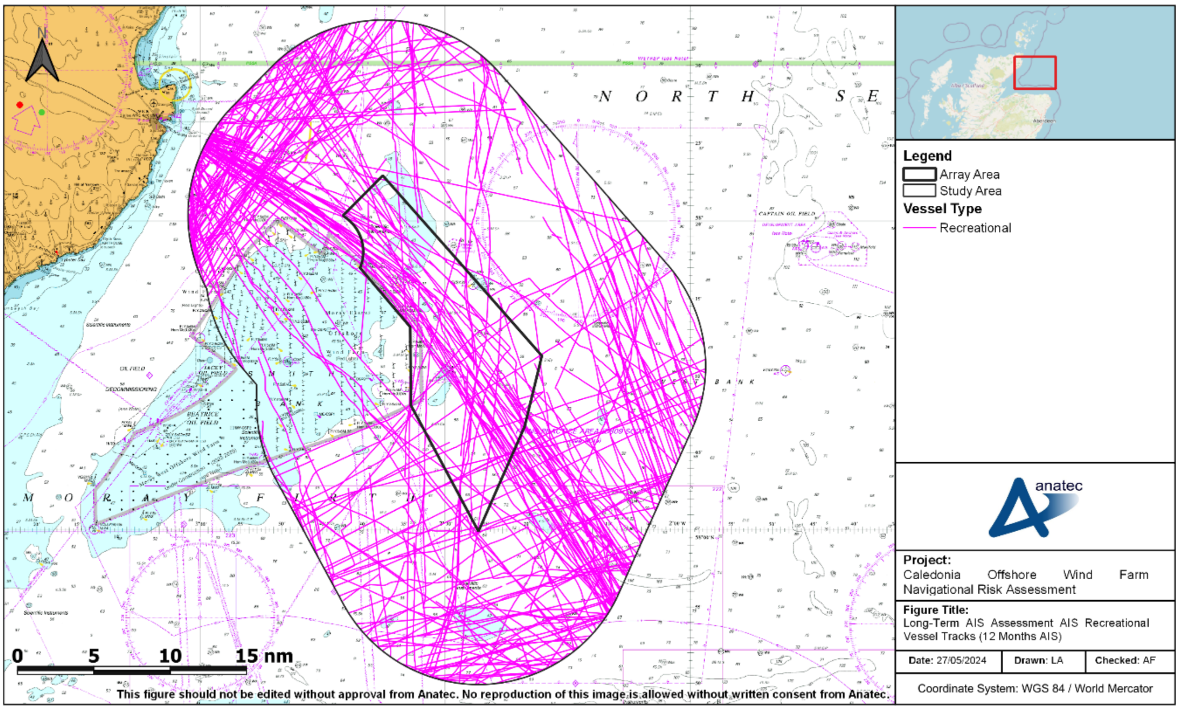

Figure E.11 Recreational Vessel Tracks (12 Months AIS)

Recreational Vessel activity was observed throughout the study area, with particular prominence in near-shore areas around Wick. Recreational routeing can be seen on a northwest/southeast course through Caledonia OWF, with a potential that a large proportion of recreational vessels were sailing towards the Northern Isles via Inverness, Whitehills, and Wick.

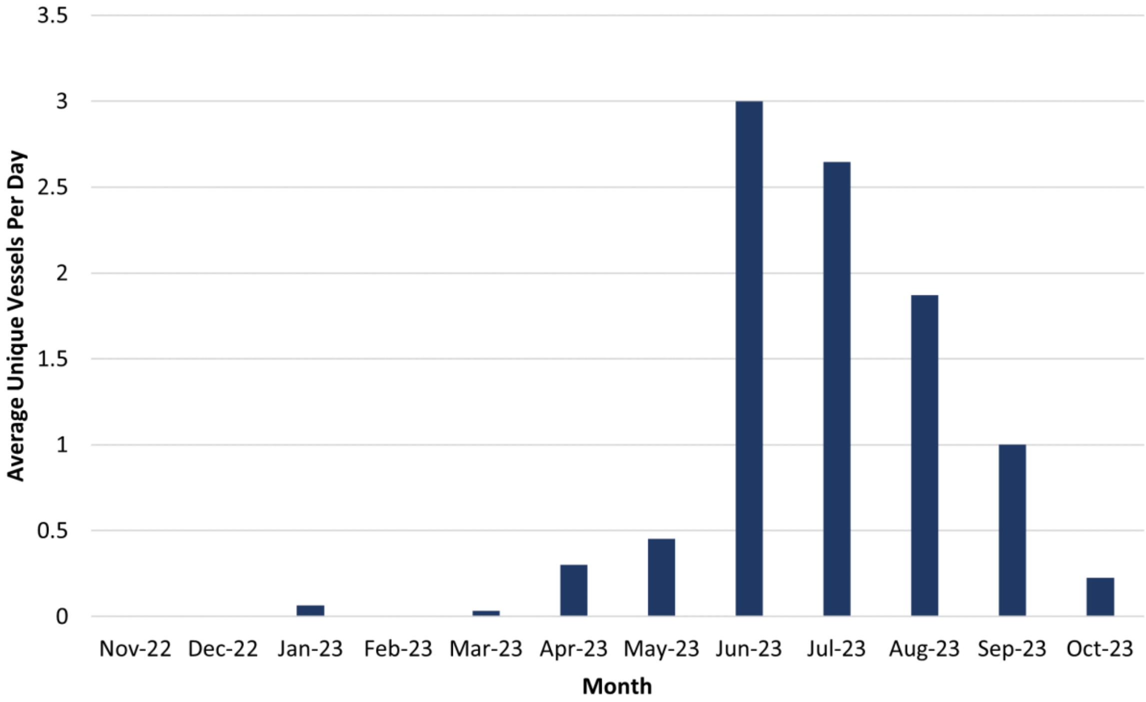

Figure E.12 Average Daily Recreational Vessel Count per Month within Study Area (12 Months AIS)

Recreational vessels shown high seasonality, with summer months being the busiest. June 2023 was the busiest month recording 90 vessels, corresponding to an average of three per day within the study area. November 2022, December 2023, and February 2023 were the quietist months during which no recreational vessels were recorded within the study area.

E.4 Site Specific Analysis

The vessel tracks intersecting Caledonia OWF during the data period are presented in Figure E.13.

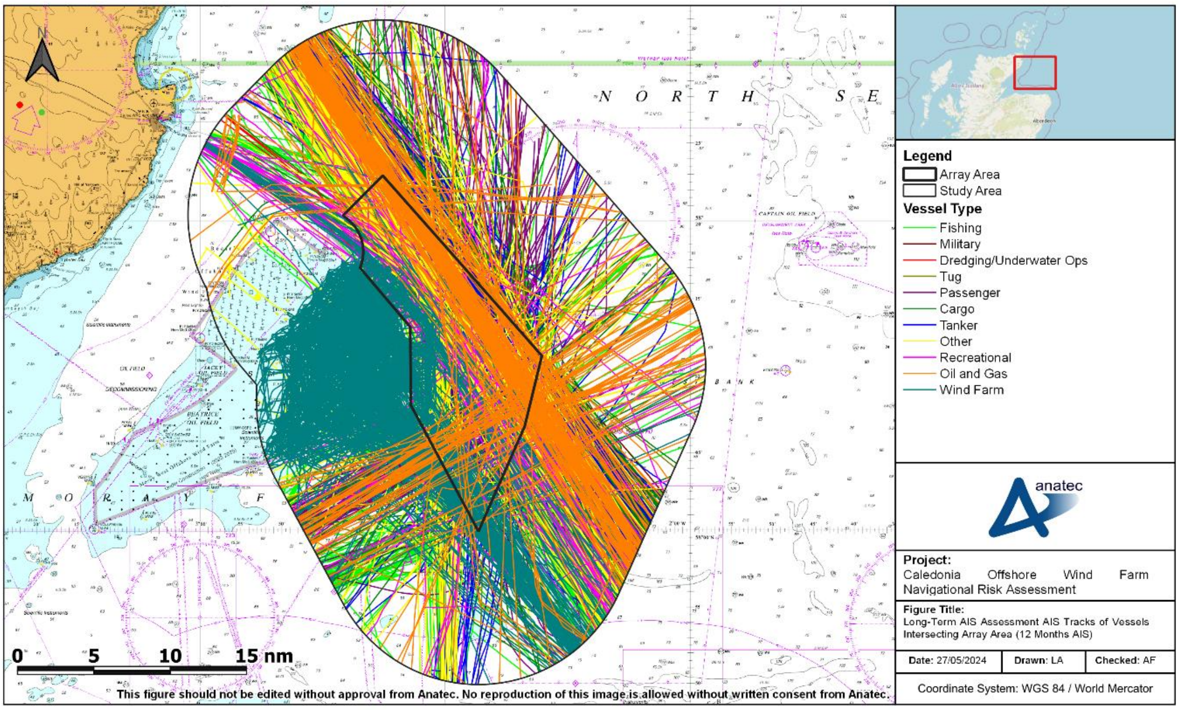

Figure E.13 Tracks of Vessels Intersecting Caledonia OWF (12 Months AIS)

On average, six to seven vessels per day were recorded intersecting Caledonia OWF. The busiest month was June 2023 which recorded between eight and nine unique vessels per day within Caledonia OWF, with the 2 June 2023 being the busiest day overall, recording 15 unique vessels within Caledonia OWF. The quietist month was December 2022 which recorded an average of four to five unique vessels within Caledonia OWF.

The vessel type distribution of vessels intersecting Caledonia OWF during the data period is presented in Figure E.14.

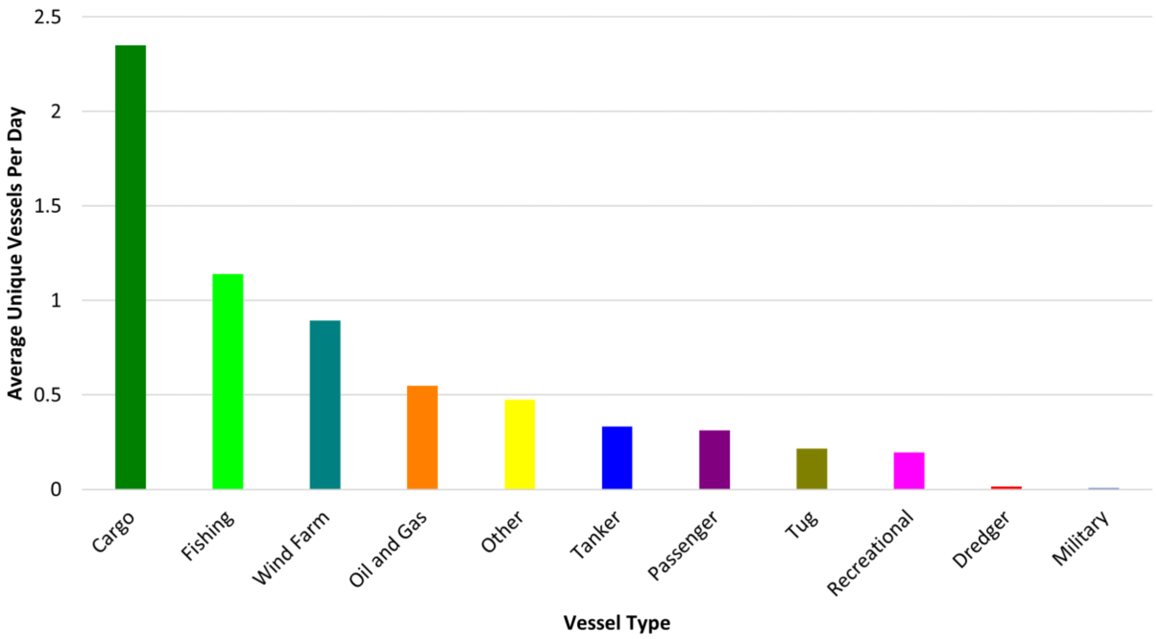

Figure E.14 Distribution of Vessels Intersecting Caledonia OWF by Vessel Type (12 Months AIS)

The most common vessel types recorded within Caledonia OWF were cargo vessels (comprising 36%), followed by fishing vessels (18%) and wind farm vessels (14%).

It can be seen from Figure E.14 that considerable levels of commercial vessel activity was observed within Caledonia OWF. On average two to three cargo vessels passed through Caledonia OWF per day, while an average of one tanker every three days, and one passenger vessel every three to four days was also recorded.

E.5 Survey Data Comparison

Survey data recorded during the 14-day periods in winter and summer 2023 were collected using a combination of AIS, Radar, and visual observation. This subsection provides comparison of the 28-Day survey data (summer and winter combined) against the long-term 2022-2023 AIS data.

A comparison of the average number of each main vessel type recorded during the long -term 2022-2023 data and the two 14-day survey periods area presented in Table E.2.

Vessel Type	Long-term 2022-2023 AIS Data (Vessels per Day)			Winter Survey (Jan-Feb 2023)	Summer Survey (Jul-Aug 2023)
	Quietest Month	Busiest Month	Average Vessels per Day	Average Vessels per Day	Average Vessels per Day
Cargo Vessels	February 2023	September 2023	6	4-5	7-8
Commercial fishing vessels	December 2022	July 2023	4	4-5	6-7
Wind Farm	October 2023	June 2023	4-5	3-4	6-7
Recreational vessels	Nov/Dec 2022, Feb 2023	June 2023	0-1	0	3
Passenger vessels	November 2022	July 2023	1-2	1 every 1-2 days	2-3

The average daily vessel count within the long-term data was mostly consistent with the survey data for the majority of vessel types.

E.6 Conclusion

A year of AIS data from November 2022 to October 2023 has been analysed to validate the summer and winter 2023 vessel traffic survey data recorded within the study area.

The main vessel types detected within the study area during the 12 months were cargo vessels (28%), wind farm vessels (23%), and fishing vessels (18%). Similarly, the main vessel types detected during the summer 2023 vessel traffic survey were cargo vessels (25%), wind farm vessels (23%), and fishing vessels (22%), with recreational (10%) following. The main vessel types recorded during the winter 2023 vessel traffic survey were fishing vessels (28%), cargo vessels (24%), and wind farm vessels (22%). Overall, the vessel types detected within the study area were similar between the long-term data and the vessel traffic surveys, with vessel traffic levels generally higher in the summer survey.

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