LLŶR FLOATING OFFSHORE WIND PROJECT

Llŷr 1 Floating Offshore Wind Farm

Environmental Statement

Volume 6: Appendix 25A – Navigational Risk Assessment

August 2024

Prepared by: Llŷr Floating Wind Ltd

FLOVENTIS ENERGY

Llŷr 1 Floating Offshore Wind Project Navigational Risk Assessment

Prepared by	Anatec Limited
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Revision Number	Date	Summary of Change
00	25th September 2023	Initial draft
01	31st January 2024	Updated following Llŷr Floating Wind review
02	20th February 2024	Updated following Llŷr Floating Wind review
03	13th March 2024	Updated following project design changes
04	28th June 2024	Updated following project design changes
05	15th July 2024	Final version

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Glossary of Terms

Abbreviation	Definition
Allision	The act of striking or collision of a moving vessel against a stationary object.
The Applicant	The developer of the Project, Llŷr Floating Wind Limited
Array	All wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the Array Area, as defined, when considered collectively, excluding the offshore export cable(s).
Array Area	The area within which the Wind Turbine Generators (WTG) and inter-array cables will be situated for the proposed Project, inclusive of blade overfly.
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity, key statistics including location, destination, length, speed and current status, e.g., under power. Most commercial vessels and United Kingdom/European Union fishing vessels over 15m length are required to carry AIS.
Baseline	The existing conditions as represented by the latest available survey and other data which is used as a benchmark for making comparisons to assess the impact of the proposed Project.
Collision	The act or process of colliding (crashing) between two moving objects.
Embedded Mitigation Measure	Mitigation measures to avoid or reduce environmental effects that are directly incorporated into the design for the proposed Project.
Environmental Impact Assessment (EIA)	The process of evaluating the likely significant environmental effects of a proposed development over and above the existing circumstances (or 'baseline').
Floventis Energy	The company developing the proposed Project, a joint venture between Cierco Ltd and SBM Offshore Ltd
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Future Case	The assessment of risk based on the predicted growth in future shipping densities and traffic types as well as foreseeable changes in the marine environment.
Landfall	The location where the offshore export cable(s) from the Array Area, as defined, are brought onshore and connected to the onshore export cables (as defined) via the transition joint bays (TJB).
Llŷr 1	The proposed Project, for which the Applicant is applying for Section 36 and Marine Licence consents. Including all offshore and onshore infrastructure and activities, and all project phases.
Main Commercial Route	Defined transit route (mean position) of commercial vessels identified within each shipping and navigation study area.
Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency which provide significant advice relating to the improvement of the safety of shipping at sea, and to prevent or minimise pollution from shipping.
Marine Licence	A licence required under the Marine and Coastal Access Act 2009 for marine works which is administered by Natural Resources Wales (NRW) Marine Licensing Team (MLT) on behalf of the Welsh Ministers.

Abbreviation	Definition
Navigational Risk Assessment (NRA)	A document which assesses the hazards to shipping and navigation of a proposed Offshore Renewable Energy Installation based upon Formal Safety Assessment.
Offshore Development Area	The footprint of the offshore infrastructure and associated temporary works, comprised of the Array Area and the offshore export cable corridor (OfECC), as defined, that forms the offshore boundary for the S36 Consent and Marine Licence application
Offshore Export Cable	The cable(s) that transmit electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OfECC)	The area within which the offshore export cable circuit(s) will be located, from the Array Area to the Landfall.
Offshore Export Cable Corridor (OfECC) Study Area	A buffer of two nautical miles (nm) applied around the OfECC.
Offshore Renewable Energy Installation (OREI)	As defined by Marine Guidance Note (MGN) 654 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response (Maritime and Coastguard Agency (MCA), 2021). For the purposes of this report and in keeping with the consistency of the Environmental Impact Assessment (EIA), OREI can mean offshore wind turbines and the associated electrical infrastructure such as offshore substations.
Proposed Project	All aspects of the Llŷr 1 development (i.e. the onshore and offshore components).
Radio Detection and Ranging (Radar)	An object-detection system which uses radio waves to determine the range, altitude, direction or speed of objects.
Regular Operator	Commercial operator whose vessel(s) are observed to transit through a particular region on a regular basis.
Safety Zone	A statutory marine zone demarcated for the purposes of safety around a possibly hazardous installation or works/construction area.
Scoping Opinion	The report adopted by the Planning Inspectorate on behalf of the Secretary of State
Scoping Report	The report that was produced in order to request a Scoping Opinion from the Secretary of State.
Section 36 Consent	Consent to construct and operate an offshore generating station, under Section 36 (S.36) of the Electricity Act 1989. This includes deemed planning permission for onshore works.
Study Area	A buffer of ten nautical miles (nm) applied around the Array Area.
Unique Vessel	An individual vessel identified on any particular calendar day, irrespective of how many tracks were recorded for that vessel on that day. This prevents vessels being over counted. Individual vessels are identified using their Maritime Mobile Service Identity (MMSI).

Abbreviations Table

Abbreviation	Definition
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ALB	All-Weather Lifeboat
ARPA	Automatic Radar Plotting Aid
ATBA	Area to be Avoided
BWEA	British Wind Energy Association
CAA	Civil Aviation Authority
CBA	Cost Benefit Analysis
CD	Chart Datum
CEA	Cumulative Effects Assessment
CHIRP	Confidential Human Factors Incident Reporting Programme
COLREGs	International Regulations for Preventing Collisions at Sea
DC	Direct Current
DECC	Department of Energy and Climate Change
DF	Direction Finding
DfT	Department for Transport
DSC	Digital Selective Calling
EIA	Environmental Impact Assessment
EEZ	Exclusive Economic Zone
EMF	Electromagnetic Field
ERCoP	Emergency Response Cooperation Plan
ES	Environmental Statement
ESRI	Environmental Systems Research Institute
ETRS	European Terrestrial Reference System
FLO	Fisheries Liaison Officer
FSA	Formal Safety Assessment
GIS	Geographical Information System
GLA	General Lighthouse Authority
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GRP	Glass Reinforced Plastic

Abbreviation	Definition
GT	Gross Tonnage
HAT	Highest Astronomical Tide
HMCG	His Majesty's Coastguard
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ILB	Inshore Lifeboat
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
IPS	Intermediate Peripheral Structure
ITOPF	International Tanker Owners Pollution Federation
ITZ	Inshore Traffic Zone
JRCC	Joint Rescue Coordination Centre
kHz	Kilohertz
kt	Knot
LAT	Lowest Astronomical Tide
LMP	Lighting and Marking Plan
LNG	Liquefied Natural Gas
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MEHRA	Marine Environmental High Risk Area
MGN	Marine Guidance Note
MHPA	Milford Haven Port Authority
MOD	Ministry of Defence
MHWS	Mean High Water Springs
MRCC	Maritime Rescue Coordination Centre
MPCP	Marine Pollution Contingency Plan
MSI	Maritime Safety Information
MSL	Mean Sea Level
NAVTEX	Navigational Telex
nm	Nautical Mile
nm^2	Square Nautical Mile
NPS	National Policy Statement
NRA	Navigational Risk Assessment

Abbreviation	Definition
NSIP	Nationally Significant Infrastructure Project
NUC	Not Under Command
OfECC	Offshore Export Cable Corridor
OREI	Offshore Renewable Energy Installation
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
OWF	Offshore Wind Farm
PDA	Project Development Area
PEXA	Practice and Exercise Area
PLGR	Pre Lay Grapnel Run
PLL	Potential Loss of Life
POB	People on Board
QHSE	Quality, Health, Safety and Environment
Racon	Radar Beacon
RAM	Restricted in Ability to Manoeuvre
RNLI	Royal National Lifeboat Institution
RoRo	Roll-on/Roll-off Cargo
RoPax	Roll-on/Roll-off Passenger
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 and Ranging
SPS	Significant Peripheral Structure
TCE	The Crown Estate
TLP	Tension Leg Platform
TSS	Traffic Separation Scheme
TPV	Third Party Verification
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
US	United States
UTC	Coordinated Universal Time
UXO	Unexploded Ordnance
VHF	Very High Frequency

Abbreviation	Definition
VTS	Vessel Traffic Service
WTG	Wind Turbine Generator

1 Introduction

1.1 Background

1. Anatec was commissioned by Floventis Energy (hereafter referred to as 'the Applicant'), to undertake a Navigational Risk Assessment (NRA) for the proposed Llŷr 1 Floating Offshore Wind Project (hereafter the 'proposed Project'). This NRA presents information on the proposed Project relative to the existing and estimated future navigational activity and forms the technical Appendix to **Volume 3 Chapter 25: Shipping and Navigation.**

2. A separate NRA will be undertaken for the proposed Llŷr 2 Floating Offshore Wind Project when the proposals for that project are moved forward at a later date as part of separate Section 36 and marine licence applications. Much of the information collected to date encapsulates both Llŷr 1 and Llŷr 2, and therefore will be used to support the separate NRA, although additional information will also be sought at that time including in consultation with relevant stakeholders.

1.2 Navigational Risk Assessment

3. An Environmental Impact Assessment (EIA) is a process which identifies the environmental effects of a proposed development, both negative and positive. An important requirement of the EIA for proposed Projects is the NRA. Following the Maritime and Coastguard Agency's (MCA) Marine Guidance Note (MGN) 654 (MCA, 2021), including the methodology document (Annex 1), this NRA includes:

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

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

- Construction;

- Operation and maintenance; and
- Decommissioning.
- The assessment of the proposed Project is based on a parameter-based design envelope approach, which is recognised in:
- Overarching National Policy Statement (NPS) for Energy (EN-1) (Department for Energy Security and Net Zero (Department for Energy Security and Net Zero (DESNZ)), 2023b);
- NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023a); and
- Planning Inspectorate Advice Note Nine: Rochdale Envelope (The Planning Inspectorate, 2018).

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

6. The design envelope includes conservative assumptions to form a worst case scenario which is considered and assessed for all risks. Further details on the design envelope are provided in **Volume 1 Chapter 4: Description of the Proposed Project**.

7. The shipping and navigation baseline and risk assessment has been undertaken based upon the information available and responses received at the time of preparation, including the worst case scenario as discussed above.

2 Guidance and Legislation

2.1 Legislation and Policy

8. Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIP) specifically in relation to shipping and navigation is contained in the NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023). Additionally, planning policy on NSIP for ports is contained in the NPS for Ports (Department for Transport (DfT), 2012).

9. As well as the NPSs, the United Kingdom (UK) Marine Policy Statement (HM Government, 2011) and Welsh National Marine Plan (Welsh Government, 2019) and South West Inshore and South West Offshore Marine Plan (HM Government, 2021) are relevant to the NRA.

10. **Volume 3 Chapter 25: Shipping and Navigation** summarises the relevant matters within the above legislation and policy and where they are considered in the Environmental Statement (ES).

2.2 Primary Guidance

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

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

12. MGN 654 highlights issues that shall be considered when assessing the effect on navigational safety from offshore renewable energy developments, proposed in UK internal waters, UK territorial sea, or the UK Exclusive Economic Zone (EEZ).

13. The MCA require that their methodology is used as a template for preparing NRAs. It is centred on risk management and requires a submission that shows that sufficient controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with mitigation (see **Section 3.2**). Across **Volume 3 Chapter 25: Shipping and Navigation** and the NRA, both base and future case levels of risk have been identified and what measures are required to ensure the future case remains broadly acceptable or tolerable with mitigation.

2.3 Other Guidance

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

- MGN 372 Amendment 1 (Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2022);
- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, 2021 (a));
- IALA Guideline G1162 Guidance on the Marking of Offshore Man-Made Structures (IALA, 2021 (b));
- The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy (RYA, 2019 (b));
- Standard Marking Schedule for Offshore Installations (DECC, 2011);
- Regulatory Expectations on Moorings for Floating Wind and Marine Devices (MCA and Health and Safety Executive (HSE), 2017); and
- Marine and Coastal Access Act 2009.

2.4 Lessons Learnt

15. There is considerable benefit for the Applicant in the sharing of lessons learnt within the offshore industry from existing and previous relevant projects. The NRA, and in particular the risk assessment undertaken in **Volume 3 Chapter 25: Shipping and Navigation**, 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.

3 Navigational Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

16. A shipping and navigation user can only be exposed to a risk caused by a hazard if there is a pathway through which a risk can be transmitted between the source activity and the user. Such users include:

- Commercial vessels;
- Commercial fishing vessels in transit;
- Recreational vessels;
- Military vessels;
- Anchored vessels;
- Emergency responders; and
- Local ports and associated services.

17. In cases where a user is exposed to a risk, the overall significance of risk to the user is determined. This process incorporates a degree of subjectivity. The assessments presented herein for shipping and navigation users have considered the following criteria:

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

18. It is noted that, with regards to commercial fishing vessels, the methodology and assessment has been applied to hazards considering commercial fishing vessels in transit. A separate methodology and assessment have been applied in **Volume 3 Volume 3 Chapter 26: Commercial Fisheries** to consider hazards on commercial fishing vessels including safety risks which are directly related to commercial fishing activity (rather than commercial fishing vessels in transit).

3.2 Formal Safety Assessment Process

19. The IMO FSA process (IMO, 2018) as approved by the IMO in 2018 will be applied to the risk assessment within this NRA, and informs **Volume 3 Chapter 25: Shipping and Navigation**.

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

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

Figure 3.1 Flow Chart of the FSA Methodology

3.2.1 Hazard Workshop Methodology

21. A key tool used in the NRA process is the Hazard Workshop which ensures that all hazards are identified and the corresponding risks qualified in discussion with relevant consultees. Table 3.1 and Table 3.2 define the severity of consequence and the frequency of occurrence rankings that have been used to assess risks within the Hazard Log, completed based on the outputs of the Hazard Workshop.

Table 3.1 Severity of Consequence Ranking Definitions

Rank	Description	Definition			
		People	Property	Environment	Business
1	Negligible	No perceptible impact	No perceptible impact	No perceptible impact	No perceptible impact
2	Minor	Slight injury(s)	Minor damage to property i.e., superficial damage	Tier 1 local assistance required	Minor reputational risks – limited to users
3	Moderate	Multiple minor or single serious injury	Damage not critical to operations	Tier 2 limited external assistance required	Local reputational risks
4	Serious	Multiple serious injuries or single fatality	Damage resulting in critical impact on operations	Tier 2 regional assistance required	National reputational risks
5	Major	More than one fatality	Total loss of property	Tier 3 national assistance required	International reputational risks

Table 3.2 Frequency of Occurrence Ranking Definitions

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

22. The severity of consequence and frequency of occurrence are then used to define the significance of risk via a tolerability matrix approach as shown in Table 3.3. The significance of risk is defined as Broadly Acceptable (low risk), Tolerable with Mitigation (intermediate risk) or Unacceptable (high risk).

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 with Mitigation (intermediate risk)
	Broadly Acceptable (low risk)

23. Once identified, the significance of risk will be assessed with the inclusion of embedded mitigation measures to ensure it is ALARP. Further mitigation measures may be required to further mitigate a hazard in accordance with the ALARP principles. Unacceptable risks are not considered to be ALARP.

3.3 Methodology for Cumulative Risk Assessment

24. The hazards identified in the FSA are also assessed for cumulative risks with the inclusion of other projects and proposed developments. Given the varying type, status and location of developments, a tiered approach to cumulative risk assessment has been undertaken, which splits developments into tiers depending upon project status, proximity to the proposed Project and the level to which they are anticipated to cumulatively impact relevant users. It also considers data confidence, most notably in terms of the level of certainty over the location and timescales for a development.

25. The tiers are summarised in Table 3.4, with the level of assessment undertaken for each tier included. It is noted that an aggregate of the criterion is used to determine the tier of each development.

Table 3.4 Cumulative Development Screening Summary

Tier	Minimum Development Status	Criterion	Data Confidence Level	Level of Cumulative Risk Assessment
1	Under construction or consented	▪ May impact a main commercial route passing within 1 nm of the Array Area. ▪ Raised as having possible cumulative effect during consultation. ▪ Up to 25 nm from the Array Area. ▪ Up to 2 nm from the offshore export cable corridor (OfECC).	High or medium	Quantitative cumulative re-routeing of main commercial routes
2	Under construction, consented or under determination	▪ May impact a main commercial route passing within 1 nm of the Array Area. ▪ Between 25 nm and 50 nm from the Array Area. ▪ Between 2 and 5 nm from the OfECC.	High or medium	Qualitative cumulative re-routeing of main commercial routes
3	Scoped or under examination	▪ Does not impact a main commercial route passing within 1 nm of the Array Area. ▪ Up to 50 nm from the Array Area. ▪ Up to 5 nm from the OfECC.	Low	Qualitative assumptions of routeing only

26. Further information relating to cumulative methodology is provided in **Appendix 5A: Cumulative Effects Assessment Approach and Methodology**.

3.4 Study Area

27. A minimum 10 nautical mile (nm) buffer has been applied around the boundary of the NRA Array Area, hereafter termed the 'Study Area'; this is an industry-standard radius that has been used in the majority of UK OWF NRAs. A 2 nm buffer has also been applied around the boundary of the offshore export cable corridor (OfECC), hereafter the 'OfECC Study Area'. These study areas are presented in Figure 3.2.

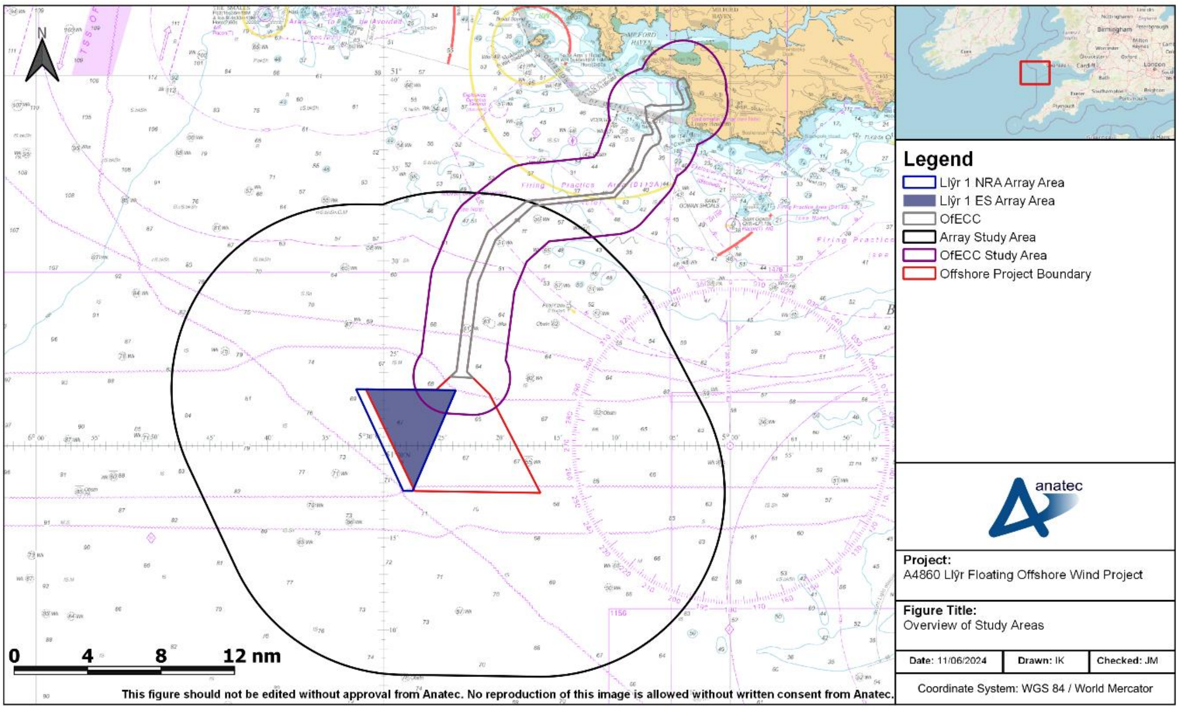

Figure 3.2 Overview of Study Areas

28. The study areas have been defined to provide local context to the analysis of risks by capturing the relevant routes, vessel traffic movements and historical incident data within and in proximity to the proposed Project. Navigational features wholly or partially outside the study areas are considered where appropriate, e.g., the various Traffic Separation Schemes (TSS) in the Celtic Sea.

29. It is acknowledged that the NRA Array Area differs from the ES Array Area assessed across the ES as a whole. Following amendments to the Offshore Project Boundary, the ES Array Area is located entirely within the Offshore Project Boundary and covers approximately 13 nm^2, whereas the NRA Array Area protrudes approximately 0.48 nm to the west and covers approximately 16 nm^2. The NRA Array Area is considered throughout this NRA (and is hereafter referred to as the 'Array Area') but the outcomes of the risk assessment are also applicable to the ES Array Area. It is noted that the ES Array Area does not overlap with The Crown Estate (TCE) Project Development Areas (PDA).

4 Consultation

4.1 Stakeholders Consulted in the Navigational Risk Assessment Process

30. Key shipping and navigation stakeholders have been consulted in the NRA process. The following stakeholders have been consulted via meetings including the hazard workshop:

- MCA;
- Trinity House;
- UK Chamber of Shipping;
- Milford Haven Port Authority (MHPA);
- Ministry of Defence (MOD);
- RYA;
- UK Major Ports Group (UKMPG); and
- GP Shipping.

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

32. As well as consulting with the organisations outlined, 20 Regular Operators identified from the vessel traffic surveys were provided with an overview of the proposed Project and offered the opportunity to provide feedback. Specific questions were included to aid Regular Operators wishing to make a response, including in relation to changes in routeing. The Regular Operator letter is presented in full in Error! Reference source not found..

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

- Arklow Shipping
- Carl F. Peters
- Eastern Pacific Shipping
- Gerdes Bereederungs
- Interscan Schiffahrtsges
- Irish Ferries
- Jungerhans Maritime Services
- Kyklades Maritime
- MF Shipping Group
- Minerva Marine
- MK Centennial Maritime
- MSC Shipmanagement
- OSM Ship Management
- Pelagia
- Selandia Ship Management
- Sinokor Petrochemical
- TMS Tankers
- Tsakos Columbia Shipmanagement
- Wessels Reederei
- Stena Line

4.2 Consultation Response

34. 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 raised during consultation and where they have been addressed are summarised in **Volume 3 Chapter 25: Shipping and Navigation**.

4.3 Hazard Workshop

35. 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 **Section 17** 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

36. The Hazard Workshop was held in person and via teleconferencing on 22 August 2023 and was attended by the MCA, Trinity House, UK Chamber of Shipping, MHPA, RYA, UK Major Ports Group, and GP Shipping.

4.3.2 Hazard Workshop Process and Hazard Log

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

38. Following the 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.

39. The hazard log has been used to inform the risk assessment undertaken in **Section 17** of the NRA, and is presented in full in Error! Reference source not found..

5 Data Sources

40. This section summarises the main data sources used to characterise the shipping and navigation baseline relative to the proposed Project, as well as detailing any limitations associated with these data sources.

5.1 Summary of Data Sources

41. The main data sources used to characterise the shipping and navigation baseline relative to the proposed Project are outlined in Table 5.1.

Table 5.1 Data Sources Used to Inform Shipping and Navigation Baseline

Data	Source(s)	Purpose
Vessel traffic	Winter vessel traffic survey data consisting of Automatic Identification System (AIS), Radar and visual observations for the Study Area (14 days, 05 to 19 March 2022) recorded from a dedicated survey vessel on-site.	Characterising vessel traffic movements within and in proximity to the Array Area in line with MGN 654 (MCA, 2021) requirements, noting that the MCA have confirmed during a consultation meeting (January 2024) that an exemption to the 24-month requirement for the data collection prior to submission is permitted.
	Summer vessel traffic survey data consisting of AIS, Radar and visual observations for the Study Area (14 days, 09 to 25 July 2023) recorded from a dedicated survey vessel on-site.	
	Winter vessel traffic survey data consisting of AIS for the OfECC Study Area (14 days, 07 to 20 March 2022) recorded from onshore receivers and the dedicated survey vessel for the Array Area.	Characterising vessel traffic movements within and in proximity to the OfECC in line with MGN 654 (MCA, 2021) requirements.
	Summer vessel traffic survey data consisting of AIS for the OfECC Study Area (14 days, 12 to 25 July 2023) recorded from onshore receivers and the dedicated survey vessel for the Array Area.	
	AIS data for the study area (12 months 2022) (hereafter the 'long-term vessel traffic data') recorded from coastal receivers.	Validation of the vessel traffic surveys and characterising seasonal variations.
	Summer vessel traffic survey data consisting of AIS, Radar and visual observations for the Study Area (14 days, 12 to 26 August 2021) recorded from a dedicated survey vessel on-site.	
	Anatec's ShipRoutes database (2023).	Secondary source for characterising vessel traffic movements including cumulatively within and in proximity to the proposed Project.

Data	Source(s)	Purpose
Maritime incidents	Marine Accident Investigation Branch (MAIB) marine accidents database (2002 to 2021).	Review of maritime incidents within and in proximity to the proposed Project.
	Royal National Lifeboat Institute (RNLI) incident data (2013 to 2022).	
	DfT UK civilian Search and Rescue (SAR) helicopter taskings (2015 to 2023).	
Recreational traffic density and features	*UK Coastal Atlas of Recreational Boating 2.1* (RYA, 2019 (a)).	Characterising recreational activity within and in proximity to the proposed Project.
Other navigational features	Admiralty Charts 1123-0, 1156-0, 1164-0, 1178-0, 1179-0, 2649-0, 2878-0, 3273-0, 3274-0 (United Kingdom Hydrographic Office (UKHO), 2023).	Characterising other navigational features in proximity to the proposed Project.
	Admiralty Sailing Directions West Coasts of England and Wales Pilot NP37 (UKHO, 2022).	
Weather	Wind direction data from *Metocean Criteria – Llŷr 1 & Llŷr 2 Offshore Floating Wind Turbines* (Aktis Hydraulics, 2023).	Characterising weather conditions in proximity to the proposed Project for use as input in the collision and allision risk modelling.
	Significant wave height data from *Metocean Criteria – Llŷr 1 & Llŷr 2 Offshore Floating Wind Turbines* (Aktis Hydraulics, 2023).	
	Tidal data from Admiralty Charts 1178-0 and 2878-0.	
	Case studies of past weather events (Met Office, 2022).	

5.2 Vessel Traffic Surveys

42. Two 14-day AIS, Radar, and visual observation surveys undertaken in winter 2022 (05 to 19 March 2022) and summer 2023 (09 to 25 July 2023) have been considered within the baseline for a total of 28 full days, with a long-term dataset from 2022 and 14-day dataset from summer 2021 (12 to 26 August 2021) used as validation (see Error! Reference source not found.). It is noted that due to severe weather, the survey vessel left the Study Area from 12:00 Coordinated Universal Time (UTC) on 14 July to 09:00 UTC on 16 July 2023, 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.

43. Although the winter vessel traffic data was collected in March 2022 and so is outdated in relation to MGN 654 requirements, it was agreed by the MCA and Trinity House that in this instance this data is acceptable for use as a primary source with no further data collection required. The basis for this exemption from the MGN 654 requirements was:

- A total of 42 days of dedicated vessel traffic survey data has been collected (exceeding the minimum 28-day requirement);
- Other sources including long-term vessel traffic data (see **Section 5.3**) and consultation feedback (see **Section 4**) have ensured that understanding of the baseline is comprehensive;
- Non-AIS presence in winter is very limited based on the winter 2022 survey; and
- There are no developments since winter 2022 which would be expected to affect the baseline already established.

44. Several vessel tracks recorded during the survey period were classified as temporary (non-routine) and were therefore excluded from the analysis; besides the survey vessel itself, this included other survey vessels, including a vessel surveying the proposed White Cross OWF, as well as a guard vessel.

45. The dataset is assessed in full in **Section 10**.

5.3 Long-Term Vessel Traffic Data

46. The long-term vessel traffic data consisting of AIS covering 12 months in 2022 was collected from coastal receivers. Considering the moderate distance offshore of the Array Area (approximately 19nm), 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 and adverse weather routeing to be identified.

47. The long-term vessel traffic data is assessed in full in Error! Reference source not found..

5.4 Data Limitations

5.4.1 Automatic Identification System Data

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

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

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

5.4.2 Historical Incident Data

51. Although all UK commercial vessels are required to report accidents to the MAIB, non-UK vessels do not have to report unless they are in a UK port or within 12 nm territorial waters (noting that the Study Area is not located entirely within 12 nm territorial waters) or carrying passengers to a UK port. There are also no requirements for non-commercial recreational craft to report accidents to the MAIB.

52. 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.

5.4.3 United Kingdom Hydrographic Office Admiralty Charts

53. 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. Additionally, not all navigational features may be charted, e.g., certain aids to navigation and wrecks.

54. However, 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 as of June 2024.

6 Project Description Relevant to Shipping and Navigation

55. The NRA reflects the design envelope which is detailed in full in **Volume 1 Chapter 4: Description of the Proposed Project**. The following subsections outline the maximum extent of the proposed Project for which any shipping and navigation hazards are assessed.

6.1 Proposed Project Boundaries

6.1.1 Array Area

56. The proposed Project will consist of one array contained within the boundaries of one Array Area. This Array Area is located approximately 19 nm south of the Linney Head on the southwestern Welsh coast and covers an area of approximately 16 nautical miles square (nm^2), with water depths ranging between 67 and 71 metres (m) below Chart Datum (CD).

57. All surface piercing structures will be located entirely within the Array Area, inclusive of blade overfly. The coordinates defining the boundary of the Array Area are illustrated in Figure 6.1 and provided in Table 6.1. It is not intended that the Array Area be designated as an Area to be Avoided (ATBA), with navigation only restricted where Safety Zones are active (see **Section 21**).

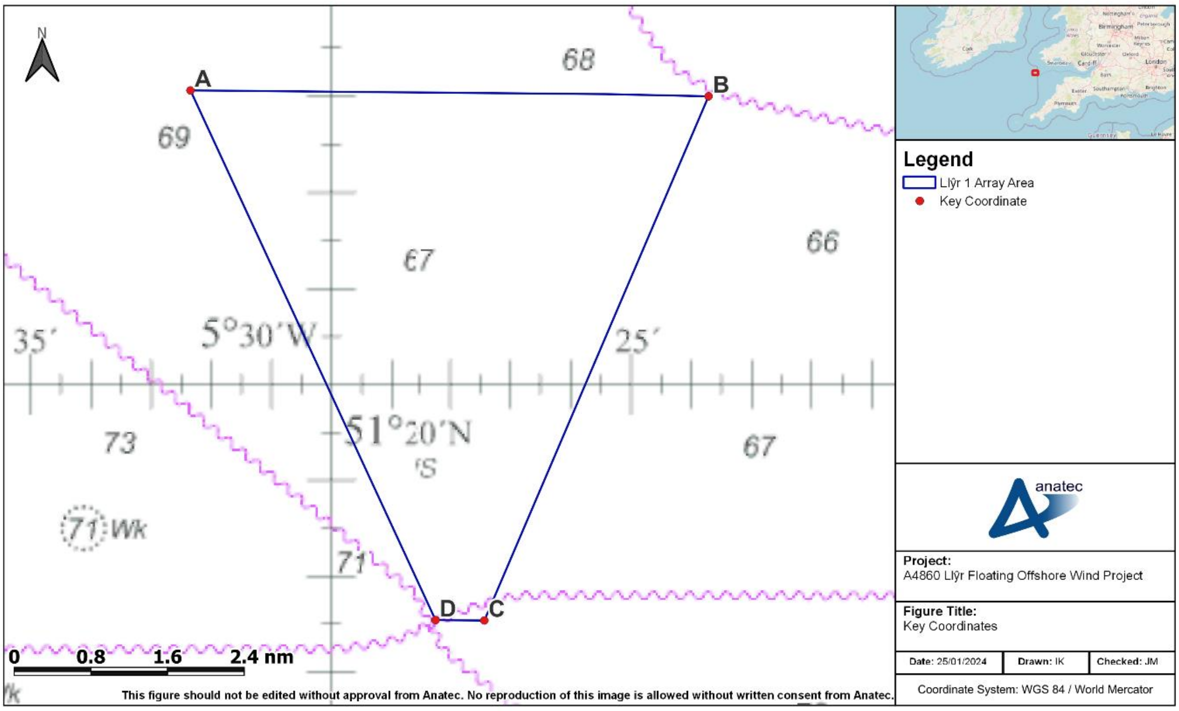

Figure 6.1 Key Coordinates

Table 6.1 Key Coordinates of the Array Area

ID	Latitude (WGS84)	Longitude (WGS84)
A	51° 23′ 03.39″ N	005° 32′ 20.20″ W
B	51° 22′ 59.71″ N	005° 23′ 43.37″ W
C	51° 17′ 32.37″ N	005° 27′ 27.03″ W
D	51° 17′ 32.63″ N	005° 28′ 15.69″ W

58. It is noted that the Array Area represents a change from that considered at Scoping and was made following stakeholder feedback (see **Section 4.2**). The Array Area changes are presented in Figure 6.2**.**

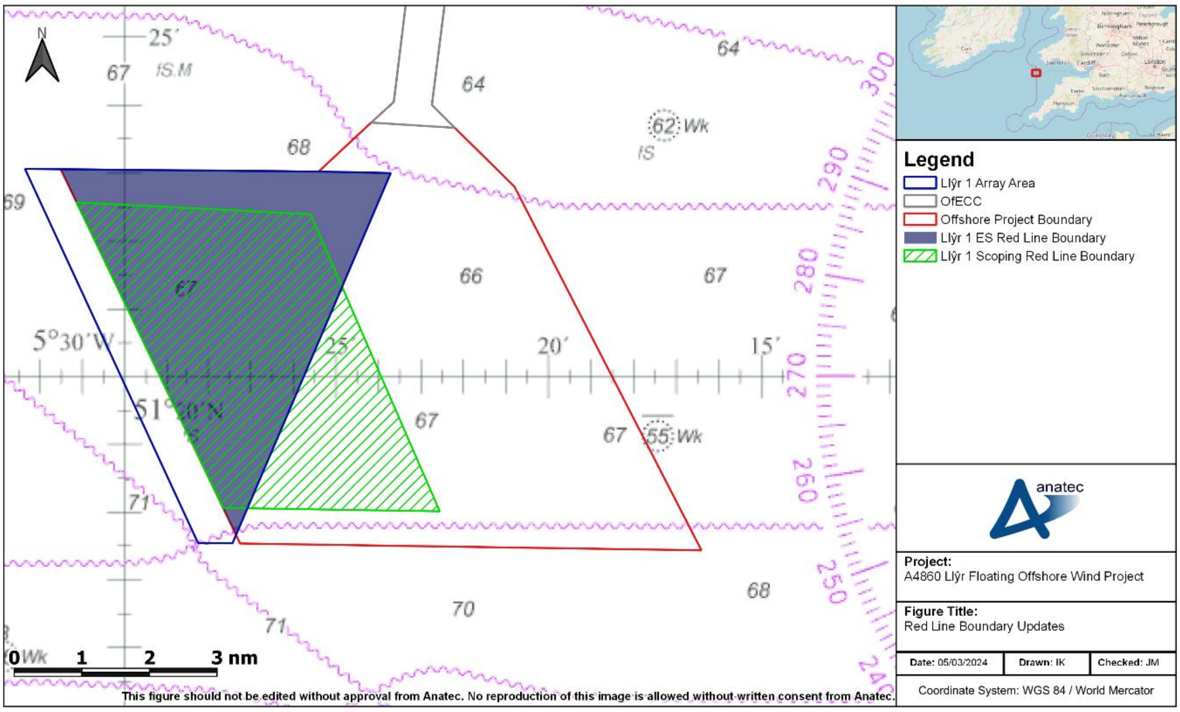

Figure 6.2 Red Line Boundary Updates

59. The key change relates to the eastern extent of the former Array Area (shown in green in **Figure 6.2**) and a tanker route to/from Milford Haven with which multiple stakeholders raised concerns. The eastern boundary of the updated Array Area aligns with the western extent and orientation of the route, thus ensuring that disruption to this route is minimal.

60. Highly surveyed routes highlighted by the MOD have also featured in discussions, although MOD have since withdrawn this concern.

61. For the purposes of assessing a worst-case scenario within the NRA, the western periphery of the Array Area as shown in blue line in Figure 6.2 and considered for

collision and allision risk modelling (see **Section 16**) extends west of the Offshore Project Boundary. Proposed Project infrastructure will however be located only within a reduced Array Area (shown in shaded purple in **Figure 6.2),** the western extent of which aligns with the Offshore Project Boundary, of which further information is available in **Chapter 4: Project Description**. Therefore a precautionary layout and spatial extent of the Array Area was used for the purpose of the NRA.

6.1.2 OfECC

62. The OfECC runs between the northeastern boundary of the Offshore Project Boundary and the landfall point at Freshwater West and is presented in **Figure 6.3**. The total length is approximately 23 nm, with water depths within the OfECC ranging between shoreline and 61 m below CD. The offshore export cables will be located fully within the OfECC.

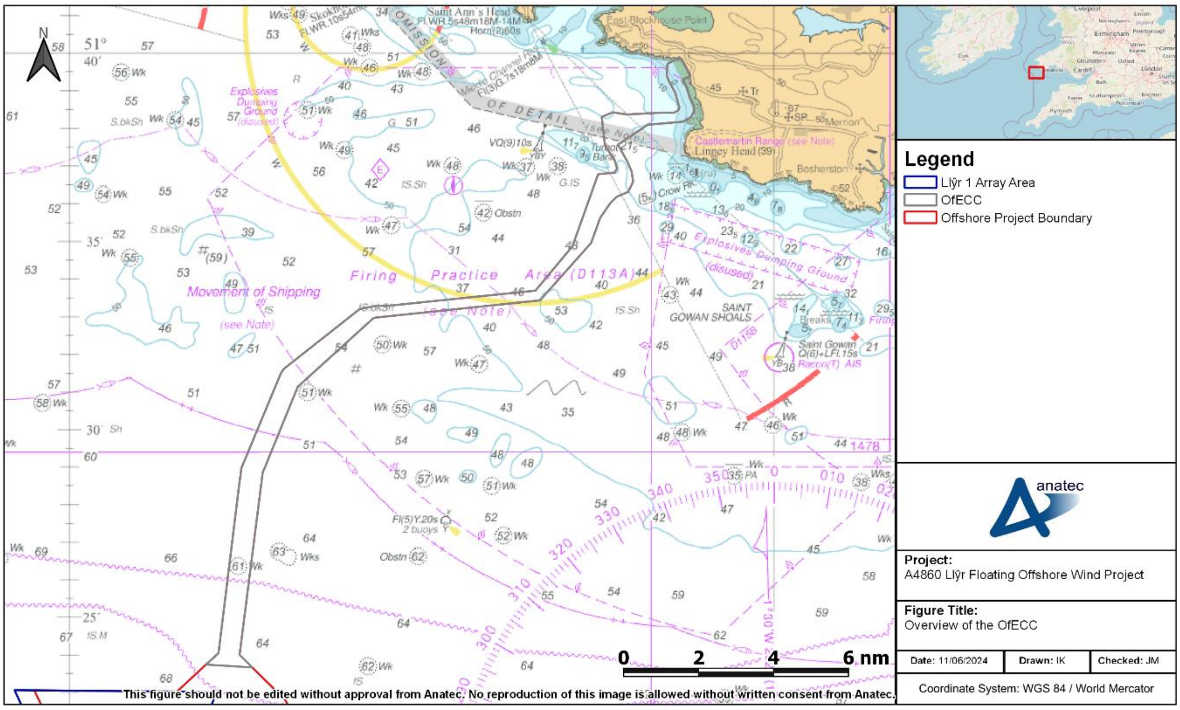

Figure 6.3 Overview of the OfECC

63. As with the Array Area, updates have been made to the OfECC boundary since the Hazard Workshop. These changes are highlighted in **Figure 6.4**.

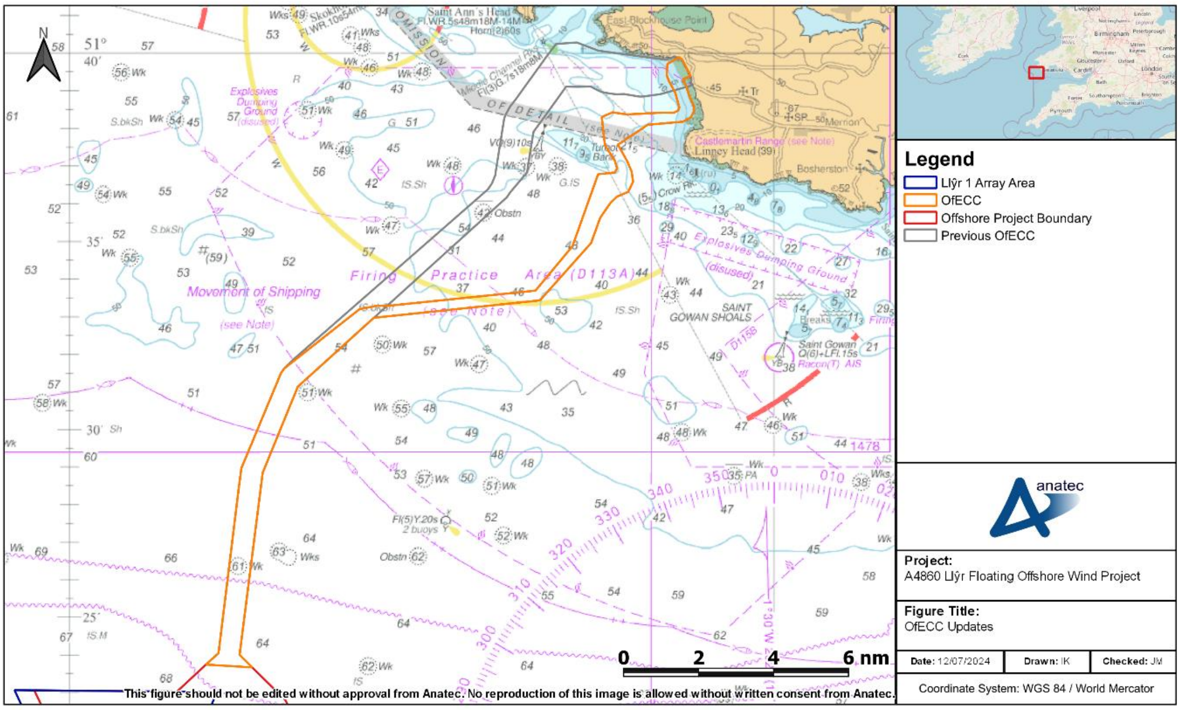

Figure 6.4 OfECC Updates

64. The primary change to the OfECC is in the northern section, with this portion now passing east of Turbot Bank, before returning to landfall at Freshwater West. In doing so, it also results in the OfECC no longer interacting with the tanker routeing into Milford Haven.

6.2 Surface Infrastructure

6.2.1 Indicative Worst-Case Layout

65. Up to 10 surface structures will be installed within the Array Area, all of them being Wind Turbine Generators (WTG). No other infrastructure (such as offshore substations) are considered.

66. The final locations of infrastructure have not yet been defined, with a layout plan in consultation with MCA and Trinity House included as an embedded mitigation measure (see **Section 21**). Therefore, an indicative worst case layout option has generally been considered in the risk assessment which represents the maximum spatial area and maximum number of WTGs. Where appropriate, the minimum centre-to-centre spacing between WTGs within the offshore PDE of 4x rotor diameter spacing (1,140 m) is considered (noting that the indicative worst case layout tests maximum spatial area rather than minimum spacing). Based on indicative positions, the minimum spacing will likely be at least 1,500 m.

67. The indicative layout is presented in Figure 6.5.

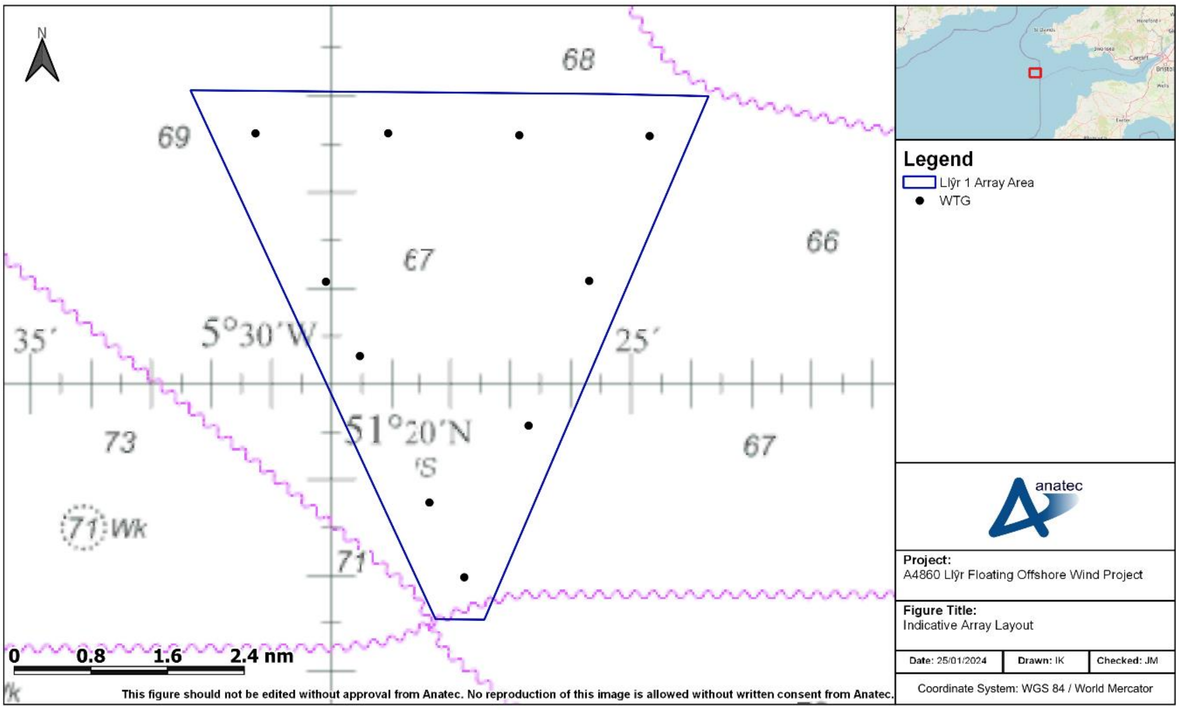

Figure 6.5 Indicative Array Layout

68. The indicative array layout in the worst case scenario for the NRW consists of a full build out of the Array Area 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.

69. An alternative array layout was presented at the Hazard Workshop and has been used for allision risk modelling. This alternative array layout features 14 surface structures, with more information provided in **Section 16.4.1**.

6.2.2 Wind Turbine Generators

70. The worst case scenario for the WTGs within the indicative array layout is a maximum rotor diameter of 280 m and minimum blade tip height (above Lowest Astronomical Tide (LAT)) of 22 m. It is noted that these values reflect the worst-case values that could be used.

71. Floating barge foundations have been considered as the worst case scenario 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 worst case scenario for the WTGs, which assume use of a barge foundation design, are provided in Table 6.2.

Table 6.2 Worst Case Scenario WTG Parameters

Parameter	Worst Case Scenario for Shipping and Navigation
Foundation type	Barge
Dimensions at sea surface	220 m diameter (Barge with 110 m length assumed to be able to rotate through 360°)
Minimum blade clearance above sea level	22 m
Maximum blade tip height above LAT	325.5 m
Maximum rotor diameter	280 m

6.2.2.1 Floating Substructures

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

Table 6.3 Floating Substructure Parameters

Parameter	TLPs	Catenary Moorings
Maximum number of mooring lines	8	8
Initial mooring line descent	Vertical	Straight line between connection point and 20m below sea surface at 95m from floater[1]
Mooring line radius (m)	n/a	1,100m
Buoyant inter-array cables range below waterline (for buoyancy aid)	25 to 55 m	
Buoyant inter-array cables distance from connection point	40 to 50 m	

73. Three mooring line options will be considered:

- Option 1 – utilising a chain to hold the mooring line in position;
- Option 2 – utilising a buoyancy aid; and
- Option 3 – utilising both a chain and buoyancy aid.

[1] Mooring lines will be parabolic in shape but straight line assumption is a conservative approach since a parabola will increase the depth of the mooring lines in the water column.

6.2.3 Inter-Array Cables

74. The inter-array cables will be fully installed within the Array Area to connect individual WTGs to each other. Up to 9.3 nm of inter-array cables will be required, although the final length and number of crossings will depend upon the final array layout. The inter-array cables will be buoyant close to the point of contact with each WTG, with minimum under keel clearance expected to be between 25 and 55 m, at a distance of approximately 50 to 100 m from the WTG. Touchdown on the seabed will occur a maximum of 150 m from the WTG.

6.3 OfECC

6.3.1 Export Cables

75. The offshore export cables will be installed within the OfECC to carry the electricity generated by the WTGs to the landfall location. Up to 53 nm of offshore export cables will be required with up to five crossings.

6.3.2 Cable Burial

76. 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. However, a target burial depth of between 0.8 and 2 m for all subsea cables associated with the proposed Project is assumed as part of the worst case scenario.

77. Where cable burial is not possible, or where the required depth of cover is not achievable alternative mechanical cable protection methods may be deployed. The locations, nature and amount of any cable protection will be determined within the cable burial risk assessment. These mechanical cable protection methods may include a combination of concrete mattresses, armoured cable, or grout bags. It is assumed that up to 27% of the offshore export cables may require cable protection as part of the worst case scenario (see **Volume 1 Chapter 4: Project Description**).

6.4 Construction Phase

78. The indicative offshore construction phase will last for up to two years, noting schedules will be subject to change (e.g., due to adverse weather, vessel availability).

79. Indicatively, 43 construction vessels may be utilised, with up to 17 vessels on site simultaneously throughout the construction phase. It is likely that construction will be seasonal with limited operations over winter months due to weather restrictions. Table 6.4 provides a breakdown of the installation activities and vessel types during the construction phase.

Table 6.4 Breakdown of Construction Vessel Peak Numbers

Vessel Activity	Maximum Number Required
Pre-construction array survey (inc. UXO clearance)	4
Installation of site boundary navigation aids & navigation markers	1
Installation of mooring lines and anchors	4
Hook-up of floating platforms into mooring lines	8
Pre-construction OfECC survey (inc. UXO clearance)	4
Boulder clearance	1
Pre Lay Grapnel Run (PLGR)	1
Sandwave levelling	2
Export cable installation	3
Export cable protection	2
Nearshore export cable installation	5
Inter-array cable installation and cable protection	4

6.5 Operation and Maintenance Phase

80. The operation and maintenance phase will last at least 30 years. Throughout the operation and maintenance phase, a maximum number of 120 annual round trips to port will occur with a worst case assumption of a maximum of 12 vessels on site simultaneously (as per the construction phase).

6.6 Decommissioning Phase

81. The decommissioning phase of the proposed Project will generally be assumed to be comparable to the construction phase in terms of duration, vessel types and vessel numbers. It is anticipated that during decommissioning phase, all infrastructure at the sea surface, above and below the seabed will be removed, with the particular approach to be considered as part of the decommissioning plan.

6.7 Worst Case Scenario

82. The worst case scenario for each shipping and navigation hazard is provided in Table 6.5 and is based on the parameters described in the previous subsections.

Table 6.5 Worst Case Scenario for Shipping and Navigation by Hazard

Potential Hazard	Phase(s)	Worst Case Scenario for Shipping and Navigation	Justification
Vessel displacement and increased vessel to vessel collision risk between third-party vessels	Construction / decommissioning	▪ Construction of up to two years; ▪ Full build out of the Array Area; ▪ Buoyed construction/decommissioning area encompassing the maximum extent of the Array Area; ▪ Presence of 500 m construction safety zones; ▪ Up to two offshore export cables of combined 53 nm length; ▪ Up to 17 construction/decommissioning vessels on-site simultaneously.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent vessel to vessel collision risk.
	Operation and maintenance	▪ Maximum operational life of 30 years; ▪ Full build out of the Array Area; ▪ Presence of 500 m safety zones during major maintenance; and ▪ Up to 12 operation and maintenance vessels on-site simultaneously and up to 120 annual round trips to port.	
Increased vessel to vessel collision risk between a third-party vessel and a project vessel	Construction / decommissioning	▪ Construction of up to two years; ▪ Full build out of the Array Area; ▪ Buoyed construction/decommissioning area encompassing the maximum extent of the Array Area; ▪ Presence of 500 m construction safety zones and 50 m pre commissioning safety zones; ▪ Up to two offshore export cables of combined 53 nm length; and ▪ Up to 17 construction/decommissioning vessels on-site simultaneously.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.

Potential Hazard	Phase(s)	Worst Case Scenario for Shipping and Navigation	Justification
	Operation and maintenance	▪ Maximum operational life of 30 years; ▪ Full build out of the Array Area; ▪ Presence of 500 m safety zones during major maintenance; and ▪ Up to 12 operation and maintenance vessels on-site simultaneously and up to 120 annual round trips to port.	
Vessel to structure allision risk	Operation and maintenance	▪ Maximum operational life of 30 years; ▪ Full build out of the Array Area; ▪ Presence of 500 m safety zones during major maintenance; ▪ Minimum spacing of 1,140 m between WTGs; and ▪ Up to 10 WTGs on floating barge foundations with sea surface dimensions of 220 m diameter.	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.
Reduced access to local ports and harbours	Construction / decommissioning	▪ Construction of up to two years; ▪ Full build out of the Array Area; ▪ Buoyed construction/decommissioning area encompassing the maximum extent of the Array Area; ▪ Presence of 500 m construction safety zones; and ▪ Up to 17 construction/decommissioning vessels on-site simultaneously.	Largest possible extent, greatest number of vessel activities associated with the proposed Project and greatest duration resulting in the maximum spatial and temporal effect on access to local ports.
	Operation and maintenance	▪ Maximum operational life of 30 years; ▪ Full build out of the Array Area; ▪ Presence of 500 m safety zones during major maintenance; and ▪ Up to 12 operation and maintenance vessels on-site simultaneously and up to 120 annual round trips to port.	

Potential Hazard	Phase(s)	Worst Case Scenario for Shipping and Navigation	Justification
Reduction of under keel clearance due to mooring lines, buoyant inter-array cables, or cable protection	Operation and maintenance	▪ Maximum operational life of 30 years; ▪ Up to 11 inter-array cables of combined 9.3 nm length; ▪ Up to two offshore export cables of combined 53 nm length; ▪ Up to five crossings in total for the offshore export cables; ▪ Buoyant inter-array cables at depth of 25 – 55 m, approximately 50 – 100 m from the WTGs; ▪ Tensioned, catenary spread, or catenary single point moorings; ▪ 3 – 8 mooring lines per WTG; ▪ Under keel clearance from above of 20 – 50 m; and ▪ Touchdown at 150 m.	Largest possible extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on under keel clearance.
Anchor interaction with mooring lines or subsea cables	Operation and maintenance	▪ Maximum operational life of 30 years; ▪ Up to 11 inter-array cables of combined 9.3 nm length; ▪ Up to two offshore export cables of combined 53 nm length; ▪ Indicative maximum proportion of inter-array cable protection requirement of 20% from the touchdown points; ▪ Indicative maximum proportion of export cable protection requirement of 27%; ▪ Up to five crossings in total for the offshore export cables; ▪ Tensioned, catenary spread, or catenary single point moorings; ▪ 3 – 8 mooring lines per WTG; and ▪ Touchdown at 150 m.	Largest possible extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on anchor interaction with subsea cables.
Loss of station	Operation and maintenance	▪ Maximum operational life of 30 years; ▪ Full build out of the Array Area; ▪ Up to 10 WTGs on floating barge foundations with sea surface dimensions of 220 m diameter; and ▪ 3 – 8 mooring lines per WTG.	Maximum number of WTGs with greatest surface dimensions.

Potential Hazard	Phase(s)	Worst Case Scenario for Shipping and Navigation	Justification
Reduction of emergency response capability (including SAR access)	Operation and maintenance	▪ Maximum operational life of 30 years; ▪ Full build out of the Array Area; ▪ Presence of 500 m safety zones during major maintenance; and ▪ Up to 12 operation and maintenance vessels on-site simultaneously and up to 120 annual round trips to port. ▪ Minimum spacing of 1,140 m between WTGs; and ▪ Up to 10 WTGs on floating barge foundations with sea surface dimensions of 220 m diameter.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability.

7 Navigational Features

83. A plot of the navigational features within the red line boundary of and in proximity to the proposed Project is presented in Figure 7.1. Each of the features shown are discussed in the following subsections and have been identified using the most detailed UKHO admiralty chart available.

84. It is noted that no precautionary areas, oil and gas infrastructure, marine archaeological sites, or spoil grounds are charted in vicinity of the proposed Project. Likewise, the nearest MEHRA is located 6.3 nm north west of the OfECC and 19 nm north of the Array Area (associated with Skomer Island).

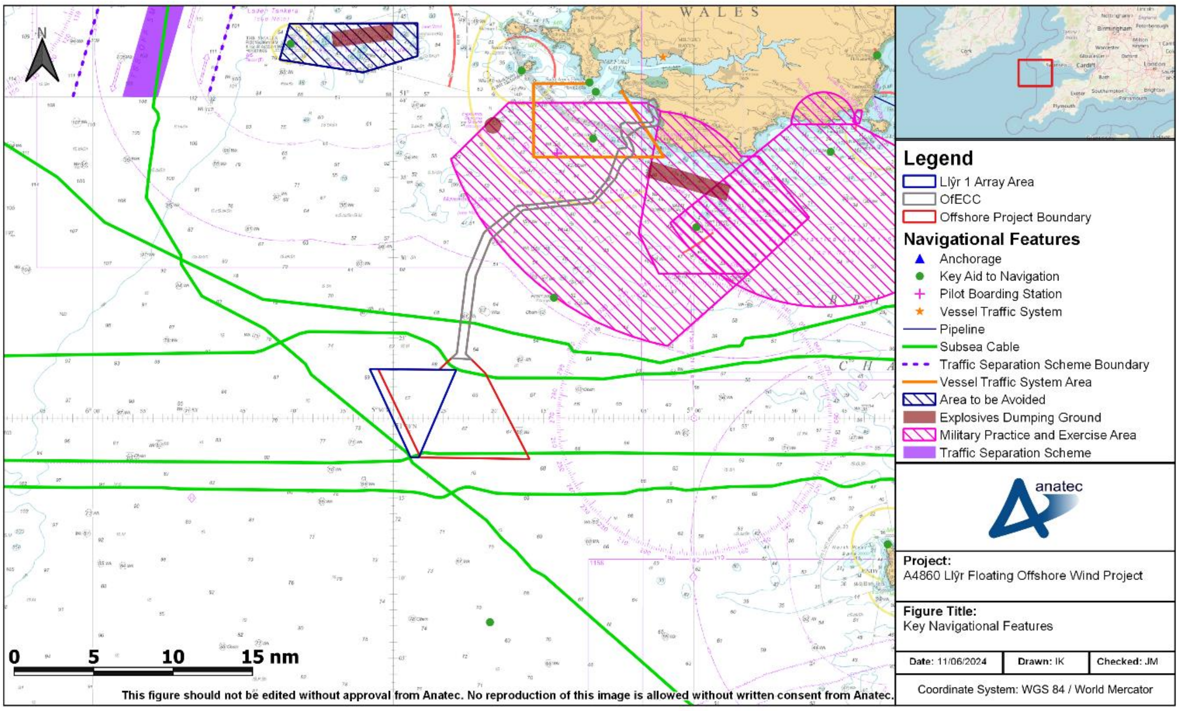

Figure 7.1 Navigational Features

7.1 Other OWFs

85. There are currently no operational OWFs in close vicinity to the proposed Project; however, other OWFs are planned, including:

- Erebus, located approximately 3 nm to the northwest of the Array Area;
- Pembrokeshire Demonstration Zone, located approximately 8 nm to the northeast of the Array Area; and
- White Cross, located approximately 9 nm to the south of the Array Area.

86. Planned developments are considered separately on a cumulative basis (see **Section 14**). For the wider all topic Cumulative Effects Assessment (CEA), see **Volume 6 Appendix 5A: CEA Approach and Methodology**.

7.2 Traffic Separation Schemes

87. There are three TSSs in the vicinity of the proposed Project, namely:

- TSS Off Smalls, located approximately 21 nm to the northwest of the Array Area;
- TSS Off Land's End, located approximately 60 nm to the southwest of the Array Area; and
- TSS West of the Scilly Isles, located approximately 87nm to the southwest of the Array Area.

88. These TSSs are presented in Figure 7.2. A smaller TSS, TSS West of the Scilly Isles, is also shown; this TSS is located approximately 18 nm to the west of TSS Off Land's End.

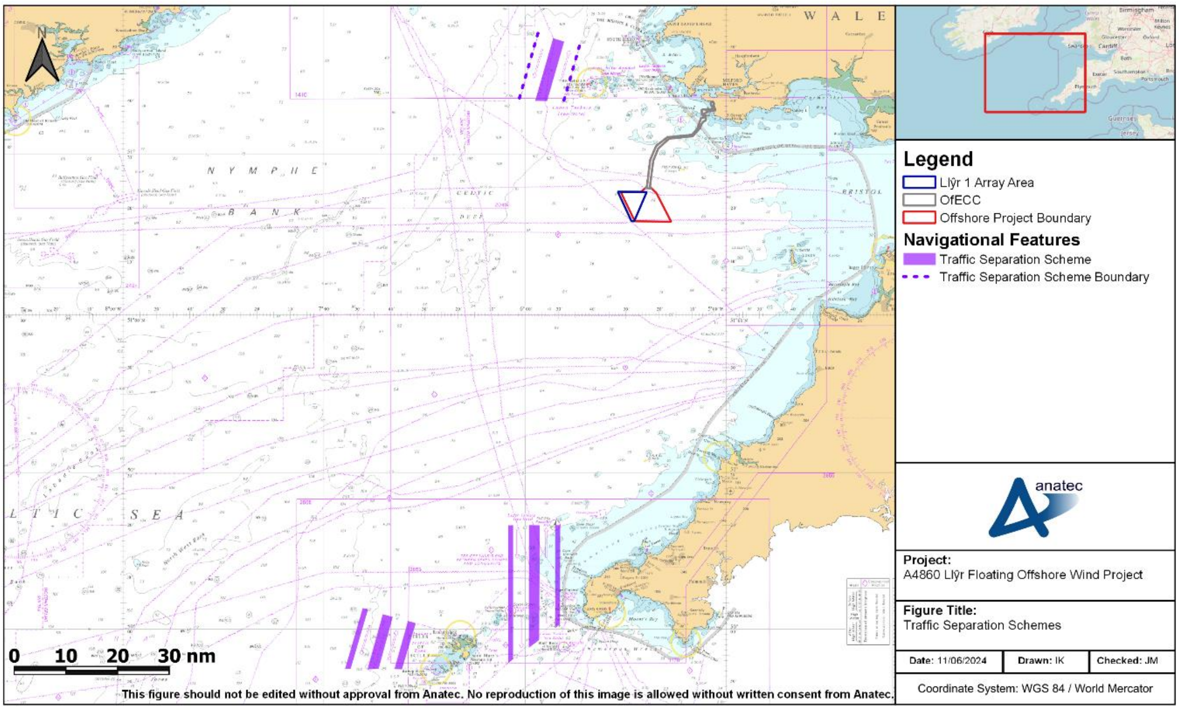

Figure 7.2 Nearby Traffic Separation Schemes

7.3 Ports, Harbours and Related Facilities

89. The main location for port facilities is within the Milford Haven Waterway, a natural harbour whose entrance is located approximately 21 nm to the northeast of the Array Area. There is a pilot boarding station in front of this entrance, located approximately 15 nm to the north of the Array Area and 3.0 nm to the north of the OfECC. Within the waterway, vessels can moor at locations such as the Port of Milford Haven and Pembroke Dock.

90. The Port of Milford Haven is described by the Admiralty Sailing Direction as a 'large, sheltered deep-water inlet' which includes Pembroke Port, and 'consists principally

of oil and Liquefied Natural Gas (LNG) terminals and associated refineries'. Operating within Pembroke Dock include a container and general cargo terminal, as well as a Roll-on/Roll-off passenger (RoPax) terminal which links the area to Ireland.

91. Vessels may also find anchorage off the east coast of Lundy Island, approximately 31 nm southeast of the Array Area.

7.4 Subsea Cables

92. There are five subsea telecommunications cables within 10 nm of the Array Area, namely:

- EXA Express, passing through the south of the Array Area and connecting England, Ireland and Canada;
- Tata TGN-Atlantic, that passes approximately 165 m north of the Array Area and connecting England with the United States (US);
- Pan European Crossing, that passes approximately 100 m southwest of the Array Area and connecting Ireland with England;
- Tata TGN-Western Europe, passing approximately 2 nm south of the Array Area and connecting England with Portugal; and
- Solas, passing approximately 3 nm northeast of the Array Area and connecting Ireland with Wales.

93. Additionally, the Green Link Interconnector is in its construction phase.

7.5 Aids to Navigation

94. There is a single charted aid to navigation located within 10 nm of the Array Area, a pair of flashing yellow buoys approximately 8 nm to the northeast. There are none within the OfECC. As described in the Admiralty Sailing Directions, the approaches to Milford Haven include 'a Vessel Traffic Service (VTS) with Information and Traffic Organisation Services and full radar surveillance' which is maintained for the control of shipping. This is mandatory for all vessels over 20 m.

7.6 Anchorage Areas

95. There is one anchorage area in the vicinity of the Array Area – the anchorage off the east coast of Lundy Island, approximately 31 nm southeast of the Array Area. Details on anchoring vessels near the Array Area and OfECC are described further in **Sections 10.1.4** and **10.2.4** respectively.

7.7 Explosives Dumping Grounds

96. There are three explosives dumping grounds in the vicinity of the proposed Project, each of which are disused. The closest is located approximately 17 nm to the northeast of the Array Area.

7.8 Area to be Avoided (ATBA)

97. There is an ATBA located approximately 18 nm to the north of the Array Area, encompassing the group of rocks known as The Smalls as well as the explosives dumping ground and shallow sandbanks to its east.

7.9 Charted Wrecks

98. There are 25 charted wrecks or obstructions located within 10 nm of the Array Area, with none located within the Array Area itself. One wreck is located within the OfECC.

7.10 Military Practice and Exercise Areas

99. There is one Military Practice and Exercise Area (PEXA) within 10 nm of the Array Area. This is identified as *D113A* approximately 7 nm to the northeast and is used as a firing practice area. No restrictions are placed on the right to transit the firing practice area at any time, with operations conducted using a clear range procedure; exercises and firing only take place when the area is considered to be clear of all shipping.

100. Although not available from desktop data, the MOD confirmed in their scoping response that there is a highly surveyed route located east of the current Array Area (which overlapped with the original Llŷr 2 Array Area– see **Section** Error! Reference source not found.).

7.11 Marine Aggregate Dredging Areas

101. There are no marine aggregate dredging areas within 10 nm of the Array Area. However, there is a marine aggregate dredging area located approximately 30 nm to the northeast of the Array Area.

7.12 Pipelines

102. There are no pipelines within 10 nm of the Array Area. However, there is a pipeline of unspecified type charted in the vicinity of Caldey Island, approximately 32 nm to the northeast of the Array Area.

8 Meteorological Ocean Data

8.1 Wind Direction

103. Based on wind direction data from *Metocean Criteria – Llŷr 1 & Llŷr 2 Offshore Floating Wind Turbines* (Aktis Hydraulics, 2023), 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 predominately from the west and southwest.

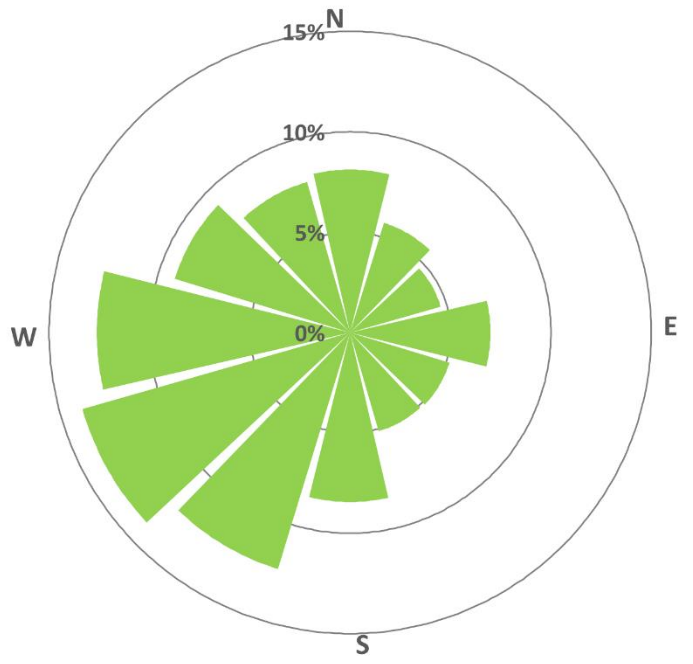

Figure 8.1 Wind Direction Distribution

8.2 Significant Wave Height

104. Based on significant wave height data (again from *Metocean Criteria – Llŷr 1 & Llŷr 2 Offshore Floating Wind Turbines* (Aktis Hydraulics, 2023)) 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 (<1 m)	21.02
Moderate (1 to 5 m)	76.48
Severe (≥5 m)	2.51

8.3 Visibility

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

8.4 Tidal Speed and Direction

106. From UKHO Admiralty Charts 1178 and 2878, currents within and in proximity to the Array Area are set in a generally northwest to southwest on the flood tide and the same on the ebb tide. The greatest flood peak tidal rate is 2.2 knots (kt) and the greatest peak ebb tidal rate is 2.1 kt. The peak speed and corresponding direction data for the flood and ebb tides for the relevant tidal diamonds on the UKHO Admiralty Charts 1178 and 2878 are presented in Table 8.2.

Table 8.2 Peak Flood and Ebb Tidal Data

Tidal Diamond	Chart Number	Flood		Ebb	
		Direction (°)	Speed (kt)	Direction (°)	Speed (kt)
A	2878-0	137	2.2	318	2.1
H	1178-0	171	0.7	304	0.7
J	1178-0	062	1.4	247	1.3
K	1178-0	063	1.1	263	1.0

107. 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 proposed Project is not expected to result in any additional risk to the existing tidal streams in relation to their effect on existing shipping and navigation users.

9 Emergency Response and Incident Overview

108. This section summarises the existing emergency response resources (including SAR) and reviews historical maritime incident data to assess baseline incident rates in vicinity to the proposed Project.

9.1 Maritime Rescue Coordination Centres and Joint Rescue Coordination Centres

109. 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).

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

111. All of the MCA's operations, including SAR, are divided into 18 geographical regions. Area 13 – "South East Wales to Mid-Wales" – covers the south coast of Wales from Chepstow at its southeast to Gwbert at its west, and therefore covers the area encompassing the proposed Project. The Milford Haven MRCC is located within Area 13 approximately 22 nm northeast of the Array Area, as illustrated in Figure 9.1, and coordinates the SAR response for maritime and coastal emergencies within the district boundary.

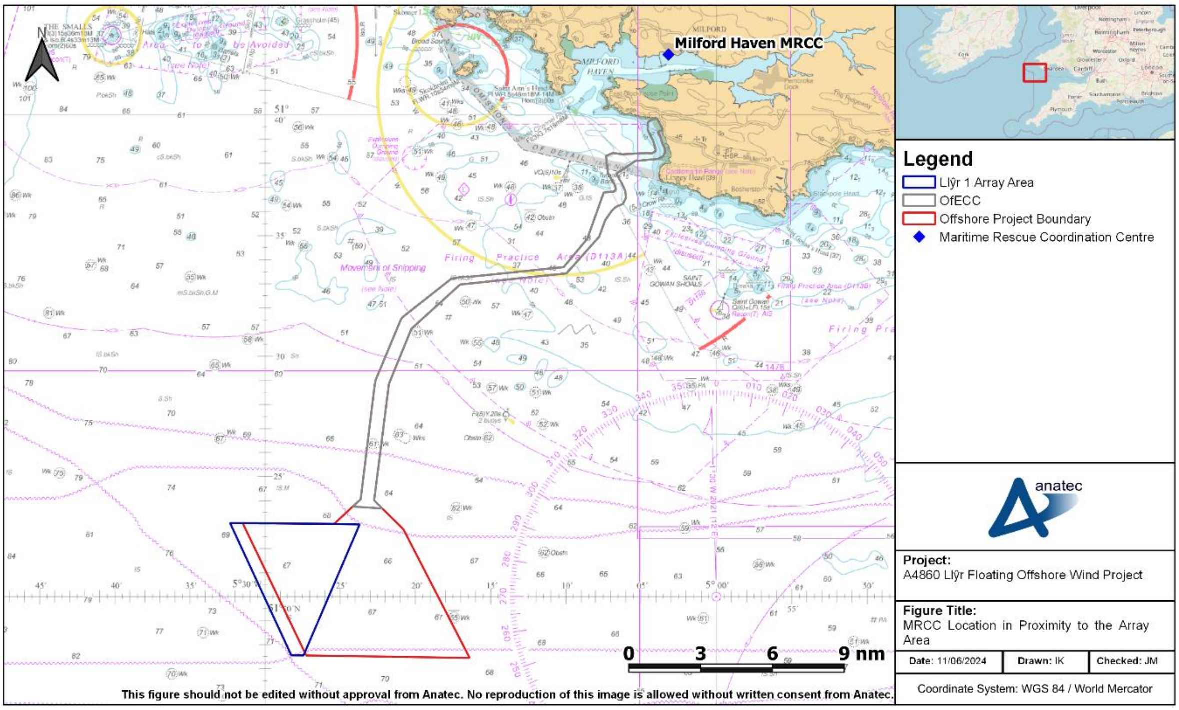

Figure 9.1 Maritime Rescue Coordination Centre in the Vicinity of the Proposed Project

9.2 Global Maritime Distress and Safety System

112. 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.

113. There are four GMDSS sea areas, and in the UK it is the responsibility of the MCA to ensure very High Frequency (VHF) coverage from coastal stations within sea area A1. The proposed Project is located within an A1 sea area, as shown in **Figure 9.2**, and therefore any vessel located in the vicinity of the proposed Project would be able to contact HMCG via VHF in the event of an emergency.

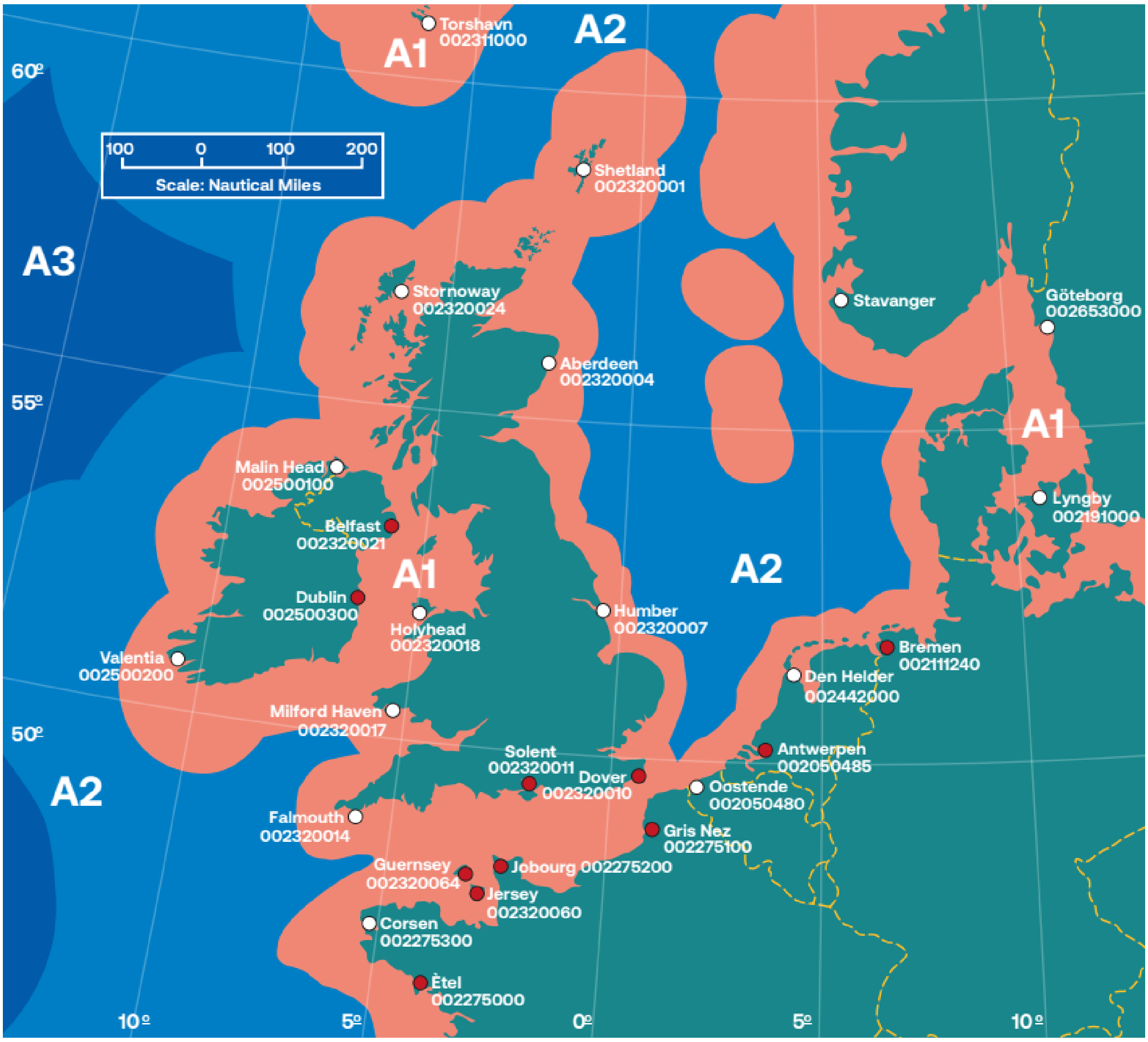

Figure 9.2 Global Maritime Distress and Safety System Sea Areas (MCA, 2021)

9.3 Search and Rescue Helicopters

114. In July 2022, the Bristow Group were awarded a new 10-year contract by the MCA (as an executive agency of the DfT) commencing in September 2024 to provide helicopter SAR operations in the UK. Bristow have been operating the service since April 2015.

115. There are currently ten base locations for the SAR helicopter service. The closest SAR helicopter base to the proposed Project is St Athan, located approximately 67 nm to the east, as illustrated in **Figure 9.3**.

116. The SAR helicopter taskings undertaken between April 2015 and March 2023 within the Study Area are presented in **Figure 9.3**, colour-coded by tasking type. Also shown is the SAR helicopter base at St Athan.

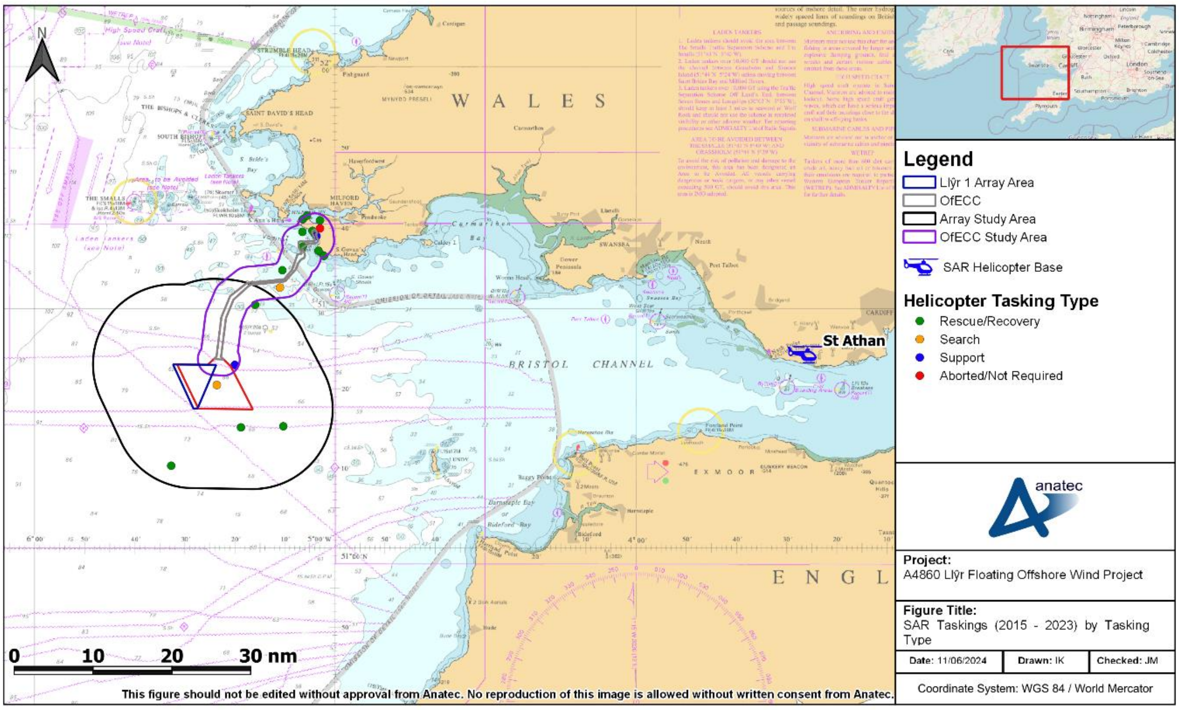

Figure 9.3 SAR Helicopter Taskings (2015 to 2023) by Tasking Type

117. A total of six SAR helicopter taskings were undertaken for incidents within the Study Area between April 2015 and March 2023, corresponding to an average of one tasking per year. Four of these taskings were of type "*rescue/recovery*", while one was "*support",* and one was "*search*". No SAR helicopter taskings were undertaken within the Array Area.

118. A total of fourteen SAR helicopter taskings were undertaken for incidents within the OfECC Study Area between April 2015 and March 2023, corresponding to an average of one to two taskings per year. Ten of these taskings were of type "*rescue/recovery*", while there were two instances of "*support",* and one each of "*search*", and "*aborted/not required"*. Three SAR helicopter taskings were undertaken within the OfECC, with all being "*rescue/recovery"*.

9.4 Royal National Lifeboat Institution

119. The RNLI is organised into six divisions, with the relevant region for the proposed Project being the Wales and West division. 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). There are a number of RNLI stations in the vicinity of the proposed Project, as illustrated in **Figure 9.4**.

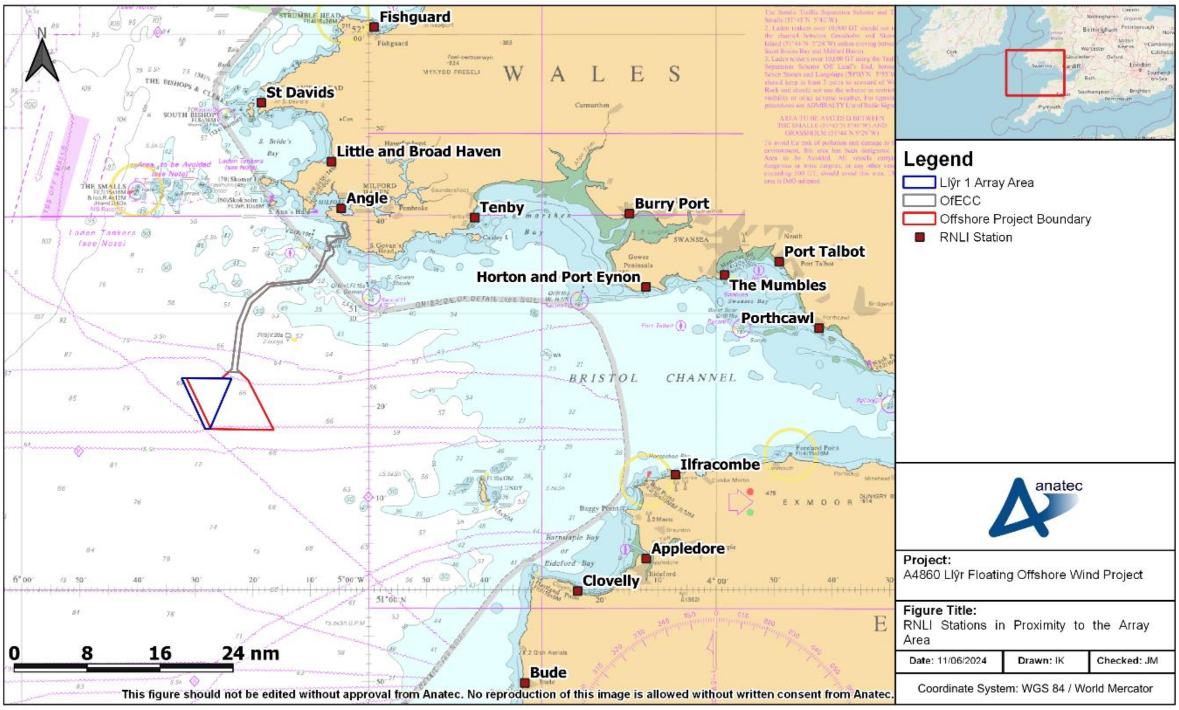

Figure 9.4 RNLI Stations in Proximity to the Array Area

120. It is noted that incidents which were deemed hoaxes or false alarms have been excluded from the analysis in this section.

121. **Figure 9.5** presents the RNLI incidents documented by the RNLI that occurred within the Study Area during the period 2013 to 2022 (inclusive), colour-coded by incident type. **Figure 9.6** presents the same data with the incidents colour-coded by casualty type.

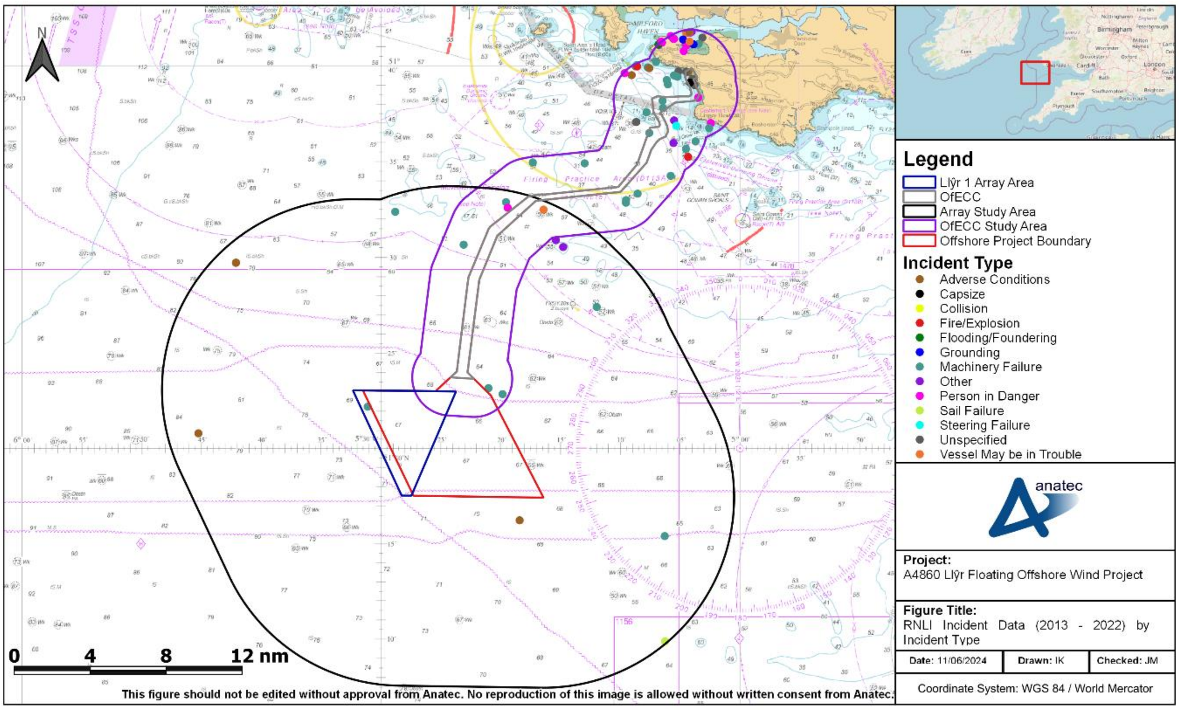

Figure 9.5 RNLI Incidents (2013 to 2022) within Study Area by Incident Type

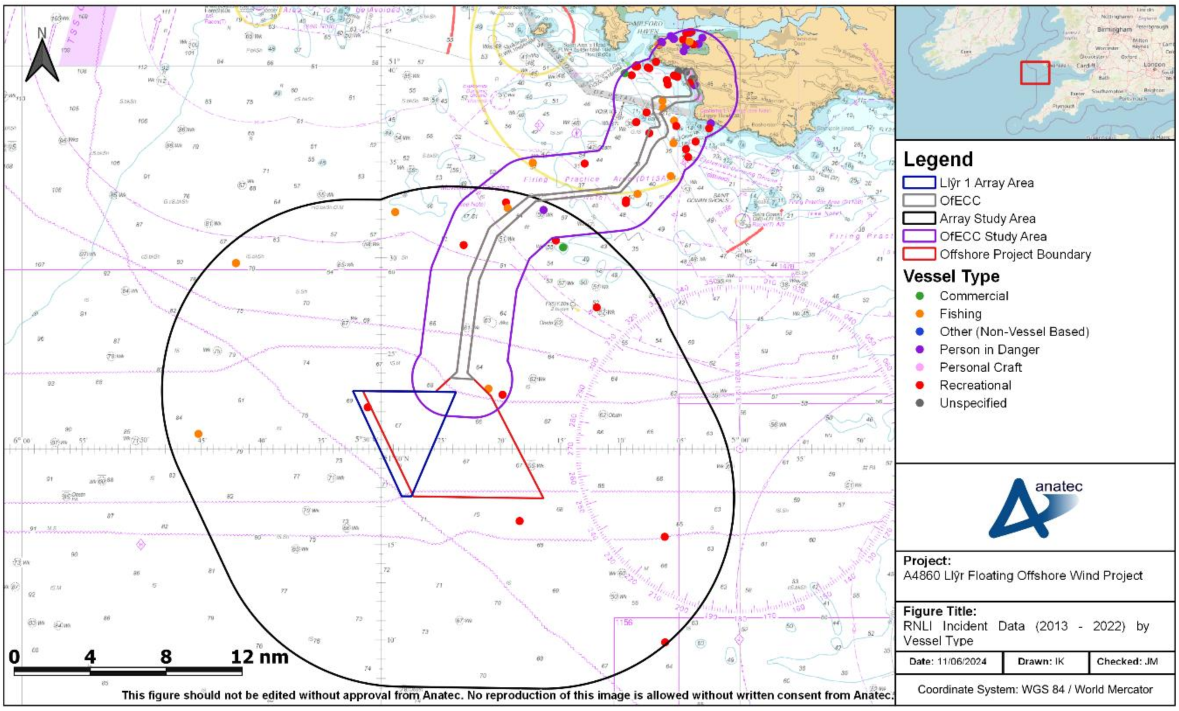

Figure 9.6 RNLI Incidents (2013 to 2022) within Study Area by Casualty Type

122. A total of 18 lifeboat responses to 16 unique incidents were recorded within the Study Area during the ten-year period, corresponding to an average of one to two unique incidents per year. Incidents were mainly located within the eastern half of

the Study Area, with only two occurring at the western extent of the Study Area. One incident was located within the Array Area itself – a powered recreational vessel experiencing machinery failure.

123. The most common incident type in the RNLI data within the Study Area was "*machinery failure*", accounting for 50% of the incidents. Other incident types which were recorded included "*adverse conditions*" (19%), with one count each of "*sail failure*", "*person in danger*", and "*vessel may be in trouble*". Two instances of "*other*" incident types were record. Excluding "*person in danger*" and non-vessel incidents, the most frequent casualty type was powered recreational vessels, accounting for 60%, with fishing vessels (33%) and other commercial vessels (7%) comprising the remainder of incidents.

124. All of the lifeboat responses were from Angle station.

125. A total of 71 lifeboat responses to 70 unique incidents were recorded within the OfECC Study Area during the ten-year period, corresponding to an average of seven unique incidents per year. Incidents were primarily located close to shore. A total of nine incidents were located within the OfECC itself, corresponding to approximately one incident per year.

126. The most common incident type in the RNLI data within the OfECC study area was "*machinery failure*", accounting for 39% of the incidents. Other frequently recorded incident types recorded included "*person in danger*" (21%), "*other*" (10%), and "*adverse conditions*" (7%). Excluding "*person in danger*" and non-vessel incidents, the most frequent casualty type was powered recreational vessels, accounting for 62%, with fishing vessel incidents (22%) also frequently recorded.

9.5 Marine Accident Investigation Branch

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

128. The incidents recorded within the MAIB data between 2012 and 2021 occurring within the Study Area are presented in **Figure 9.7**, colour-coded by incident type. Following this, **Figure 9.8** shows the same data colour-coded by the type of vessel(s) involved in each incident.

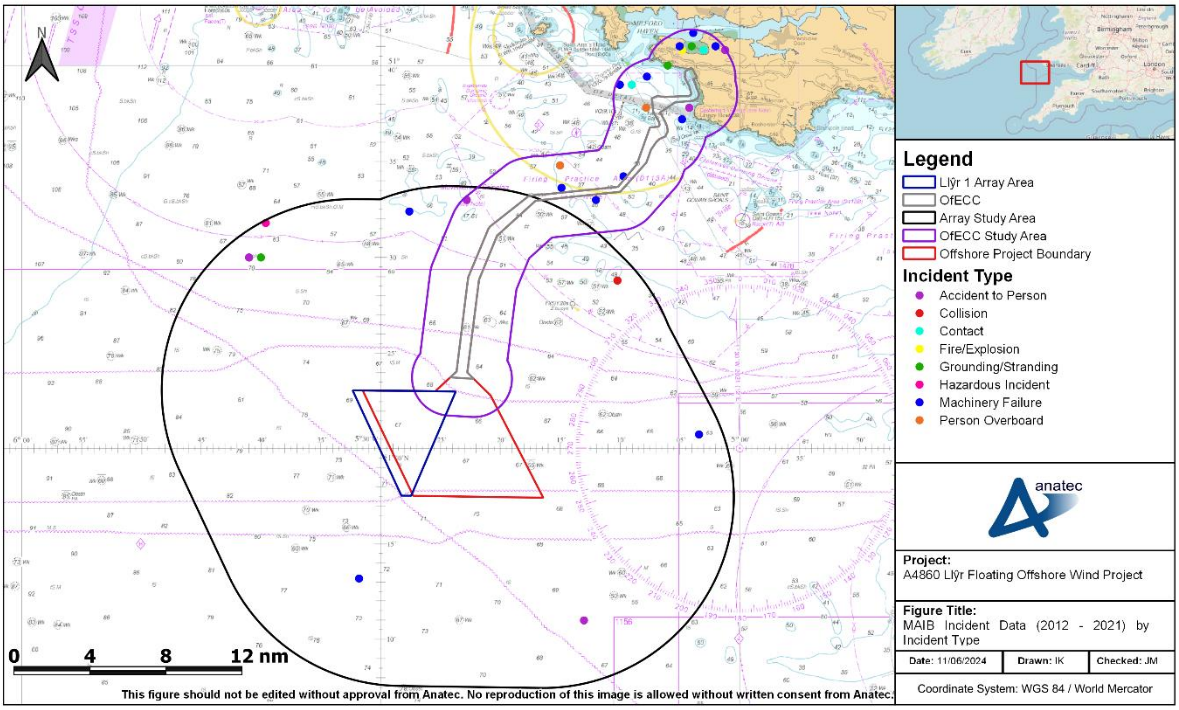

Figure 9.7 MAIB Incidents (2012 to 2021) by Incident Type

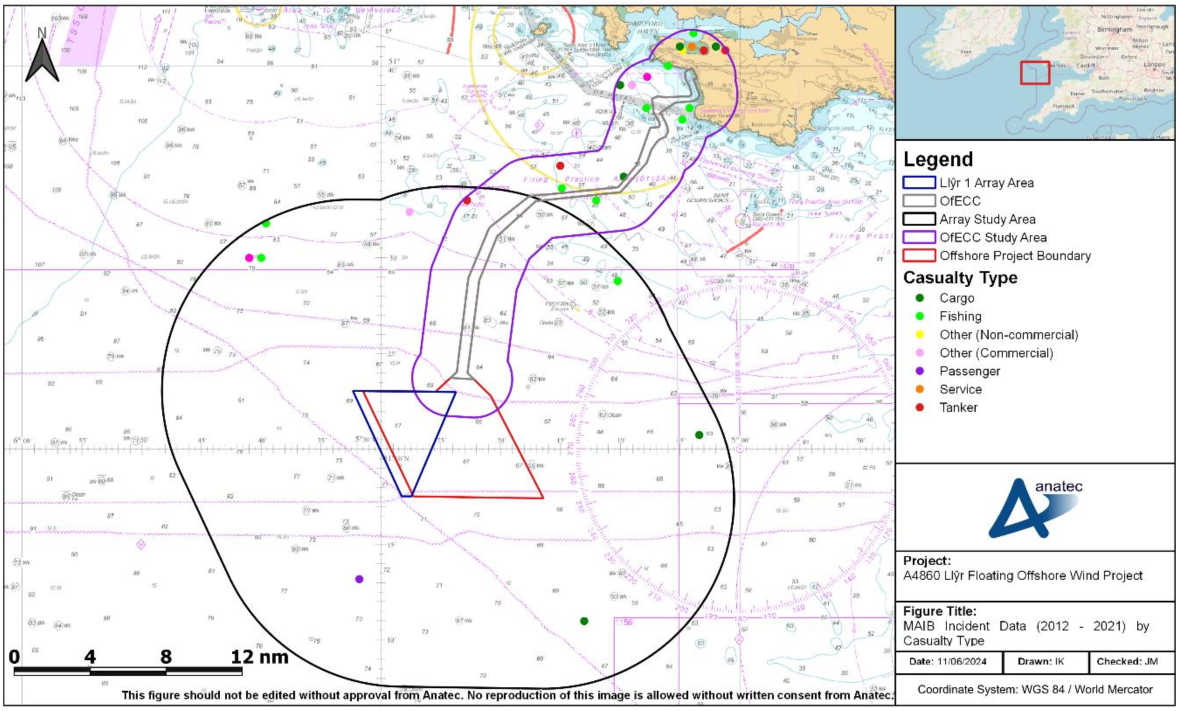

Figure 9.8 MAIB Incidents (2012 to 2021) by Casualty Type

129. A total of nine incidents were recorded by the MAIB within the Study Area between 2012 and 2021, which corresponds to an average of one incident per year. No incidents occurred within the Array Area during the 10 year period.

130. Four of the nine incident types (44%) were "*accident to person*", two were *"machinery failure"*, and the remaining three were of type "*collision", "grounding/stranding"* and "*loss of control"*. The most common casualty types were cargo vessel, fishing vessel, recreational craft and tanker, two of each being involved in an incident.

131. A total of 21 incidents were recorded by the MAIB within the OfECC Study Area between 2012 and 2021, which corresponds to an average of two incidents per year. No incidents occurred within the OfECC during the 10 year period.

132. The most common incident types were "*machinery failure*" (52%), and "*accident to person"* (14%). The most common casualty types were fishing (38%), cargo (24%), and tanker (14%).

133. A review of older MAIB incident data within the study areas between 2002 and 2011 indicates that the number of incidents has remained consistent within the Study Area over time with eight incidents recorded and has decreased in the OfECC study area with 23 unique incidents recorded in the 10-year period, corresponding to an average of two to three incidents per year.

9.6 Historical OWF Incidents

134. As of June 2024, there are 42 operational OWFs in the UK, ranging from the North Hoyle OWF (fully commissioned in 2003) to Hornsea Project Two (fully commissioned in 2022). Between them these developments encompass approximately 23,584 fully operational WTG years.

135. MAIB incident data has been used to collate a list of reported historical collision and allision incidents involving UK OWF developments[2], 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.

[2] Includes only incidents reported to an accident investigation branch or an anonymous reporting service. Unconfirmed incidents have not been considered noting that to date two 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 OWF 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

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision	20 October 2012	Project vessel allision with WTG monopile following human error (misjudgement of distance). Minor damage sustained by vessel.	Minor	None	MAIB
Project	Allision	21 November 2012	Passenger transfer catamaran allision with buoy following navigational error. Vessel abandoned by crew of 12 having been holed, causing extensive flooding but no injuries sustained.	Major	None	MAIB
Project	Allision	21 November 2012	Work boat allision with unlit WTG transition piece at moderate speed following navigational error. Vessel able to proceed to port unassisted with no water ingress but some structural damage sustained.	Moderate	None	MAIB
Project	Allision	1 July 2013	Service vessel allision with WTG foundation following machinery failure. Minor damage sustained by vessel.	Minor	None	IMCA Safety Flash
Project	Allision	14 August 2014	Standby safety vessel allision with WTG pile. Oil leaked by vessel which moved away from environmentally sensitive areas until leak was stopped.	Minor with pollution	None	UK CHIRP

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Third-party	Allision	26 May 2016	Third-party fishing vessel allision with WTG following human error (autopilot). Lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)
Project	Allision	14 February 2019	Survey vessel contacted with WTG jacket whilst autopilot was engaged.	Minor	None	MAIB
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 personal 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.

136. 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.

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

138. As of June 2024, there have been 13 formally reported cases of an allision between a vessel and a WTG (under construction, operational or disused) in the UK, with all but one involving a support vessel for the development and the errant vessel in each case under power rather than drifting. Therefore, there has been an average of 1,814 WTG years per allision incident in the UK, noting that this is a conservative

calculation given that only operational WTG hours have been included (whereas allision incidents counted include non-operational WTGs).

9.6.1 Incidents Involving Non-UK OWFs

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

140. One high profile non-UK incident which is noted is that involving a bulk carrier in January 2022 which broke its anchor chain during a storm in Dutch waters and collided with another anchored vessel. The vessel began to take on water, leading to all crew members being evacuated by helicopter. The vessel then continued to drift towards shore including though 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).

9.6.2 Incidents Responded to by Vessels Associated with UK OWFs

141. From news reports, basic web searches and experience at 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**.

142. **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)

Incident Type	Date	Related Development	Description of Incident	Source
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. Guard vessel proceeded to undertake search but did not find anything to report.	Internal daily progress report received by Anatec
Aircraft crash	15 June 2020	Hornsea Project One	US jet crashed into sea during routine flight. CTV and SOV for Hornsea Project One joined the search for the missing pilot.	Web search (4C Offshore, 2020)
Fire / explosion	15 December 2020	Dudgeon	Fishing vessel experienced explosions on board with crew injured. SOV for Dudgeon deployed its Fast Rescue Boat (FRB) and evacuated the crew from the 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)

Incident Type	Date	Related Development	Description of Incident	Source
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)

10 Vessel Traffic Movements

143. This section presents an overview of vessel traffic movements within the Study Area, primarily based upon the findings of the summer and winter vessel traffic surveys undertaken in March 2022 and July 2023, respectively (see **Section 5**).

10.1 Array Area

144. Figure 10.1 presents the vessel tracks recorded within the Study Area during the 14-day winter survey period, colour-coded by vessel type. Following this, a density heat map of this data is presented in Figure 10.2.

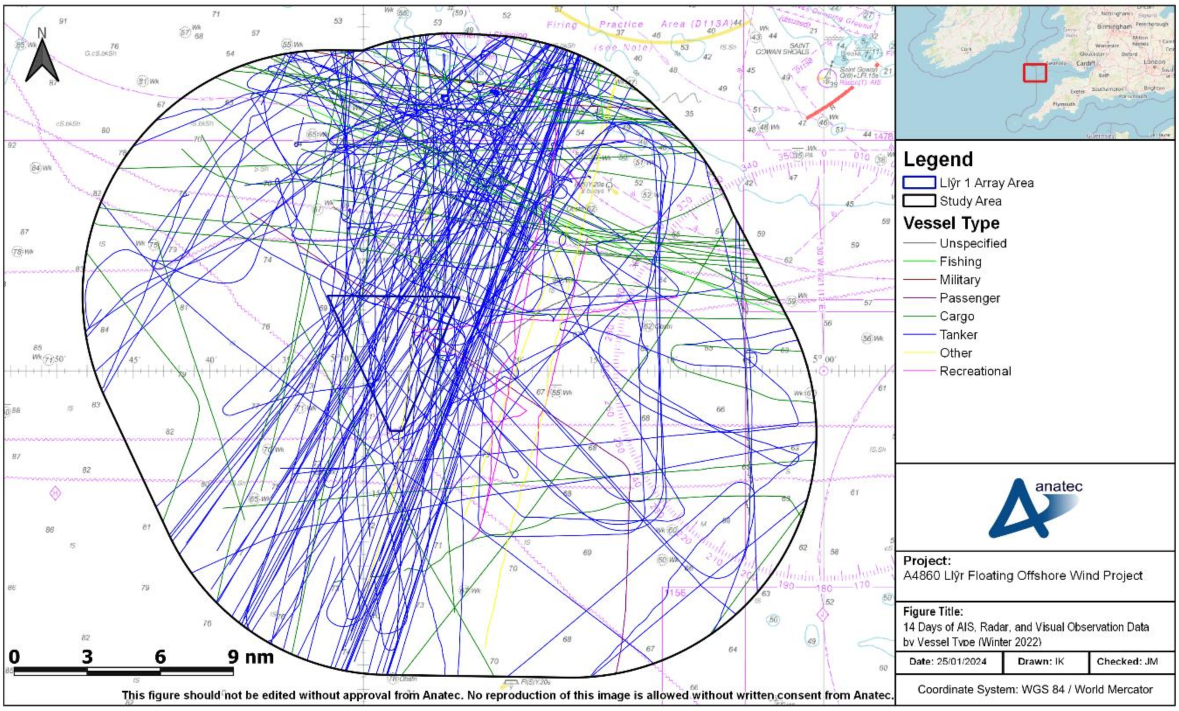

Figure 10.1 14 Days of AIS, Radar, and Visual Observation Data by Vessel Type (Winter 2022)

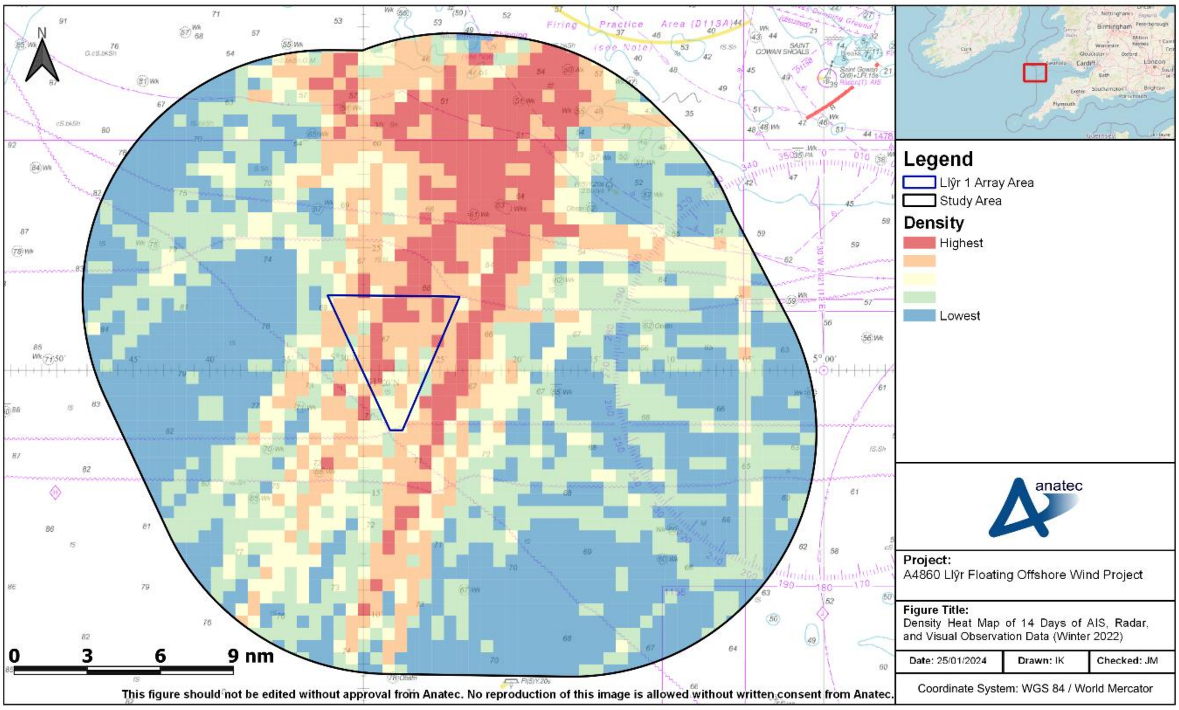

Figure 10.2 Density Heat Map of 14 Days of AIS, Radar, and Visual Observation Data (Winter 2022)

145. Figure 10.3 presents the vessel tracks recorded within the Study Area during the 14-day winter survey period, colour-coded by vessel type. Following this, a density heat map of this data is presented in Figure 10.4.

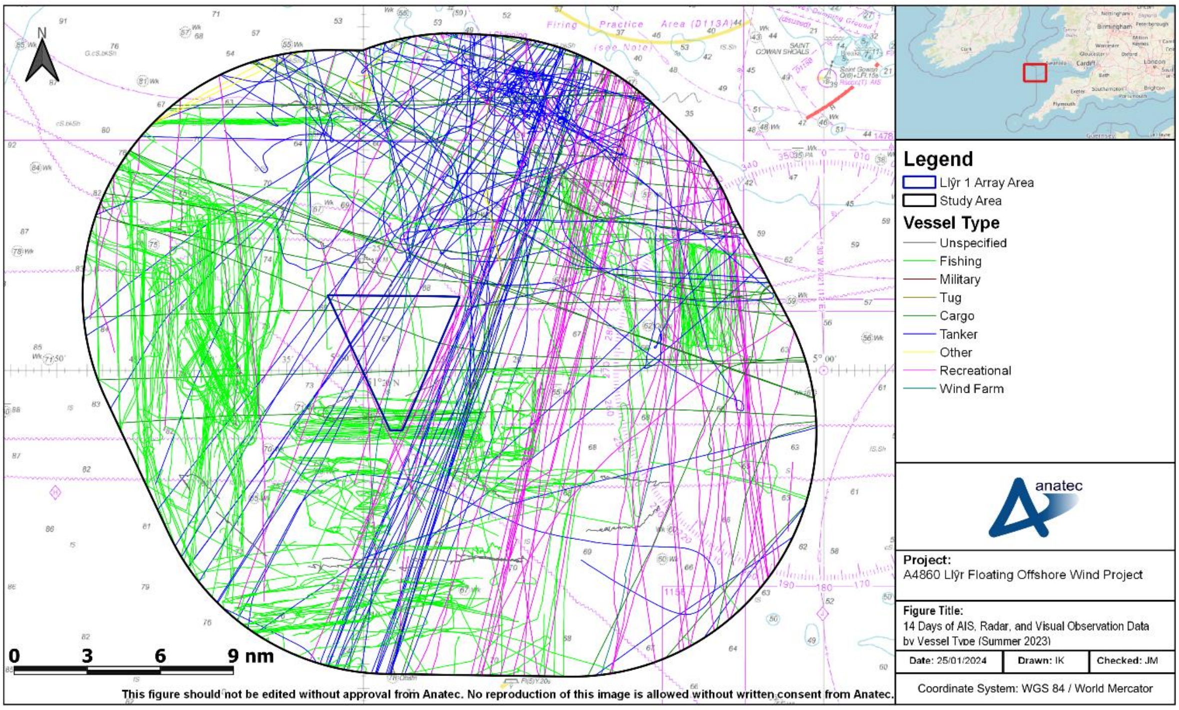

Figure 10.3 14 Days of AIS, Radar, and Visual Observation Data by Vessel Type (Summer 2023)

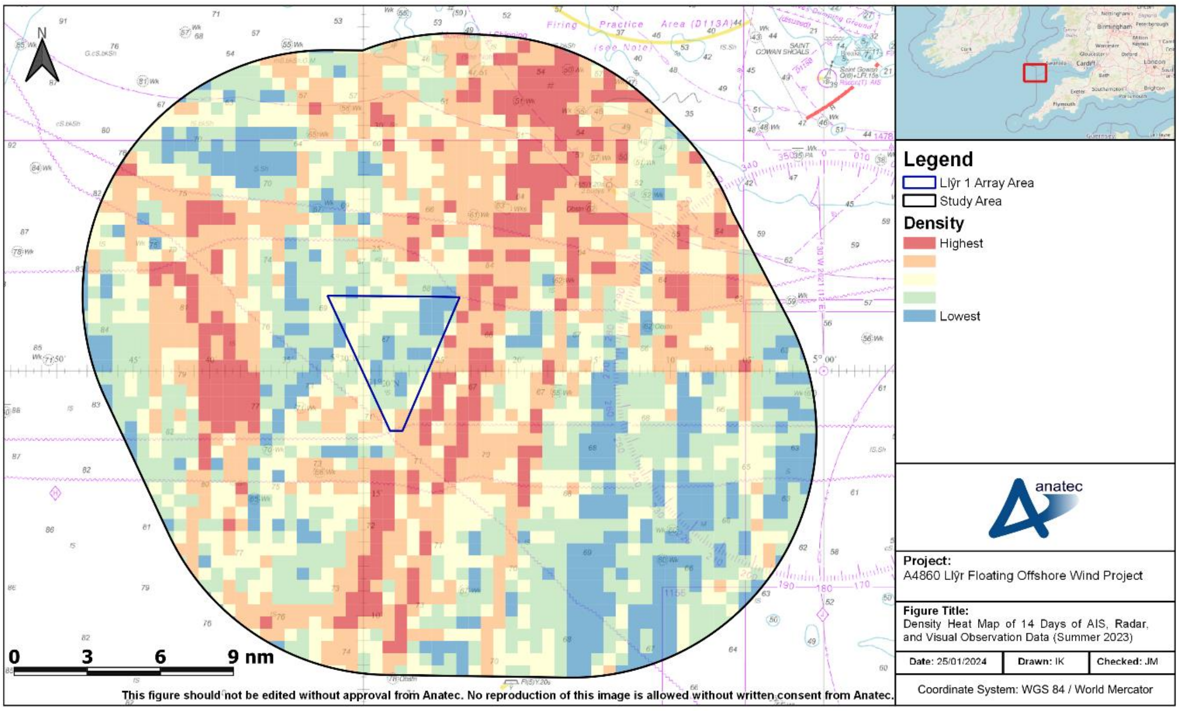

Figure 10.4 Density Heat Map of 14 Days of AIS, Radar, and Visual Observation (Summer 2023)

10.1.1 Vessel Counts

146. During the 14-days broken down during the winter survey period, there was an average of 10 unique vessels recorded per day within the Study Area. In terms of vessels intersecting the Array Area itself, there was an average of three unique vessels per day during the survey period. It is noted that the first and last day of the summer survey were partial survey days (as described in **Section 5.2**) and so the analysis was only carried out for full days. The vessel counts per day within the Array Area and Study Area during the winter survey period are presented in Figure 10.5.

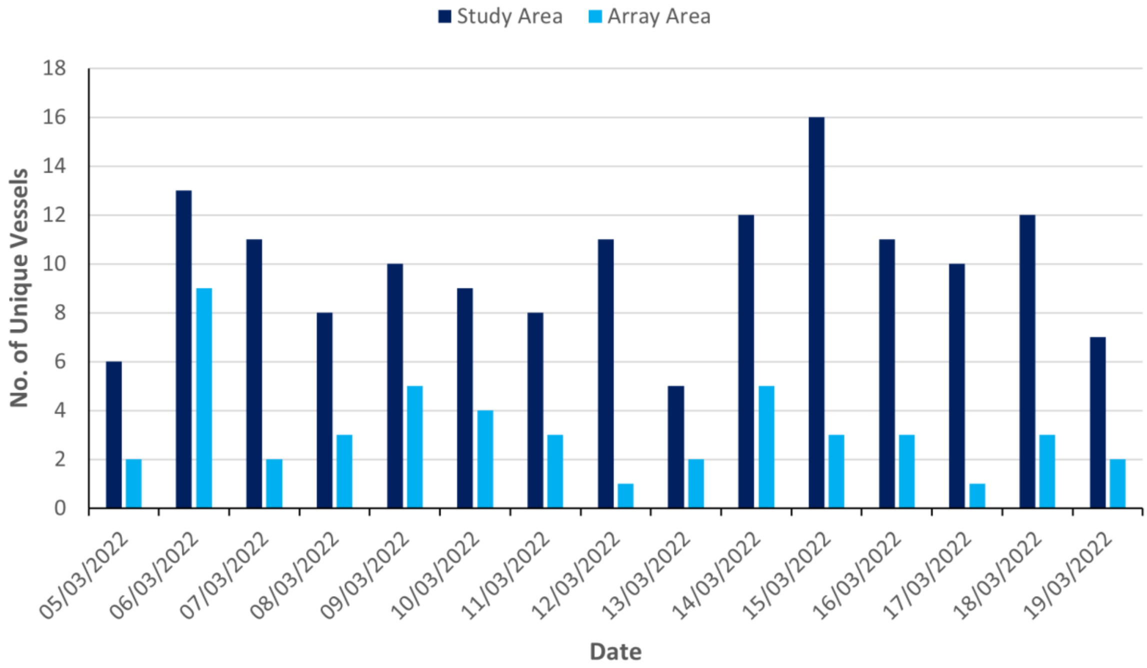

Figure 10.5 Vessels per Day (14 Days, Winter 2022)

147. Throughout the winter survey period, approximately 32% of unique vessel tracks recorded within the Study Area intersected the Array Area.

148. The busiest day recorded within the Study Area throughout the winter survey period was 15 March 2022, during which 16 unique vessels were recorded. The busiest day recorded within the Array Area during the winter survey period was 06 March 2022, during which nine unique vessels were recorded.

149. The quietest full day recorded within the Study Area throughout the winter survey period was 13 March 2022, during which five unique vessels were recorded. The quietest full day recorded within the Array Area during the winter survey period were 12 and 17 March 2022, during which one vessel was recorded.

150. During the 14-days broken down during the summer survey period, there was an average of 19 unique vessels recorded per day within the Study Area. In terms of

vessels intersecting the Array Area itself, there was an average of two unique vessels per day during the survey period. It is noted that the first and last day of the summer survey, as well as 14 to 16 July 2023, were partial survey days (as described in **Section 5.2**) and so the analysis was only carried out for full days. The vessel counts per day within the Array Area and Study Area during the summer survey period are presented in **Figure 10.6**.

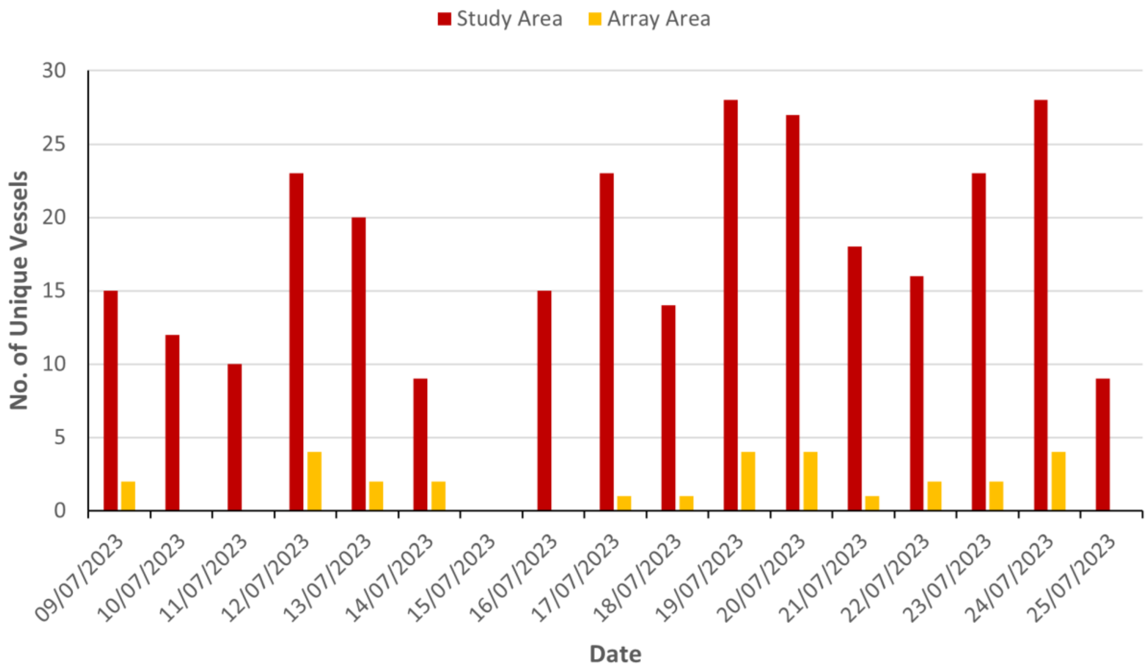

Figure 10.6 Vessels per Day (14 Days, Summer 2023)

151. Throughout the summer survey period, approximately 10% of unique vessel tracks recorded within the Study Area intersected the Array Area.

152. The busiest days recorded within the Study Area throughout the summer survey period were 19 and 24 July 2023, during which 28 unique vessels were recorded each. The busiest days recorded within the Array Area during the summer survey period were 12, 19, 20, and 24 July 2023, during which four unique vessels were recorded each.

153. The quietest full day recorded within the Study Area throughout the summer survey period was 11 July 2023, during which ten unique vessels were recorded. The quietest full days recorded within the Array Area during the winter survey period were 10 and 11 July 2023, during which no vessels were recorded.

10.1.2 Vessel Types

154. The percentage distribution of the main vessel types recorded passing within the Study Area, as well as intersecting the Array Area, during the winter and summer survey periods is presented in Figure 10.7.

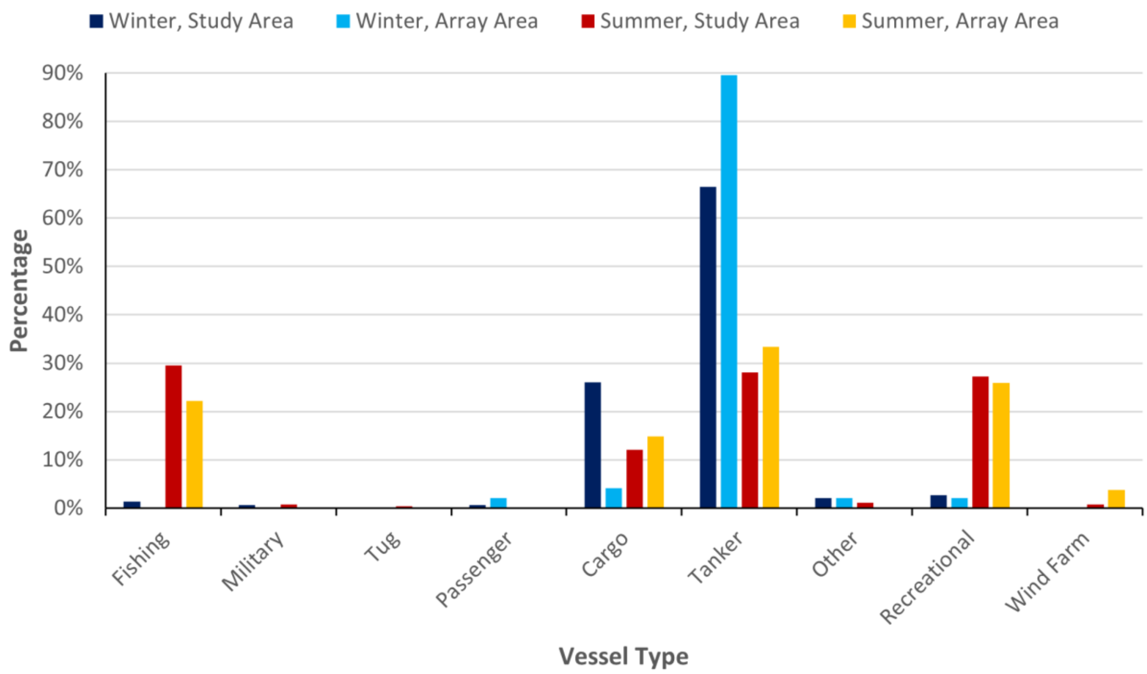

Figure 10.7 Distribution of Vessel Types (28 Days, Winter 2022 and Summer 2023)

155. Throughout the winter survey period, the most common vessel types within the Study Area were tankers (66%) and cargo vessels (26%). Throughout the summer survey period, the most common vessel types within the Study Area were fishing vessels (30%), tankers (28%), and recreational vessels (27%). A passenger vessel was recorded as transiting through the Study Area on only one occasion, a RoPax passing closer to the coast than its usual passage between Rosslare and Le Havre – this may be related to an instance of adverse weather.

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

10.1.2.1 Tankers

157. Figure 10.8 presents the tankers recorded within the Study Area during the 28-day survey period.

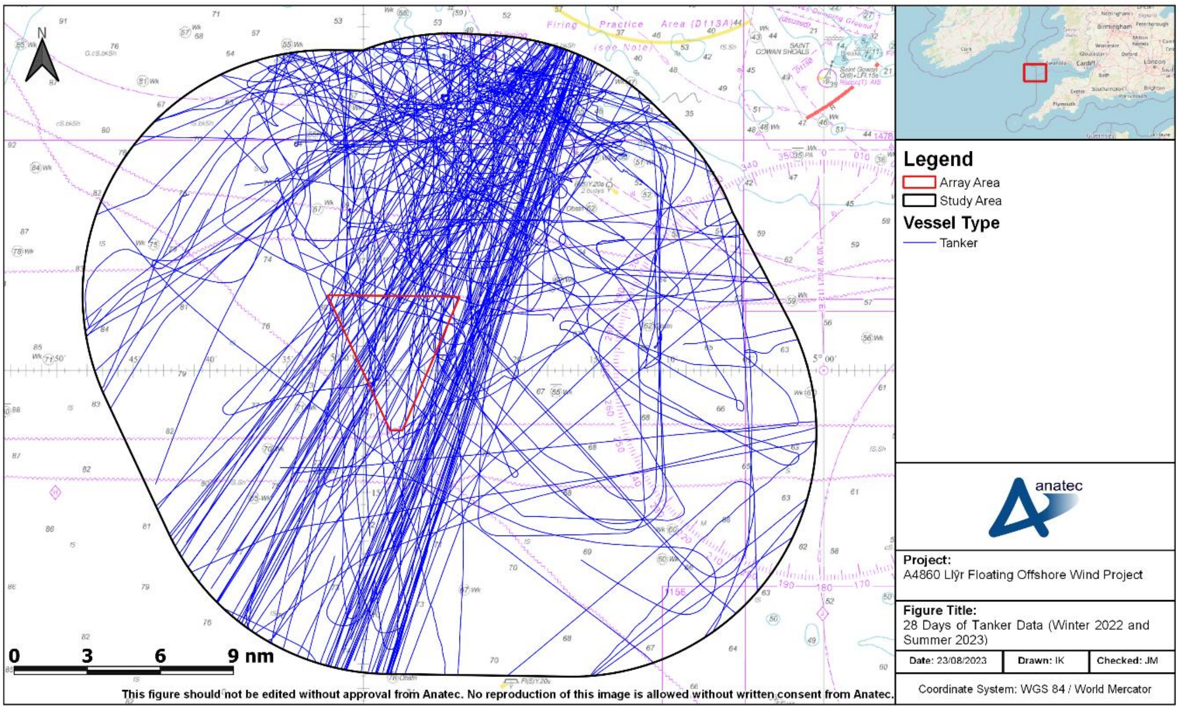

Figure 10.8 28 Days of Tanker Data (Winter 2022 and Summer 2023)

158. An average of six unique tankers per day were recorded within the Study Area during the 28-day period. An average of two unique tankers per day were recorded within the Array Area during the 28-day period. The most frequently recorded tanker sub-types within the Study Area during the survey period were oil/chemical (32%) and crude oil (28%). It is noted that tanker subtypes are seasonal, with LNG tankers frequently recorded in the winter routeing to Milford Haven, compared to summer. Presence of LNG tankers in greater volumes in winter compared to summer, whilst produce tankers are steady year-round, was confirmed by MHPA during the Hazard Workshop in August 2023.

159. Tankers were mainly observed either waiting for orders or transiting to / from Milford Haven. The tankers recorded within the Study Area during the survey period are colour-coded by behaviour[3] and presented in Figure 10.9. The tankers noted as transiting are then presented in Figure 10.10 colour-coded by average course.

[3] In various cases, a tanker was in transit and awaiting orders within the same track which result in Figure 10.9 not accurately reflecting behaviour throughout each track; however, it does provide a high level illustration of the differing tanker behaviours.

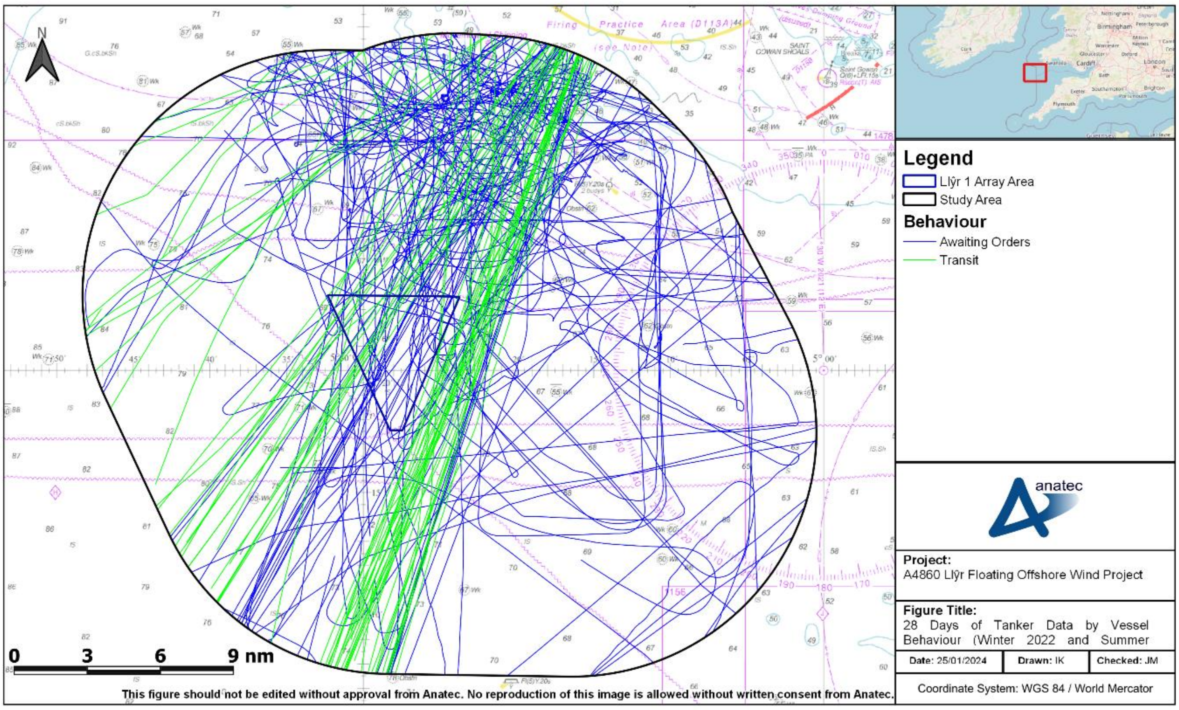

Figure 10.9 28 Days of Tanker Data by Vessel Behaviour (Winter 2022 and Summer 2023)

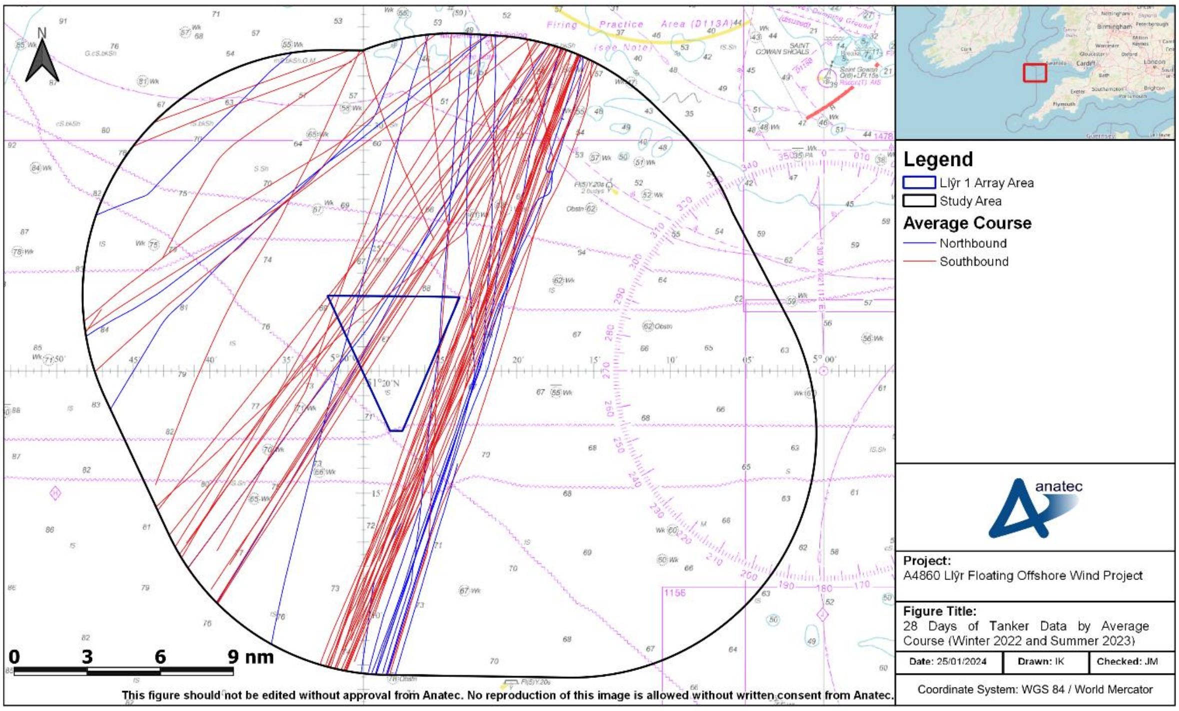

Figure 10.10 28 Days of Tanker Data by Average Course (Winter 2022 and Summer 2023)

160. Separation of tankers by course on similar routes was identified, with tankers routeing northbound tending to transit slightly further east than their counterparts routeing southbound. The majority of routeing tankers were recorded transiting in a

southbound direction (77%) – although this may be due to the higher likelihood of tankers routeing north falling under the 'awaiting orders' category.

10.1.2.2 Fishing Vessels

161. Commercial fishing vessel data was extracted from the vessel tracks recorded during the vessel traffic surveys. It is noted that the term 'fishing vessel' as used throughout this NRA refers to commercial fishing vessels, and any non-commercial fishing activity (such as rod and line angling) is categorised under recreational vessel activity. On this basis the tracks of commercial fishing vessels recorded within Study Area throughout both survey periods are presented in Figure 10.11.

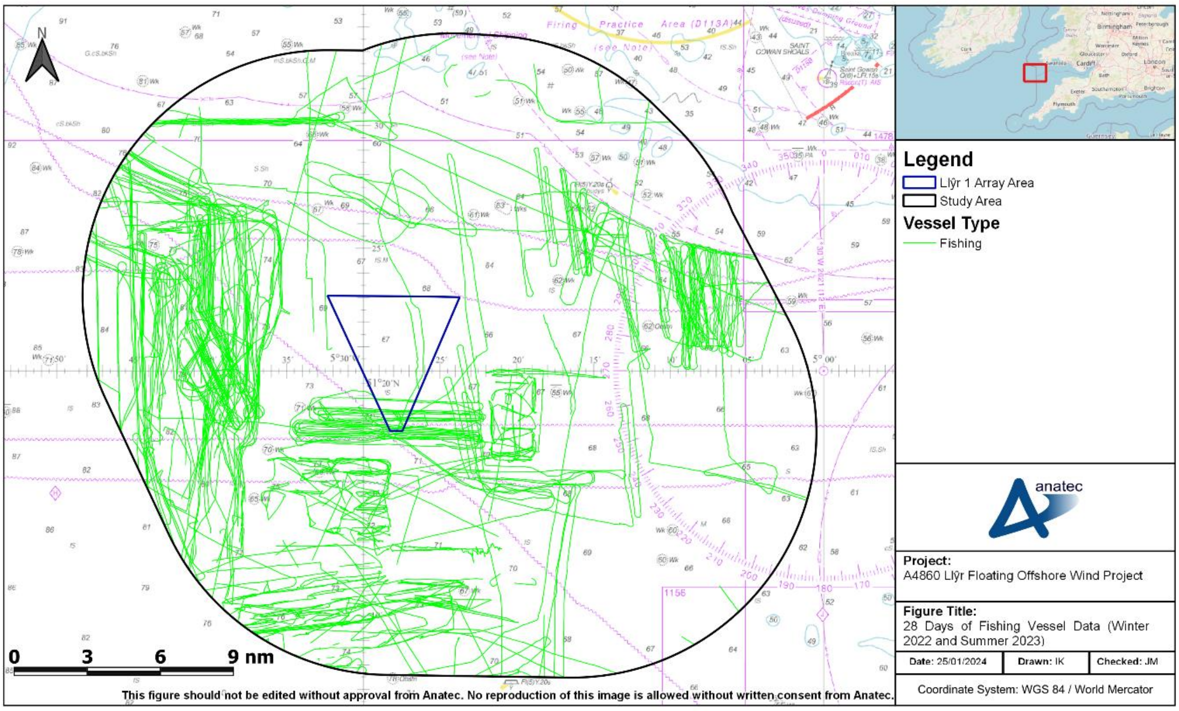

Figure 10.11 28 Days of Fishing Vessel Data (Winter 2022 and Summer 2023)

162. Active fishing behaviour was recorded at various locations within the Study Area, predominantly to the south, west, and northeast of the Array Area. During both of the survey periods, an average of three unique fishing vessels per day were recorded within the Study Area with an average of one unique fishing vessel every five days intersecting the Array Area.

163. Fishing vessel activity was highly seasonal, with 98% of fishing vessel tracks recorded during the summer survey period. Gear type was able to be identified for approximately 68% of fishing vessels, with identified tracks all beam trawlers other than one scallop dredger. Nationality was able to be identified for all vessels identified via AIS, with 68% of fishing vessels being Belgian flagged and the remaining 32% UK flagged.

10.1.2.3 Cargo Vessels

164. Figure 10.12 presents the cargo vessels recorded within the Study Area during the 28-day survey period.

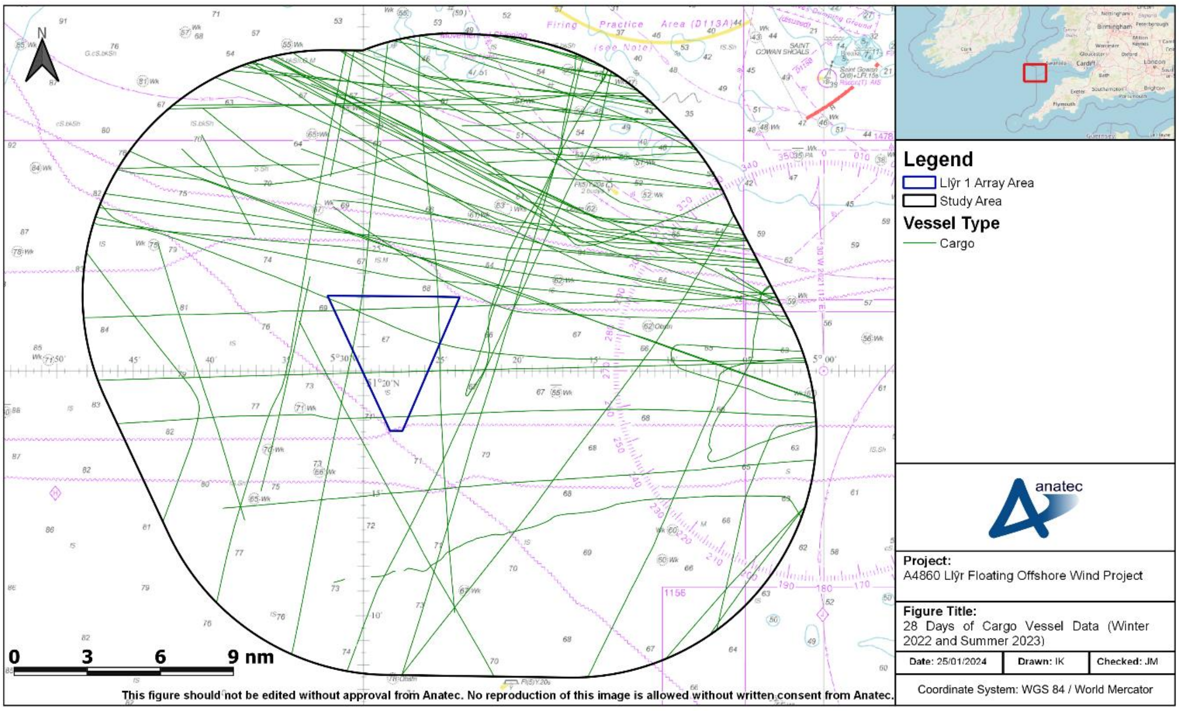

Figure 10.12 28 Days of Cargo Vessel Data (Winter 2022 and Summer 2023)

165. Cargo vessels within the survey periods were mainly seen in east/west transit inshore of the Array Area, and most frequently recorded to / from ports in Bristol Channel. An average of two to three unique cargo vessels per day were recorded within the Study Area during the 28-day survey period, with a total of one intersection through the Array Area every five days recorded.

166. No regular Roll-on/Roll-off cargo (RoRo) routeing was recorded within the Study Area during either survey period.

10.1.2.4 Recreational Vessels

167. Figure 10.13 presents the recreational vessels recorded within the Study Area during the 28-day survey period.

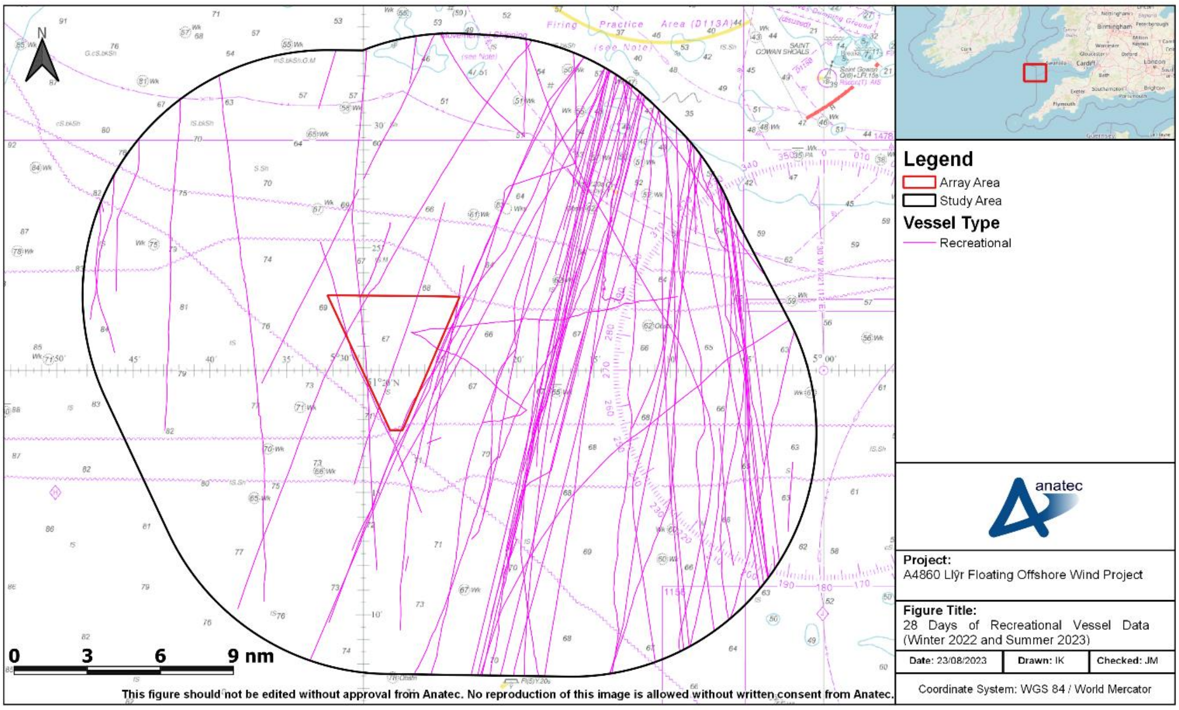

Figure 10.13 28 Days of Recreational Vessel Data (Winter 2022 and Summer 2023)

168. Recreational vessels were mainly seen in northward/southward transit during the survey periods through the Study Area to the east of the Array Area. An average of two to three unique recreational vessels per day were recorded within the Study Area during the 28-day period, with one recreational vessel every three days recorded through the Array Area. Recreational vessel activity was also highly seasonal, with approximately 95% of vessel tracks recorded during the summer survey period.

169. From consultation with the RYA, the majority of routeing is between Milford Haven and either Padstow or the Inshore Traffic Zone (ITZ) off Land's End. A plot of the RYA Coastal Atlas heat map relative to the Array Area is presented in Figure 10.14.

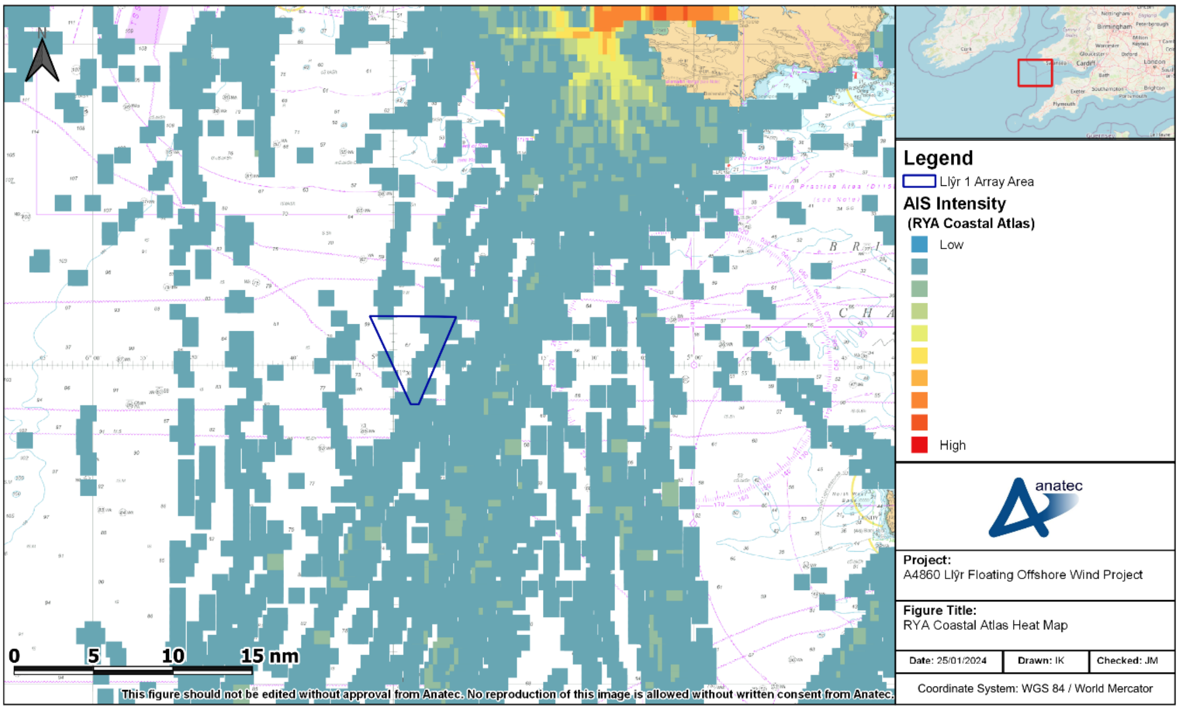

Figure 10.14 RYA Coastal Atlas Heat Map

170. The RYA Coastal Atlas heat map shows good agreement with the vessel traffic data, with recreational traffic most prominent to the east of the Array Area.

10.1.3 Vessel Sizes

171. This section analyses vessel traffic data in terms of size; in particular, in terms of vessel lengths and vessel draughts.

10.1.3.1 Vessel Length

172. Vessel length information was available for 89% 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 length, is presented in Figure 10.15. Following this, the distribution of these length classes is presented in Figure 10.16.

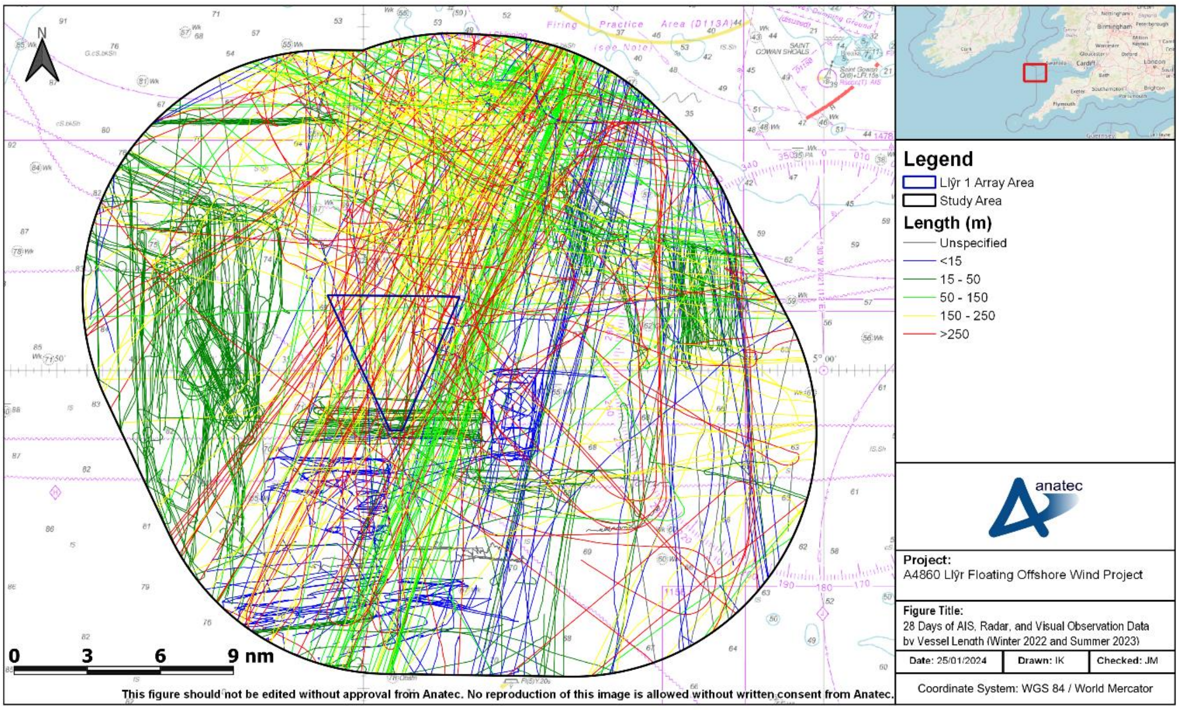

Figure 10.15 28 Days of AIS, Radar, and Visual Observation Data by Vessel Length (Winter 2022 and Summer 2023)

The majority of vessels of smaller length were noted as being fishing or recreational, with larger vessels typically tankers routeing to / from Milford Haven.

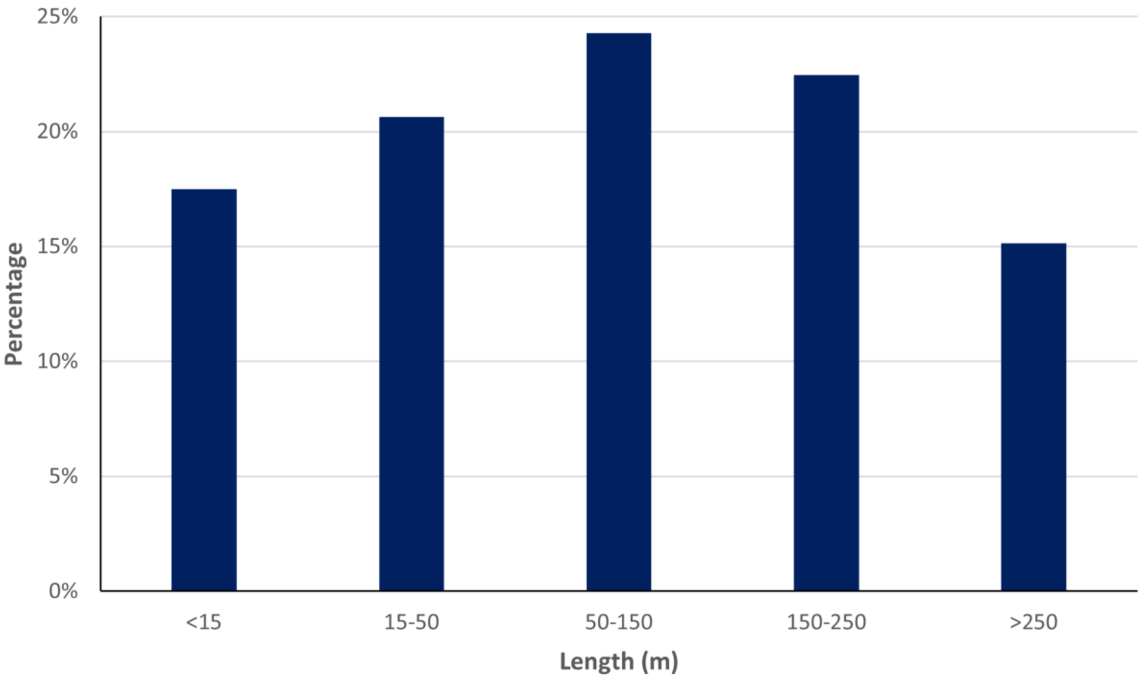

Figure 10.16 Distribution of Vessel Lengths (28 Days, Summer & Winter)

173. The average length recorded within the Study Area was 123 m. The longest vessel recorded were two LNG tankers at 315 m, recorded travelling to / from Milford Haven through the Array Area.

10.1.3.2 Vessel Draught

174. Vessel draught information was available for 62% 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 10.17. Following this, the distribution of these draught classes is presented in Figure 10.18.

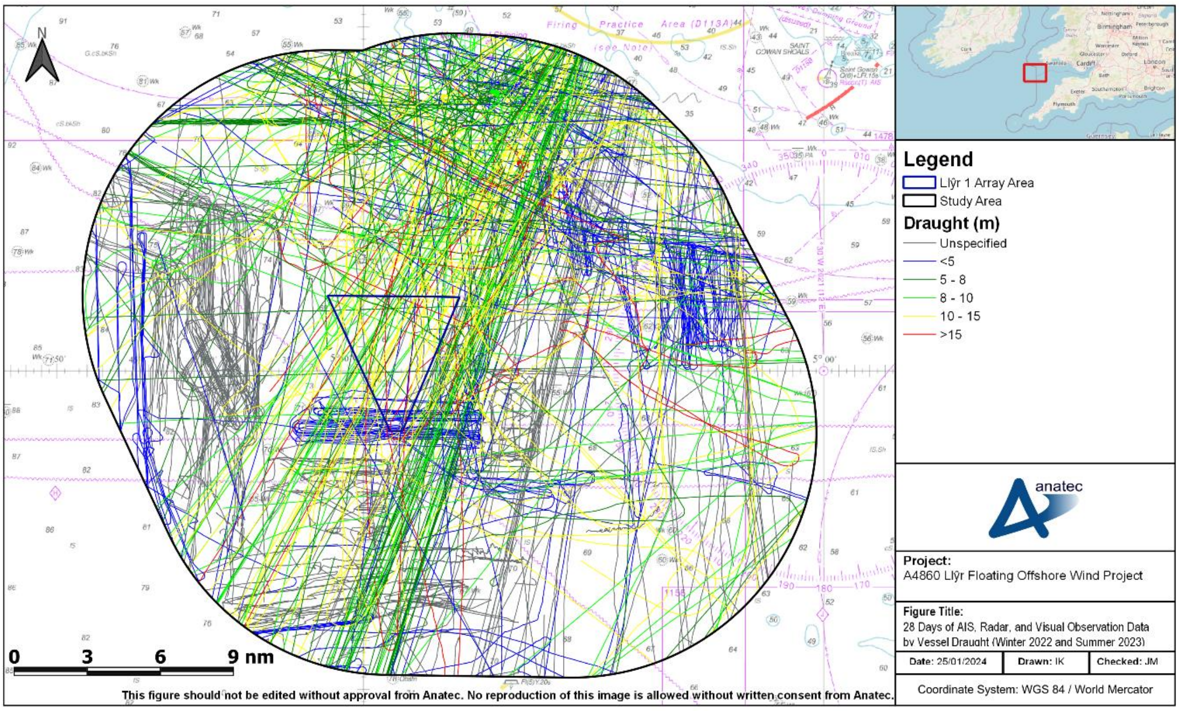

Figure 10.17 28 Days of AIS, Radar, and Visual Observation Data by Vessel Draught (Winter 2022 and Summer 2023)

175. The majority of vessels across the survey periods with unspecified draughts were either recreational (57%) or fishing (38%) vessels, noting that draughts of these vessel types are typically low relative to others. As with vessel length, the vessels of highest draughts were frequently recorded as tankers routeing to / from Milford Haven.

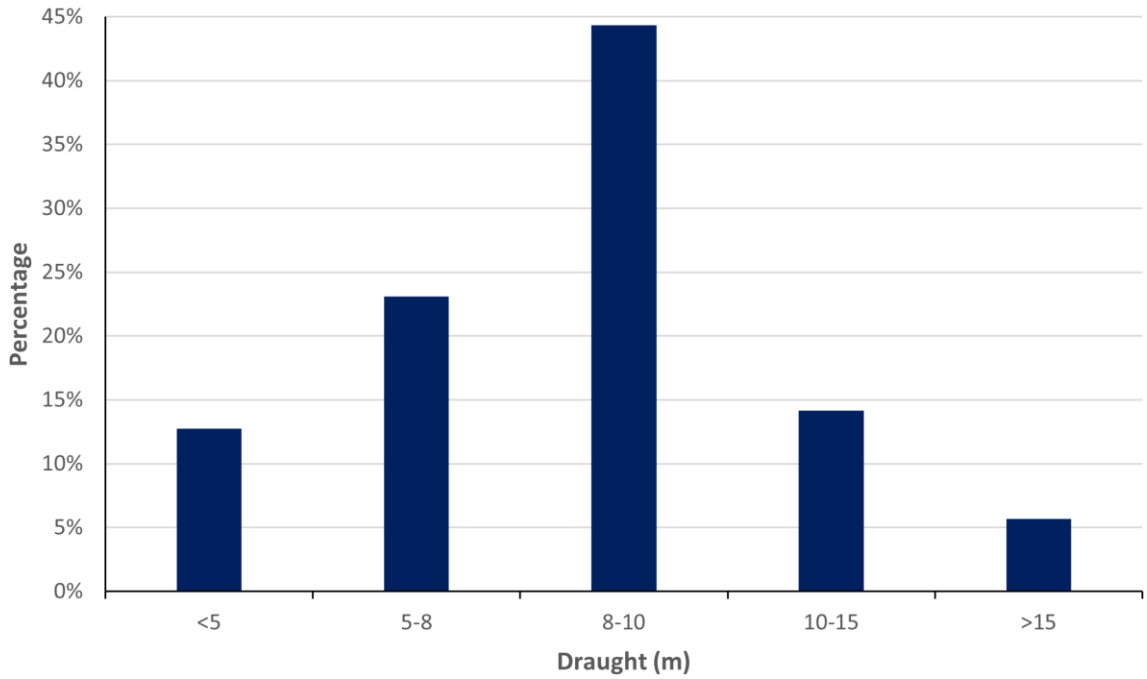

Figure 10.18 Distribution of Vessel Draughts (28 Days, Summer & Winter)

176. The average vessel draught recorded across the survey periods within the Study Area was 8.7 m. The deepest draught recorded was 16.4, from a crude oil tanker awaiting orders to the north of the Array Area.

10.1.4 Anchoring Activity

177. 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.

178. For this reason, vessels recorded within the Study Area during the survey periods which travelled at a speed of less than 1 kt for more than 30 minutes had their corresponding vessel tracks individually checked for patterns characteristic of anchoring activity. After applying these criteria, the vessels identified as likely to be anchoring are colour-coded by vessel type and presented in **Figure 10.19**.

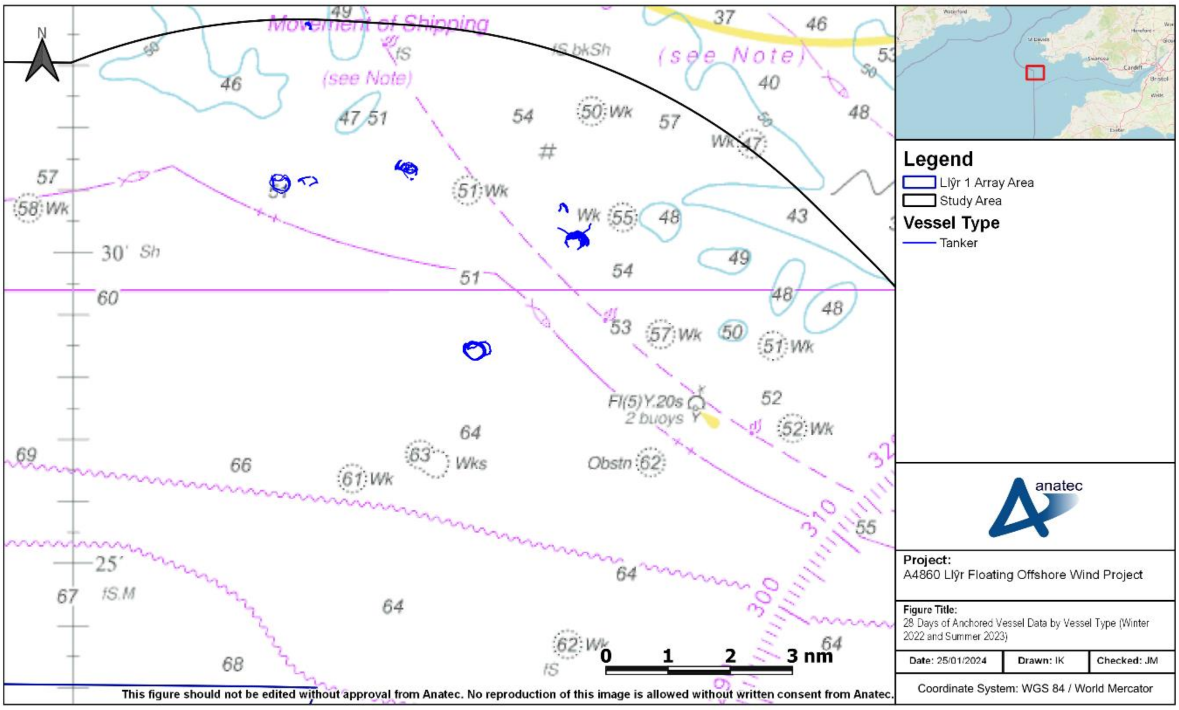

Figure 10.19 28 Days of Anchored Vessel Data by Vessel Type (Winter 2022 and Summer 2023)

179. An average of approximately one vessel per day was identified as likely to be anchoring within the Study Area during the survey period, with activity prevalent to the north of the Array Area. All anchoring vessels were tankers. This aligns with feedback from MHPA during the Hazard Workshop in August 2023 indicating that larger tankers including LNG tend to anchor more than 10nm from Milford Haven.

10.2 OfECC

180. This section presents an overview of vessel traffic movements within the OfECC Study Area based on AIS data alone. A number of tracks recorded during the data periods were classified as temporary (non-routine), such as the tracks of vessels engaged in survey work. These vessels have been excluded from the analysis in line with the approach taken for the assessment of the Array Area (**Section** Error! Reference source not found.).

181. A plot of vessel tracks recorded during the 14-day data period in March 2022 (winter), colour-coded by vessel type and excluding any temporary traffic, is presented in **Figure 10.20**. A plot of vessel tracks recorded during the 14-day data period in July 2023 (summer), colour-coded by vessel type, is presented in **Figure 10.21**.

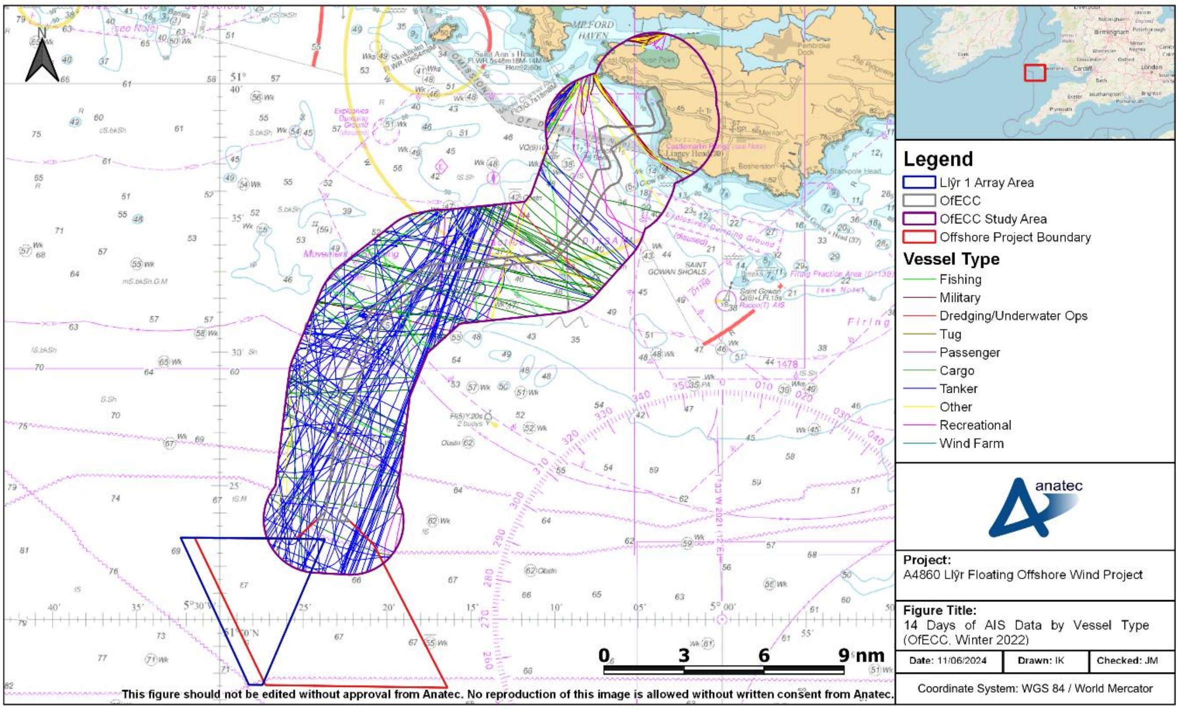

Figure 10.20 14 Days of AIS Data by Vessel Type (OfECC, Winter 2022)

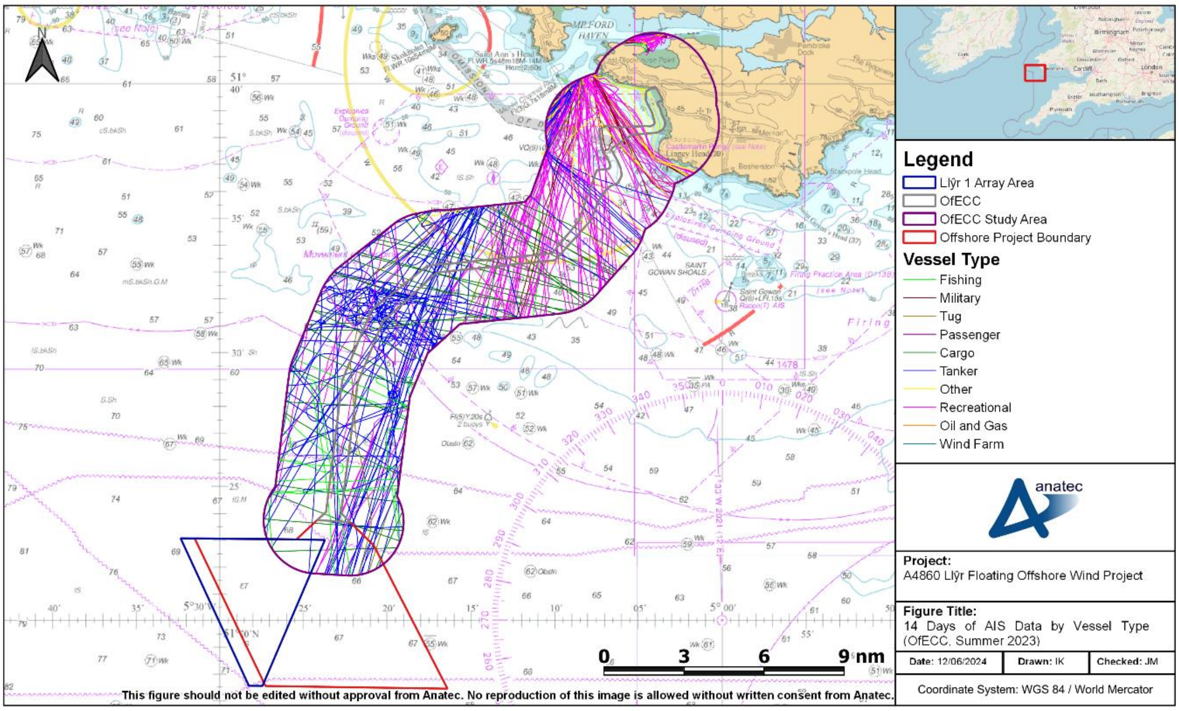

Figure 10.21 14 Days of AIS Data by Vessel Type (OfECC, Summer 2023)

182. Plots of the vessel tracks for the winter and summer data periods converted to a density heat map are presented in Figure 10.22 and Figure 10.23, respectively. It is

noted that the same density brackets were used for both data periods to allow for direct comparison in vessel density.

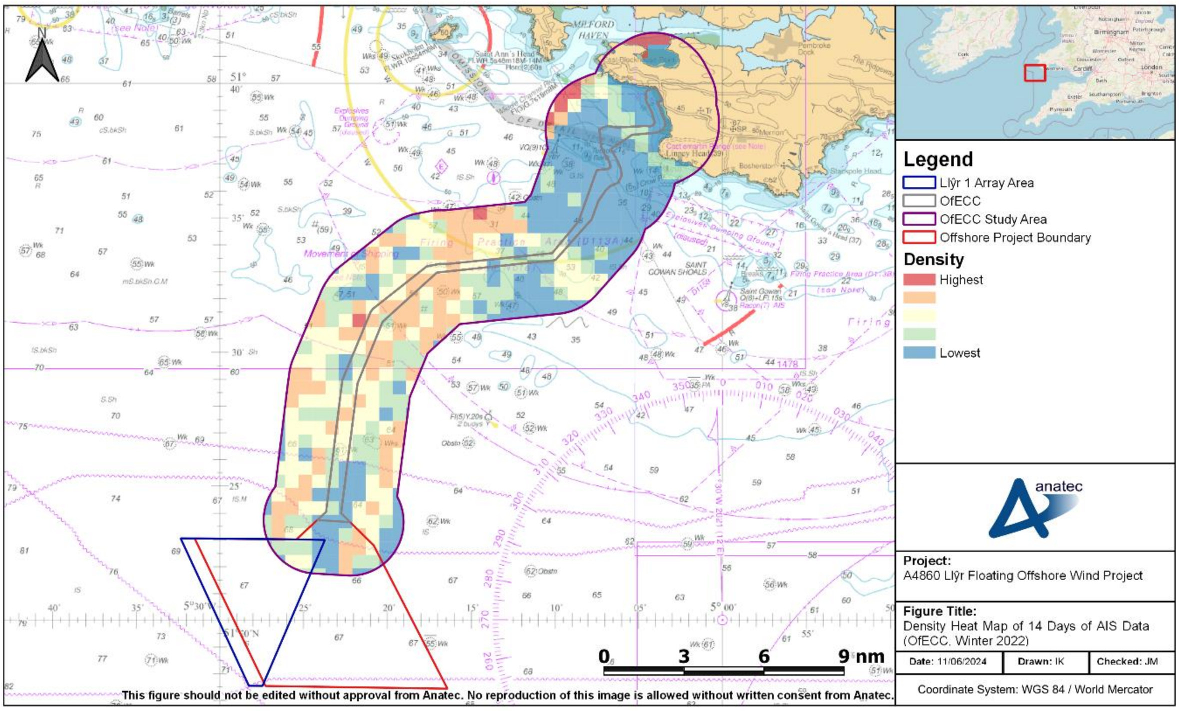

Figure 10.22 Density Heat Map of 14 Days of AIS Data (OfECC, Winter 2022)

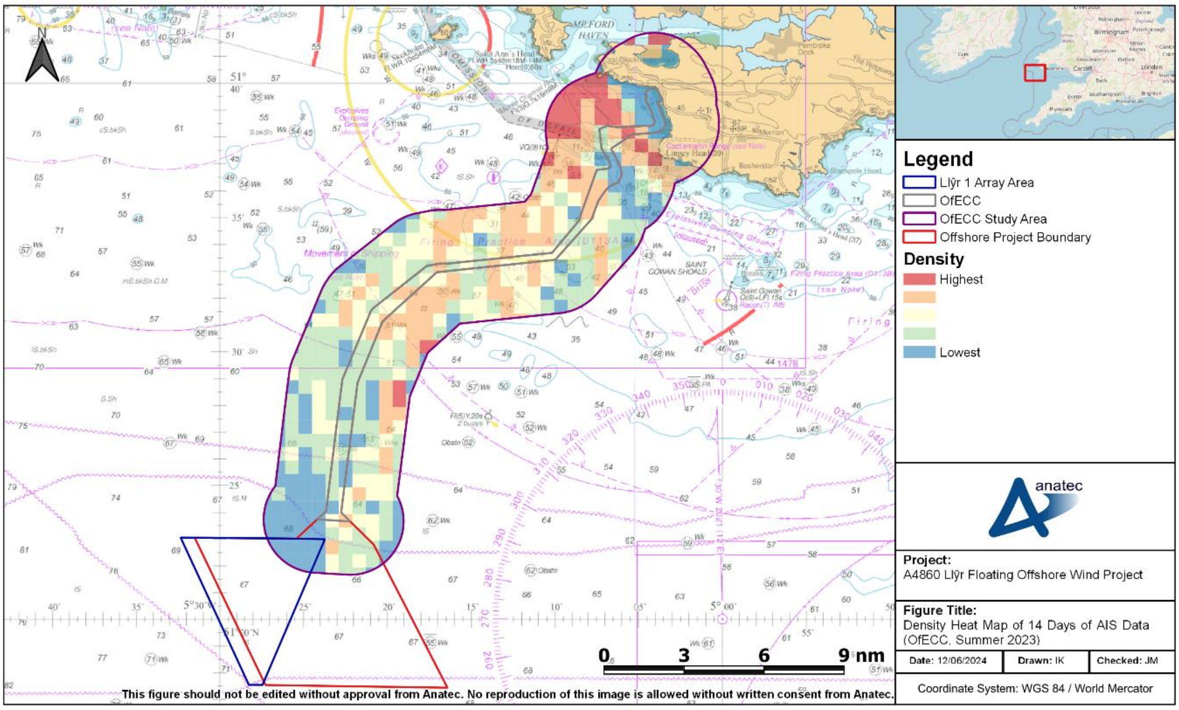

Figure 10.23 Density Heat Map of 14 Days of AIS Data (OfECC, Summer 2023)

10.2.1 Vessel Counts

183. For the 14-days broken down during the winter survey period, there was an average of 27 unique vessels recorded per day within the OfECC Study Area. In terms of vessels intersecting the OfECC itself, there was an average of eight to nine unique vessels per day during the survey period. The vessel counts per day within the OfECC and OfECC Study Area during the winter survey period are presented in Figure 10.24.

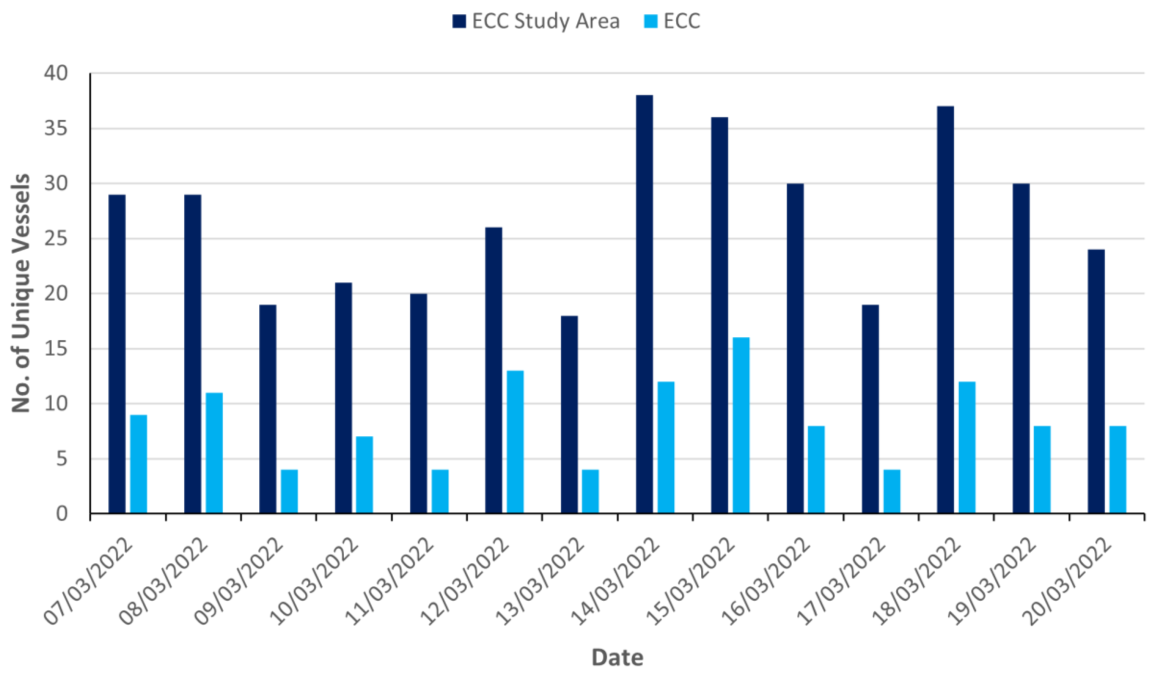

Figure 10.24 Vessels per Day (14 Days OfECC, Winter 2022)

184. Throughout the winter survey period, approximately 32% of unique vessel tracks recorded within the OfECC Study Area intersected the OfECC.

185. The busiest day recorded within the OfECC Study Area throughout the winter survey period was 14 March 2022, during which 38 unique vessels were recorded. The busiest day recorded within the OfECC during the winter survey period was 15 March 2022, during which 16 unique vessels were recorded.

186. The quietest days recorded within the OfECC Study Area throughout the winter survey period were 9 and 17 March 2022, during which 19 unique vessels were recorded each. The quietest days recorded within the OfECC during the winter survey period were 09, 11, 13, and 17 March 2022, during which four vessels were recorded each.

187. For the 14-days broken down during the summer survey period, there was an average of 39 unique vessels recorded per day within the OfECC Study Area. In terms of vessels intersecting the OfECC itself, there was an average of 13 unique vessels

per day during the survey period. The vessel counts per day within the OfECC and OfECC Study Area during the summer survey period are presented in **Figure 10.25**.

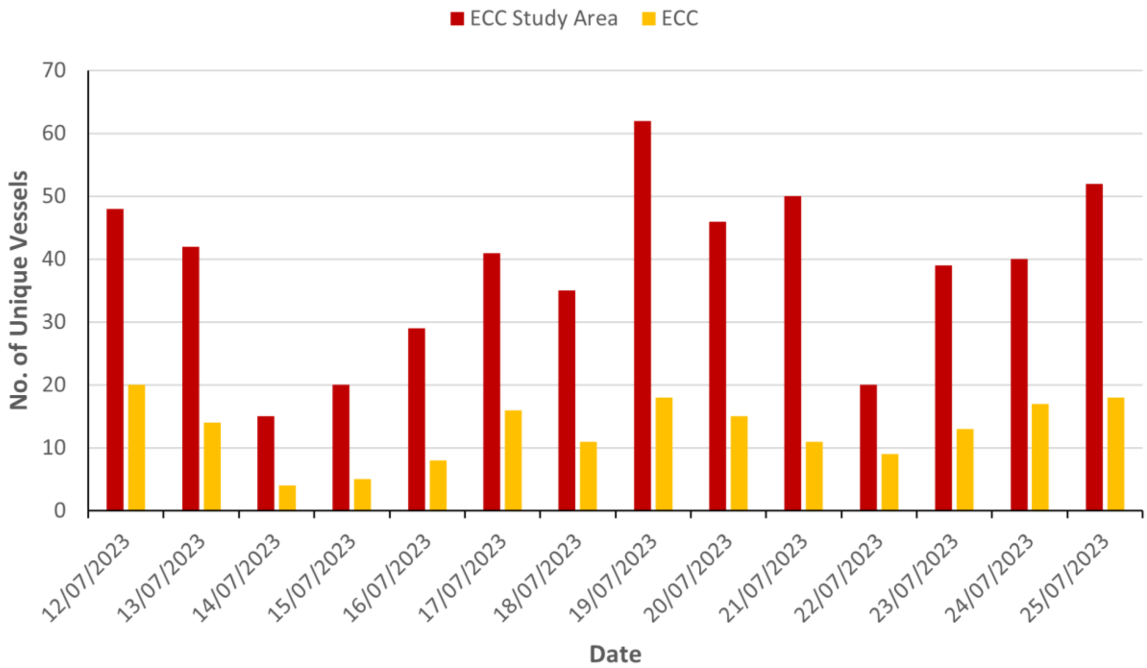

Figure 10.25 Vessels per Day (14 Days OfECC, Summer 2022)

188. Throughout the summer survey period, approximately 33% of unique vessel tracks recorded within the OfECC Study Area intersected the OfECC.

189. The busiest day recorded within the OfECC Study Area throughout the summer survey period was 19 July 2023, during which 62 unique vessels were recorded. The busiest day recorded within the OfECC during the summer survey period was 12 July 2023, during which 20 unique vessels were recorded.

190. The quietest day recorded within the OfECC Study Area throughout the summer survey period was 14 July 2023, during which 15 unique vessels were recorded. The quietest day recorded within the OfECC during the summer survey period was again 14 July 2023, during which four vessels were recorded.

10.2.2 Vessel Type

191. The percentage distribution of the main vessel types recorded passing within the OfECC Study Area, as well as intersecting the OfECC, during the winter and summer survey periods is presented in Figure 10.26.

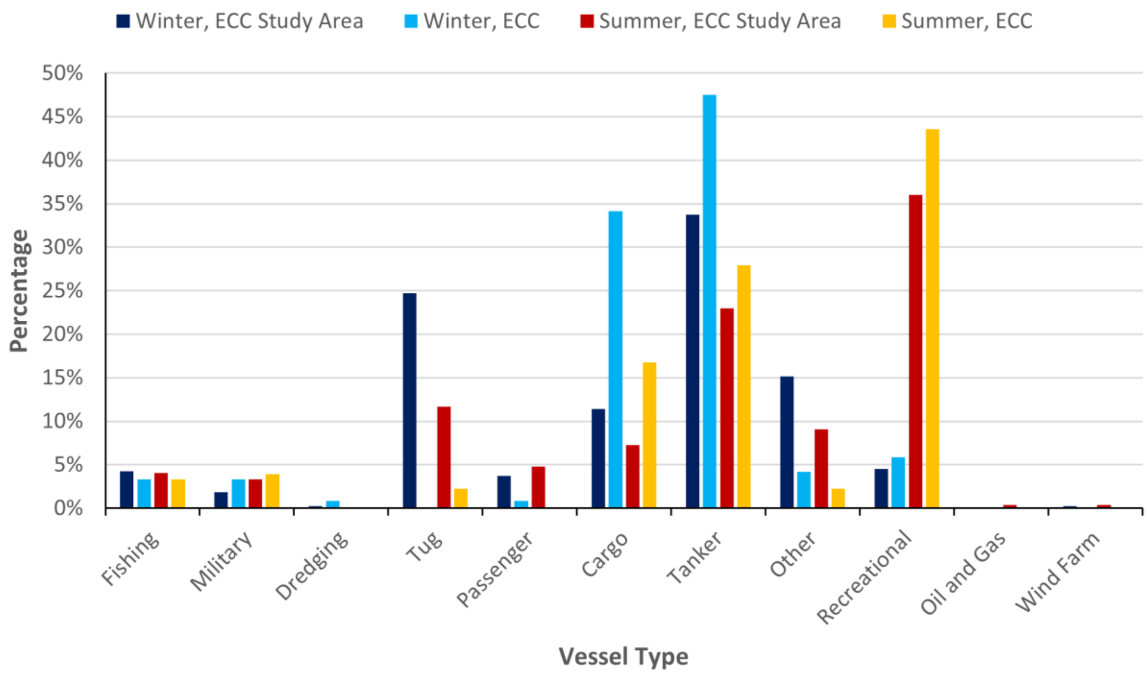

Figure 10.26 Distribution of Vessel Types (28 Days OfECC, Winter 2022 and Summer 2023)

192. Throughout the winter survey period, the most common vessel types recorded within the OfECC Study Area were tankers (34%) and tugs (25%). Throughout the summer survey period, the most common vessel types recorded within the Study Area were recreational vessels (36%) and tankers (23%).

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

10.2.2.1 Tankers

194. Figure 10.27 presents the tankers recorded within the OfECC Study Area during the 28-day survey period.

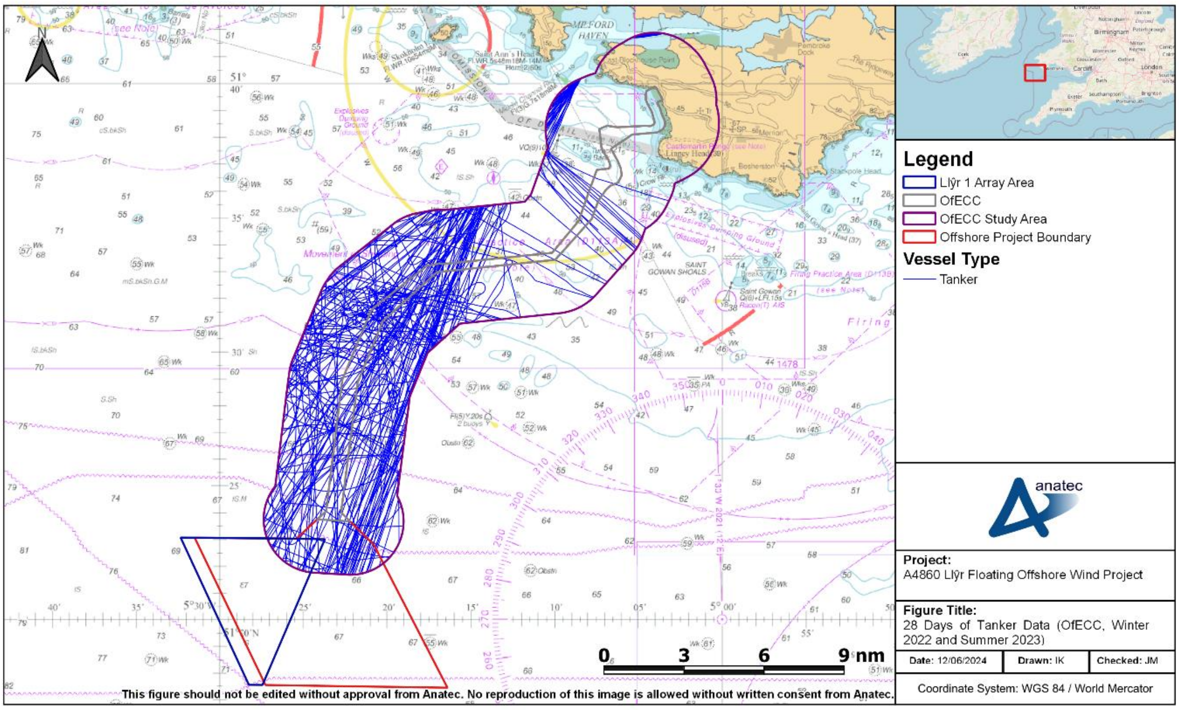

Figure 10.27 28 Days of Tanker Data (OfECC, Winter 2022 and Summer 2023)

195. An average of nine unique tankers per day were recorded within the OfECC Study Area during the 28-day period. An average of four unique tankers per day were recorded within the OfECC during the 28-day period. Tanker traffic was noted to primarily involve north-south transits, with the routeing to/from Milford Haven observed in proximity to the Array Area again present. Tankers awaiting orders were recorded in the approaches to Milford Haven.

10.2.2.2 Recreational Vessels

196. Figure 10.28 presents the recreational vessels recorded within the OfECC Study Area during the 28-day survey period.

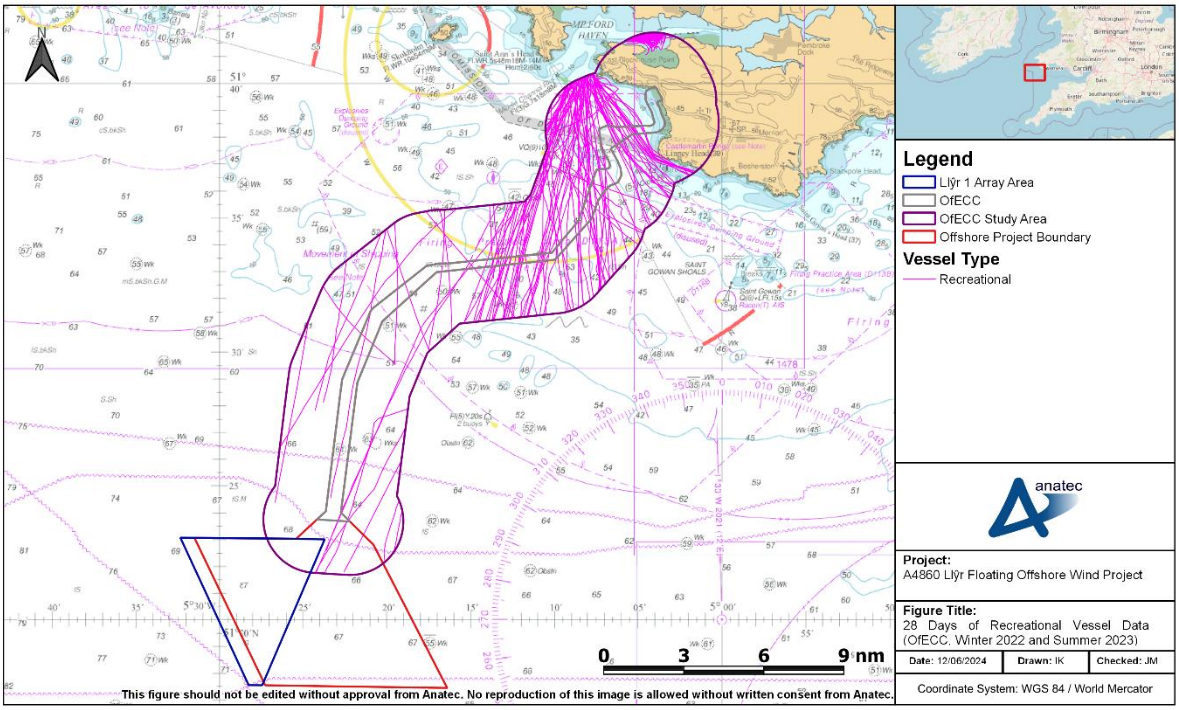

Figure 10.28 28 Days of Recreational Vessel Data (OfECC, Winter 2022 and Summer 2023)

197. An average of seven to eight unique recreational vessels per day were recorded within the OfECC Study Area during the 28-day period. An average of three unique recreational vessels per day were recorded within the OfECC during the 28-day period. The majority of recreational vessel transits were recorded passing to/from Milford Haven, crossing the OfECC towards the shore-based end. Much fewer recreational vessels crossed the OfECC further offshore.

10.2.2.3 Cargo Vessels

198. Figure 10.29 presents the cargo vessels recorded within the OfECC Study Area during the 28-day survey period.

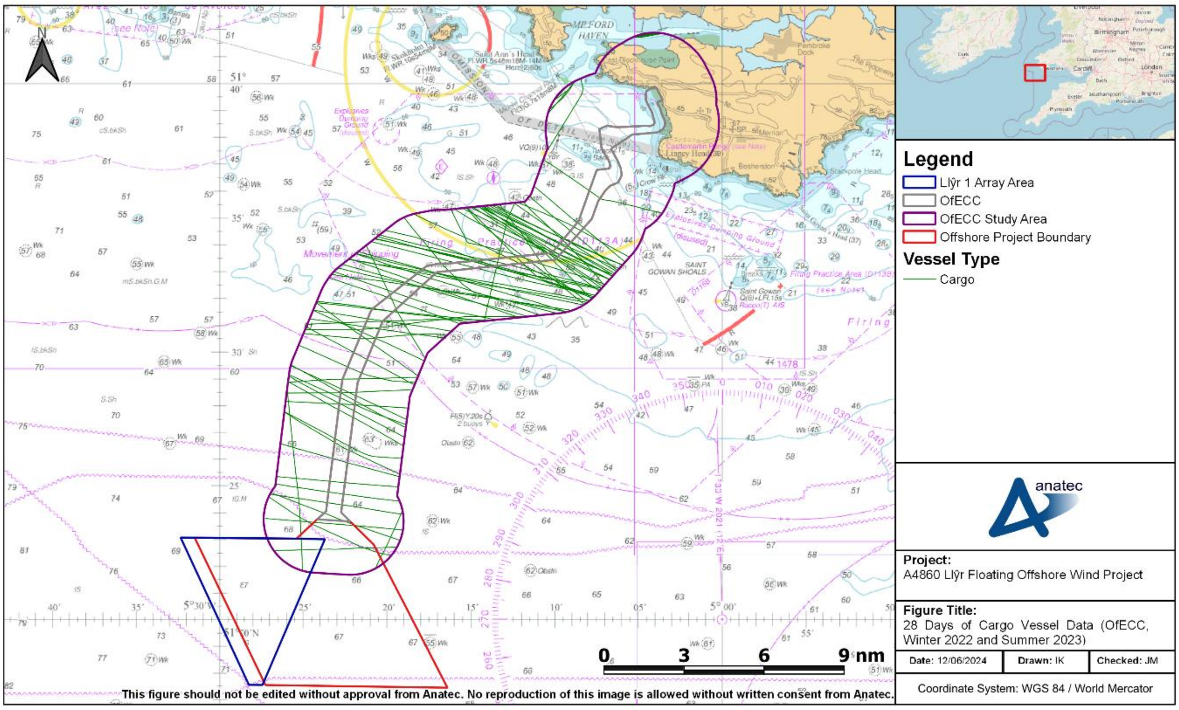

Figure 10.29 28 Days of Cargo Vessel Data (OfECC, Winter 2022 and Summer 2023)

199. An average of three unique cargo vessels per day were recorded within the OfECC Study Area during the 28-day period. An average of two to three unique cargo vessels per day were recorded within the OfECC during the 28-day period. As with the cargo vessel traffic recorded in proximity to the Array Area, the majority of cargo vessel traffic was noted in an east-west orientation to/from Bristol Channel, crossing the OfECC.

10.2.2.4 Fishing Vessels

200. Figure 10.30 presents the fishing vessels recorded within the OfECC Study Area during the 28-day survey period.

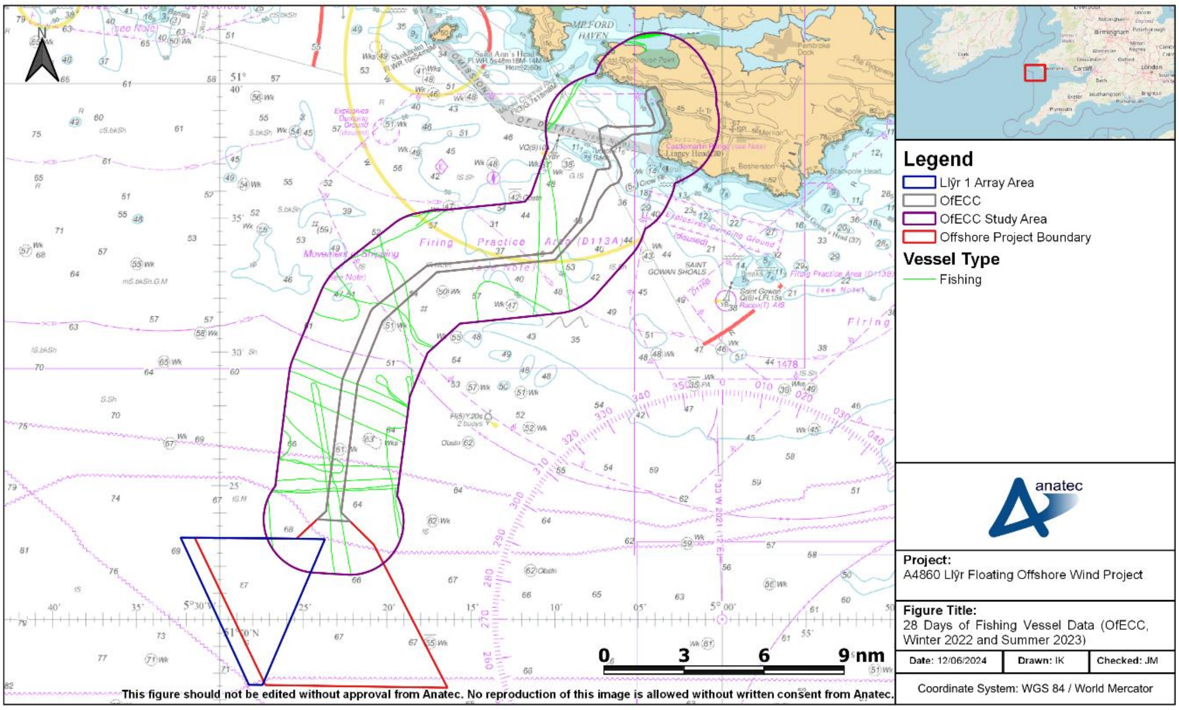

Figure 10.30 28 Days of Fishing Vessel Data (OfECC, Winter 2022 and Summer 2023)

201. An average of one to two unique fishing vessels per day were recorded within the OfECC Study Area during the 28-day period. An average of one unique fishing vessels every three days were recorded within the OfECC during the 28-day period.

10.2.3 Vessel Sizes

10.2.3.1 Vessel Length

202. Vessel length information was available for 97% of all vessels recorded throughout the combined summer and winter survey periods in the OfECC Study Area. A plot of all vessel tracks (excluding temporary traffic) recorded within the OfECC Study Area throughout the survey periods, colour-coded by length, is presented in Figure 10.31. Following this, the distribution of these length classes is presented in Figure 10.32.

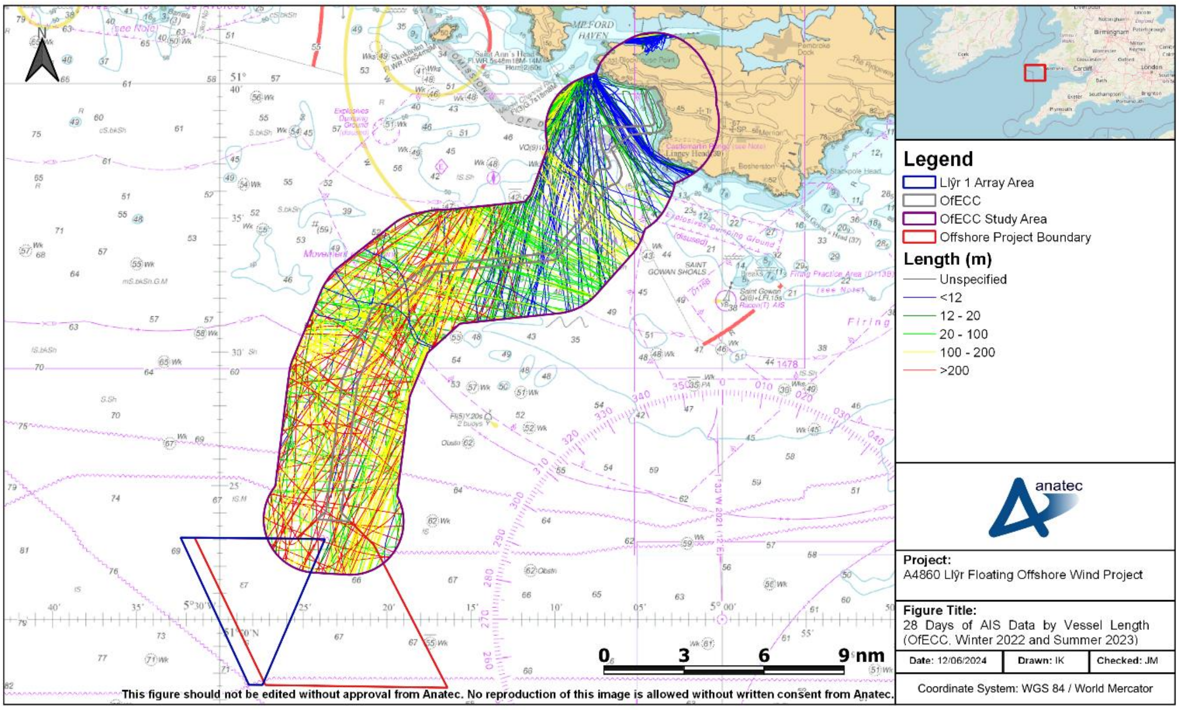

Figure 10.31 28 Days of AIS Data by Vessel Length (OfECC, Winter 2022 and Summer 2023)

203. Vessels of lower lengths were frequently recorded in transits closer to the coast, and typically fishing and recreational vessels. Vessels of greater lengths tended to transit in a northeast-southwest bearing to / from Milford Haven, with these vessels usually tankers.

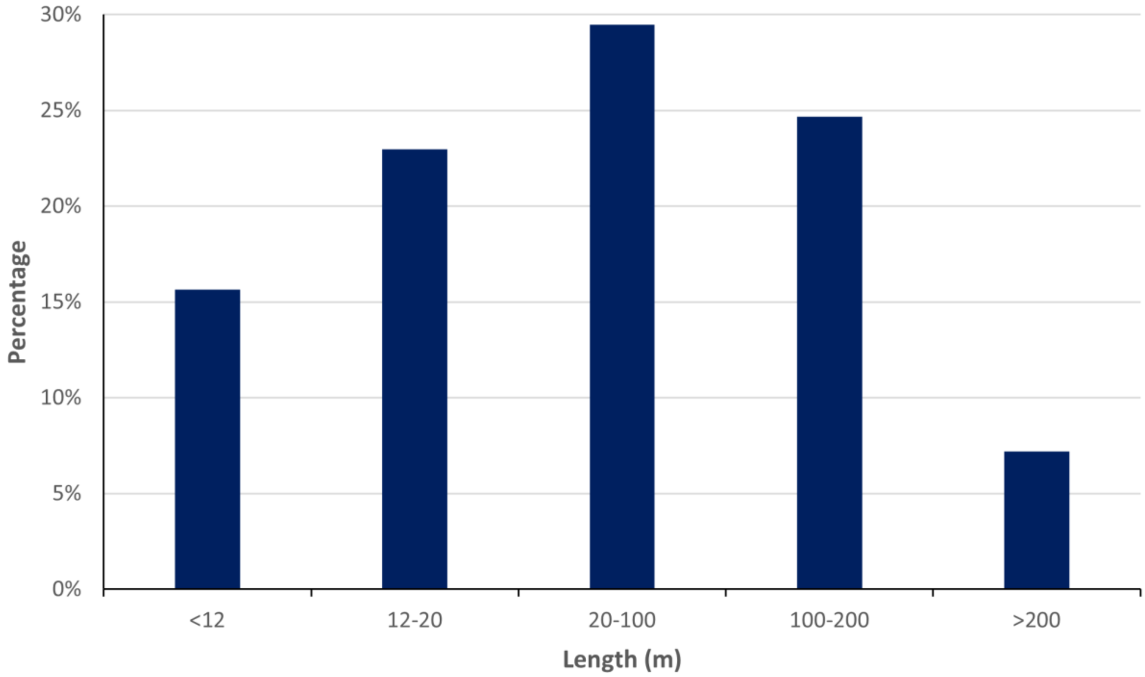

Figure 10.32 Distribution of OfECC Vessel Lengths

204. The average length recorded within the OfECC Study Area during the survey periods was 77 m. The longest vessel recorded were three LNG tankers at 315 m, recorded travelling to / from Milford Haven.

10.2.3.2 Vessel Draught

205. Vessel draught information was available for 67% of all vessels recorded throughout the combined summer and winter survey periods in the OfECC Study Area. A plot of all vessel tracks (excluding temporary traffic) recorded within the OfECC Study Area throughout the survey periods, colour-coded by length, is presented in Figure 10.31. Following this, the distribution of these length classes is presented in Figure 10.32.

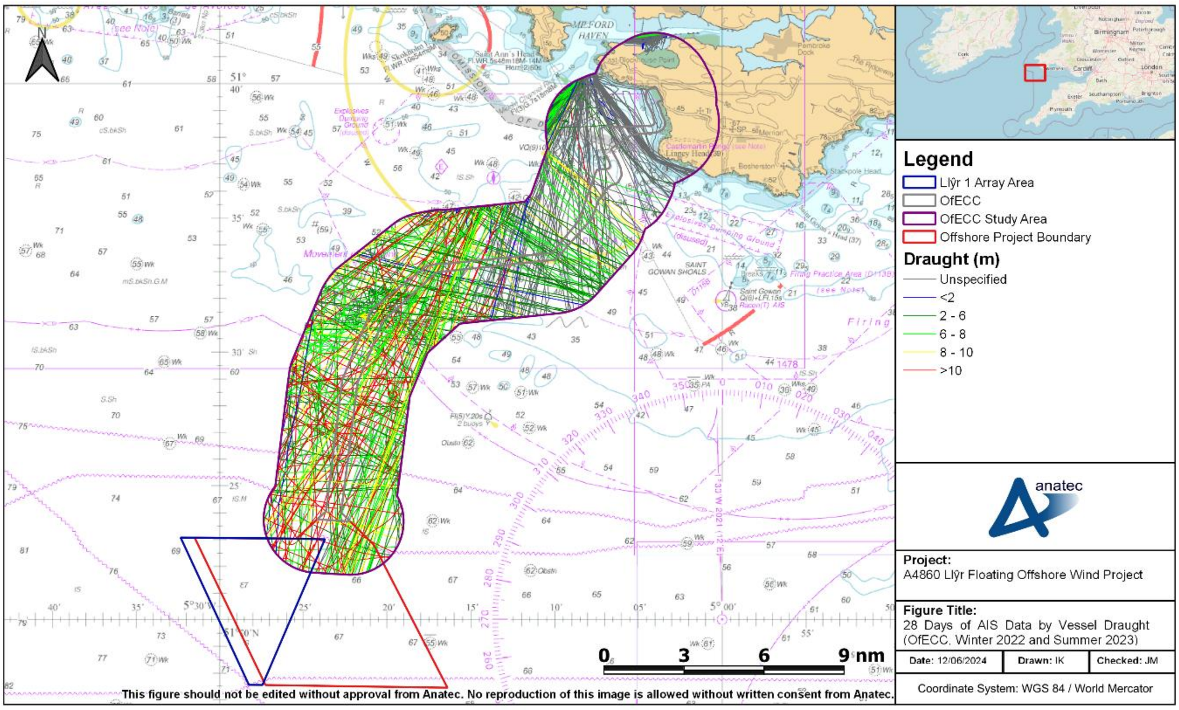

Figure 10.33 28 Days of AIS Data by Vessel Draught (OfECC, Winter 2022 and Summer 2023)

206. As with vessel length, vessels of lower draughts were recorded transiting closer to the coast, and typically fishing and recreational vessels whilst vessels of larger lengths tended to be tankers transiting in a northeast-southwest bearing to / from Milford Haven.

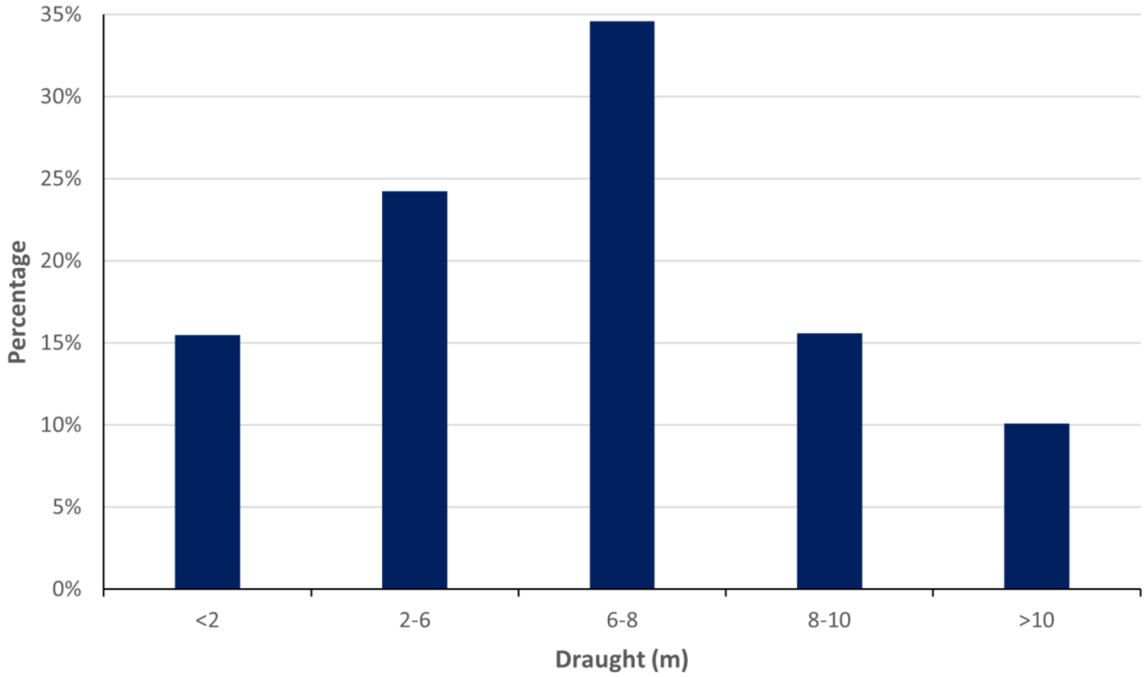

Figure 10.34 Distribution of OfECC Vessel Draughts

207. The average vessel draught recorded within the OfECC Study Area during the survey periods was 6.4 m. The deepest draught recorded was 16.4m, from a crude oil tanker awaiting orders to the north of the Array Area.

10.2.4 Anchoring Activity

208. Vessels identified as likely to be anchoring within the OfECC Study Area during the survey periods are colour-coded by vessel type and presented in **Figure 10.35**[4].

[4] Where an anchored vessel straddled the boundary of the OfECC Study Area the full extent of the track is shown for completeness.

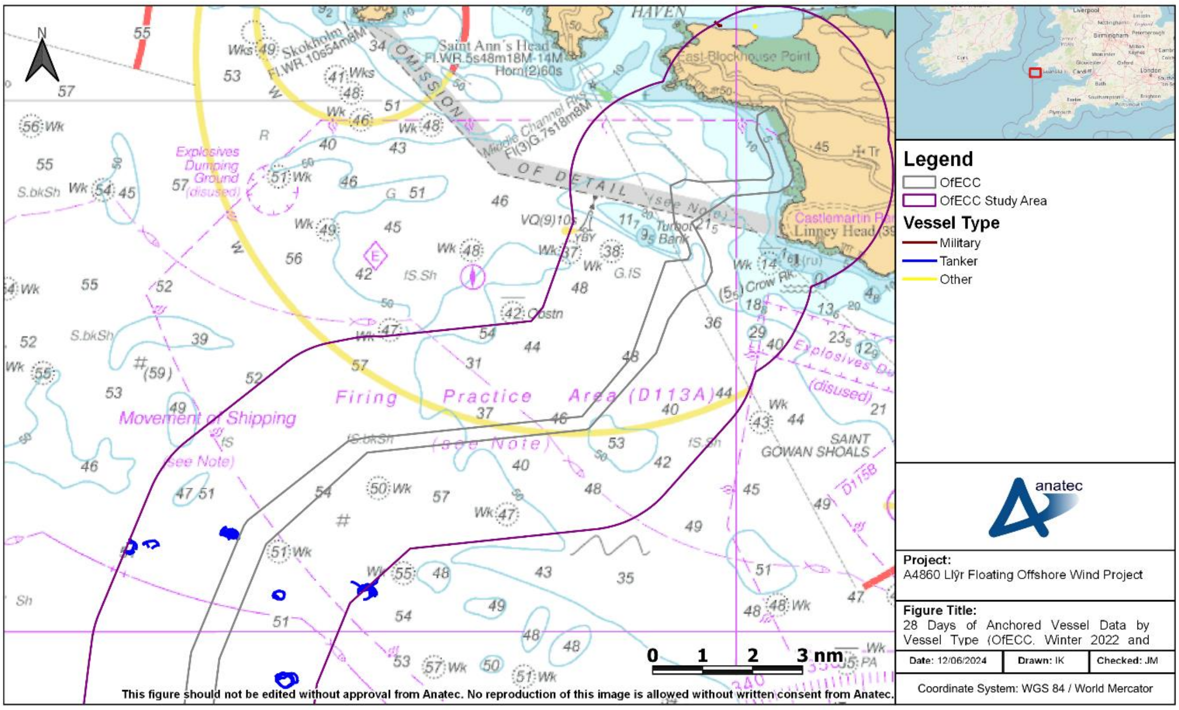

Figure 10.35 28 Days of Anchored Vessel Data by Vessel Type (OfECC, Winter 2022 and Summer 2023)

209. An average of approximately one vessel per day was identified as likely to be anchoring within the OfECC Study Area, with activity prevalent in the approaches to Milford Haven (around 10 nm offshore) and within the Milford Haven Waterway. The majority of anchoring vessels were tankers (78%).

11 Base Case Vessel Routeing

11.1 Definition of a Main Commercial Route

210. 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 using 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 has assisted in the identification of the main commercial routes.

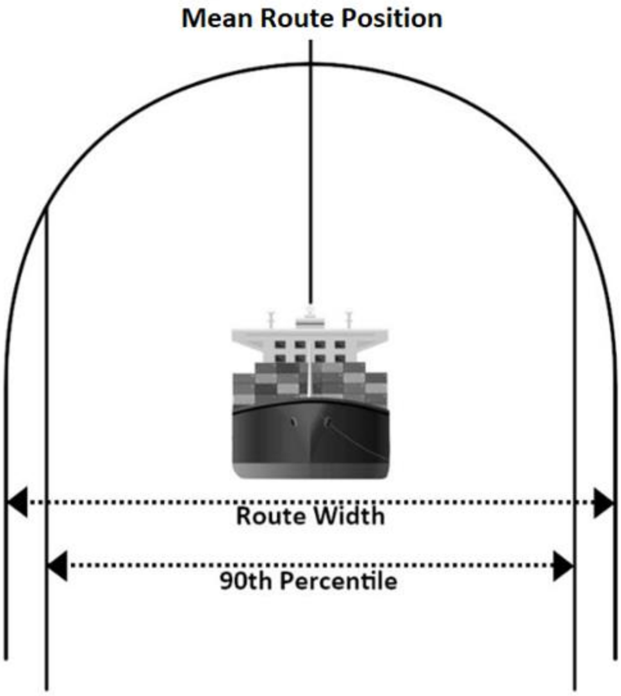

Figure 11.1 Route Illustration (MCA, 2021)

11.2 Pre Wind Farm Main Commercial Routes

211. A total of 14 main commercial routes were identified within the Study Area from the vessel traffic data, i.e., the pre wind farm scenario. These main commercial routes and corresponding 90th percentiles within the Study Area are shown relative to the Array Area in Figure 11.2. Following this, a description of each route is provided in Table 11.1, including the average number of vessels per week, 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).

212. To ensure all main commercial routes are captured, the long-term vessel traffic AIS data captured within the Study Area during 2022 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 15.5**).

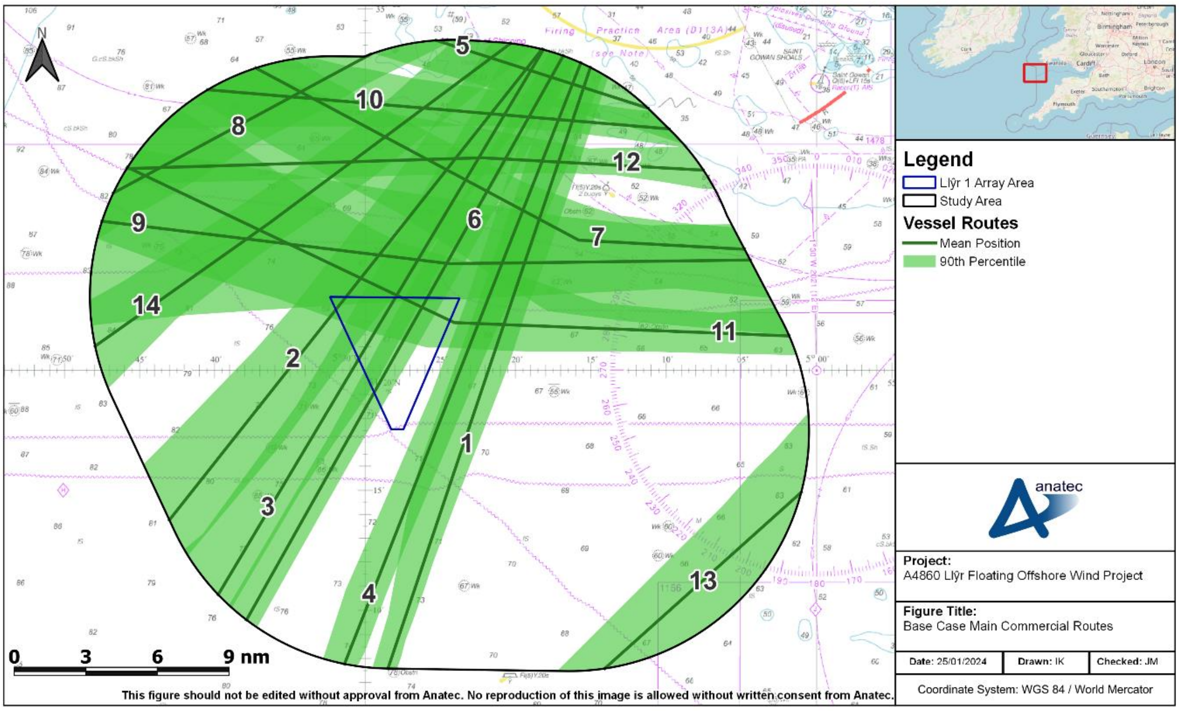

Figure 11.2 Base Case Main Commercial Routes

Table 11.1 Main Commercial Route Descriptions

Route Number	Average Vessels per Week	Description
1	5	**Milford Haven – Off Land's End TSS (one-way).** Mainly tankers.
2	3	**Milford Haven – Mediterranean ports.** Entirely tankers.
3	3	**Off the Scilly Isles TSS – Milford Haven (one-way).** Almost entirely tankers.
4	3	**Off Land's End TSS – Milford Haven (one-way).** Mainly tankers.
5	3	**Newport – Rosslare.** Mainly cargo vessels.
6	2-3	**Milford Haven – Off the Scilly Isles TSS (one-way).** Almost entirely tankers.

Route Number	Average Vessels per Week	Description
7	1-2	**Newport – Rosslare.** Mainly cargo vessels.
8	1-2	**Milford Haven – US ports.** Mainly tankers.
9	1	**Swansea – Limerick.** Mainly cargo vessels.
10	1	**Swansea – Ringaskiddy.** Mainly cargo vessels.
11	1	**Bristol – Liverpool.** Mainly cargo vessels.
12	1	**Swansea – Cork.** Mainly cargo vessels.
13	1	**Avonmouth - Dutch ports.** Mainly cargo vessels.
14	0-1	**Milford Haven - US ports.** All tankers.

12 Adverse Weather Routeing

213. Some vessels and vessel operators may operate alternative routes during periods of adverse weather. This section focuses on vessel movements in adverse weather. This takes into consideration the implications of a scenario when a commercial vessel is unable to make passage or a small craft is unable to access safe havens in adverse weather due to the presence of the proposed Project or activities associated with the proposed Project.

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

12.1 Identification of Periods of Adverse Weather

215. The survey data and long-term traffic data has been checked for instances of adverse weather, based on the weather log maintained by the on-site survey vessel. The sea state was rough from 14 to 16 July 2023 causing the survey vessel to return to port. This was the only recorded instance of adverse weather during the survey periods.

12.2 Commercial Routeing Changes

216. Other than the RoPax vessel diverting from its usual course closer to coast potentially due to sea conditions (see **Section 10.1.2**), no adverse weather routeing was recorded in the survey data; in particular no diverted tracks were identified from the vessel traffic survey data from 14 to 16 July 2023 when adverse weather was known to be present.

217. One additional instance of adverse weather routeing was identified throughout the long-term vessel data, with an Irish Ferries-operated RoPax vessel transiting closer to the coast than normal whilst routeing to Dublin. However, Irish Ferries indicated during Regular Operator consultation on 18 July 2023 that they had no adverse weather concerns and such issues were not raised by stakeholders at the Hazard Workshop.

13 Navigation, Communication and Position Fixing Equipment

13.1 Very High Frequency Communications (including Digital Selective Calling)

218. In 2004, trials of communication systems 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 Digital Selective Calling (DSC) when operated close to WTGs.

219. 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.

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

221. 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 North Hoyle Array Area and communications were reported as very clear, with no apparent degradation of performance. Communications with the service vessel located within the array were also fully satisfactory throughout the trial (MCA, 2005).

222. 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).

223. 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 Project is anticipated to have no significant impact upon VHF communications. Nevertheless, the MCA are currently requesting that radio surveys are undertaken prior to and following construction of OWF developments to allow further investigation of any potential effects.

13.2 Very High Frequency Direction Finding

224. 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 50 m). 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).

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

226. 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 Project is anticipated to have no significant impact upon VHF DF equipment.

13.3 Automatic Identification System

227. 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).

228. 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 Project.

13.4 Navigational Telex System

229. 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.

230. 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.

231. 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.

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

13.5 Global Positioning System

233. 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*".

234. 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).

235. Therefore, there are not expected to be any significant impacts associated with the use of GPS systems within or in proximity to the proposed Project, 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

236. 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.

237. 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.

238. 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 Project would have a significant impact on vessel navigation. However, some smaller craft (fishing or leisure) may rely on compasses as their sole means of navigation, and these may be affected by EMF.

13.6.1 Subsea Cables

239. The subsea cables for the proposed Project will be Alternating Current (AC). Direct Current (DC) is not under consideration.

240. 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 Project are not considered any further.

13.6.2 WTGs

241. 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 OWFs

242. 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

243. 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. For floating developments – such as the proposed Project – it is also necessary to ensure greater spacing to allow for floating specific infrastructure (e.g., mooring lines) to be installed.

13.7.1 Trials

244. 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.

245. 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).

246. Side lobe patterns are produced by small amounts of energy from the transmitted pulses that are radiated outside of the narrow main beam. The effects of side lobes are most noticeable within targets at short range (below 1.5 nm) and with large objects. Side lobe echoes form either an arc on the Radar screen similar to range rings, or a series of echoes forming a broken arc, as illustrated in **Figure 13.1**.

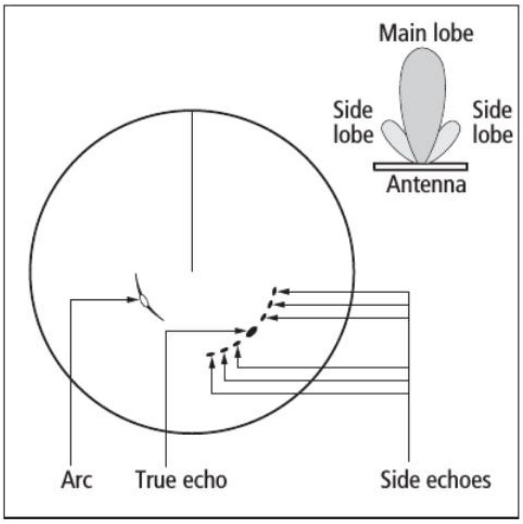

Figure 13.1 Illustration of Side Lobes on Radar Screen

247. 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**.

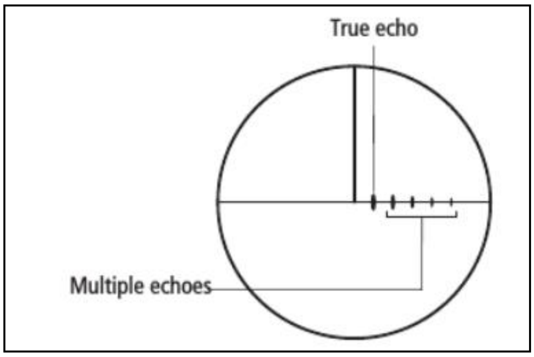

Figure 13.2 Illustration of Multiple Reflected Echoes on Radar Screen

248. 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).

249. 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.

250. Theoretical modelling of the effects of the development of the 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 ARPA to be affected when tracking targets in or near the array.

251. Regarding the last point, 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.

252. In summary, experience in UK waters has shown that mariners have become increasingly aware of potential Radar effects as more OWFs become operational.

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

Based on this increasing experience, the mariner can interpret the effects correctly, noting that effects are the same as those experienced by mariners in other scenarios such as in close proximity to other vessels or structures. Effects may be effectively mitigated by "*careful adjustment of Radar controls*" (MCA, 2008 (b)).

253. 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), and MGN 372 (MCA, 2008).

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

254. As noted in **Table 13.1**, the onset range from the WTGs of false returns is approximately 1.5 nm, with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the Convention on 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 VTS or AIS (MCA, 2016).

13.7.2 Experience from Operational Developments

255. 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 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**.

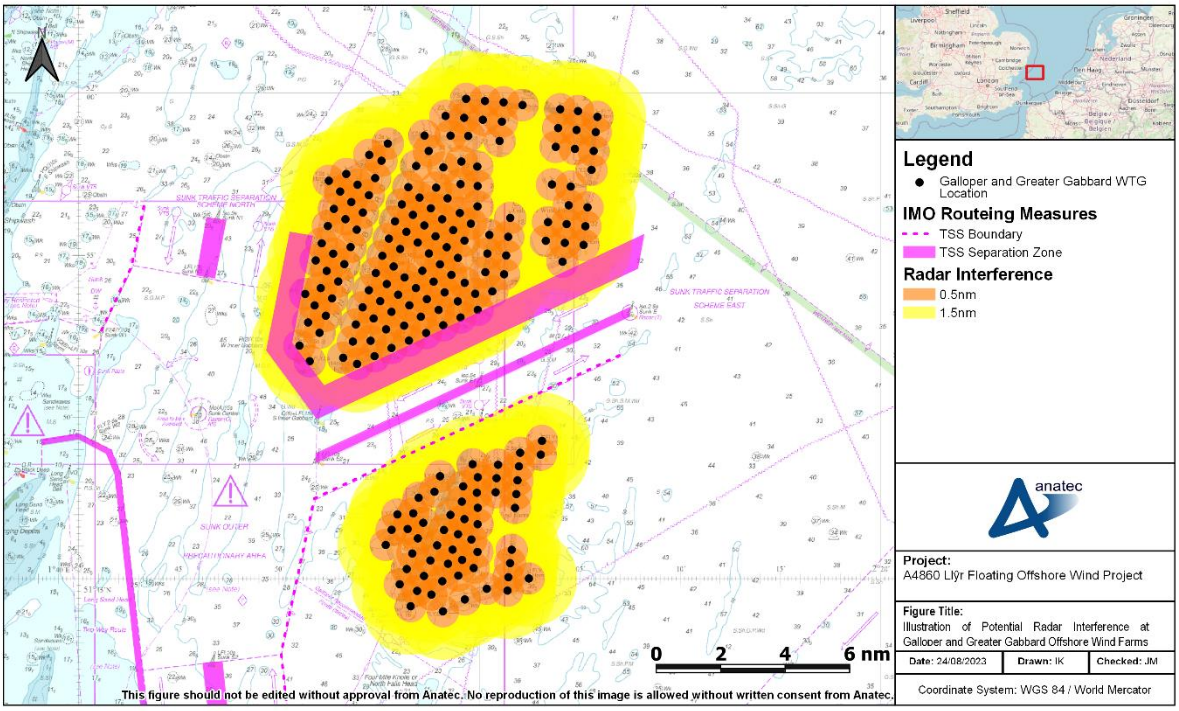

Figure 13.3 Illustration of Potential Radar Interference at Galloper and Greater Gabbard OWFs

256. As indicated by **Figure 13.3**, vessels utilising these TSS lanes would likely 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.

257. AIS information may also be used to verify the targets of larger vessels (generally vessels over 15 m LOA – the minimum threshold for fishing vessel AIS carriage requirements). Approximately 1% of the vessel traffic recorded within the Study Area was under 15 m in length, and there was a high level of AIS take-up among vessels for which AIS carriage is not mandatory.

258. 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

259. 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.

260. 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 the Array Area would not create any effects in addition to those already identified from existing operational OWFs (interfering side lobes, multiple and reflected echoes). Additionally, the level and way Radar returns occur is not expected to differ significantly for different foundation types (i.e., monopiles and jacket foundations).

261. 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 OWF

262. 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 Project

263. Upon development of the proposed Project, some commercial vessels may pass within 1.5 nm 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.

264. **Figure 13.4** presents an illustration of potential Radar interference due to the proposed Project. The Radar effects have been applied to the indicative full build out array layout introduced in **Section 6.1**.

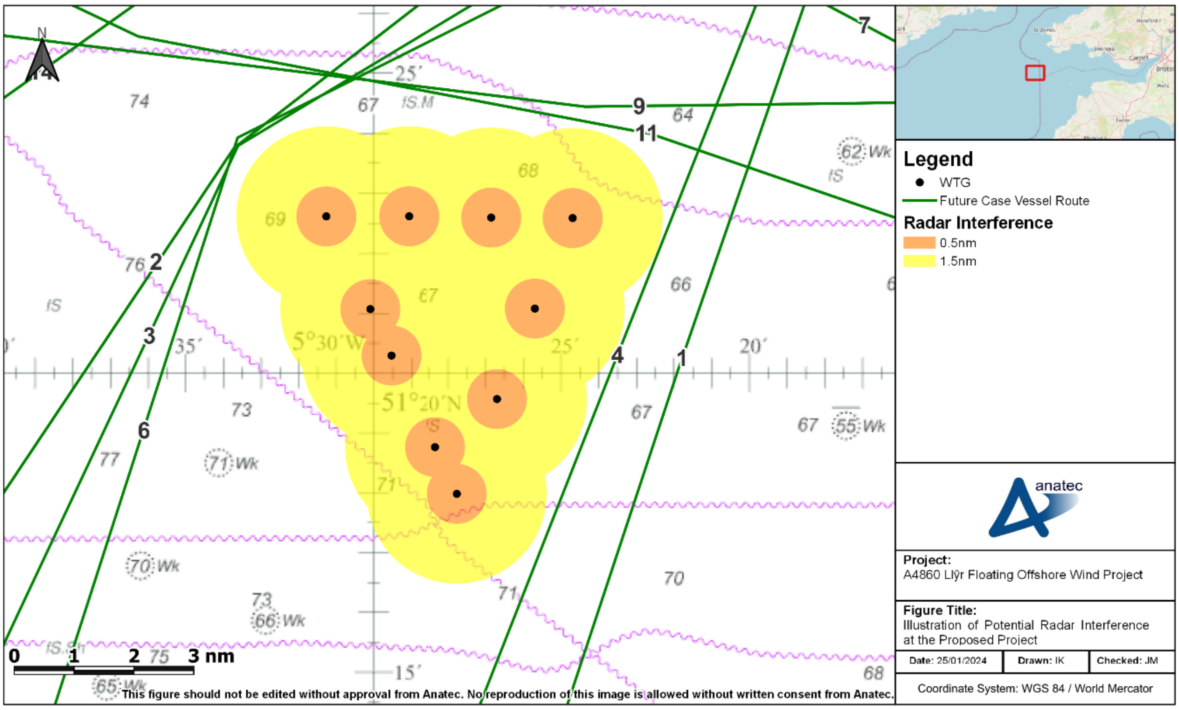

Figure 13.4 Illustration of Potential Radar Interference at the Proposed Project

265. Vessels passing within the Array Area 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.

266. 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

267. No evidence has been found to date with regard to existing OWFs to suggest that Sound Navigation and 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 Project.

13.9 Noise

268. 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

269. Based on the detailed technical assessment of the effects due to the presence of the proposed Project 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 3.1**.

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**

270. On the basis of these findings, associated risks are screened out of the Risk Assessment undertaken in **Section 17**.

14 Cumulative Screening

271. Cumulative risks have been considered for activities in combination and cumulatively with the proposed Project. 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**.

272. In addition to the proposed Project, 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 June 2024. Where Geographical Information System (GIS) data is not available for a development, distances to the proposed Project have been marked as 'unknown' and this has been accounted for when determining the level of data confidence.

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

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

Table 14.1 Cumulative Screening

Development	Development Type	Development Status	Closest Distance		Data Confidence	Cumulative Risk Assessment Screened In/Out	Tier
			Array Area (nm)	Offshore OfECC (nm)			
Erebus	OWF	Consented	2.5	5.8	High	**Screened in**	1
Llywelyn	OWF	Planned	Unknown	Unknown	Low	Screened out – preliminary status, low data confidence and overlaps with TCE PDAs	N/A
Pembrokeshire Demonstration Zone	OWF	Scoped	Unknown	Unknown	Medium	**Screened in**	3
Petroc	OWF	Planned	Unknown	Unknown	Low	Screened out – preliminary status, low data confidence and overlaps with TCE PDAs	N/A
Valorous	OWF	Scoped	1.7	6.7	Low	Screened out – low data confidence and overlaps TCE PDAs	N/A
White Cross	OWF	Consent Submitted	9.3	14.6	High	**Screened in**	2
TCE PDAs	OWF	Planned	0.0	4.4	Low	**Screened in**	3

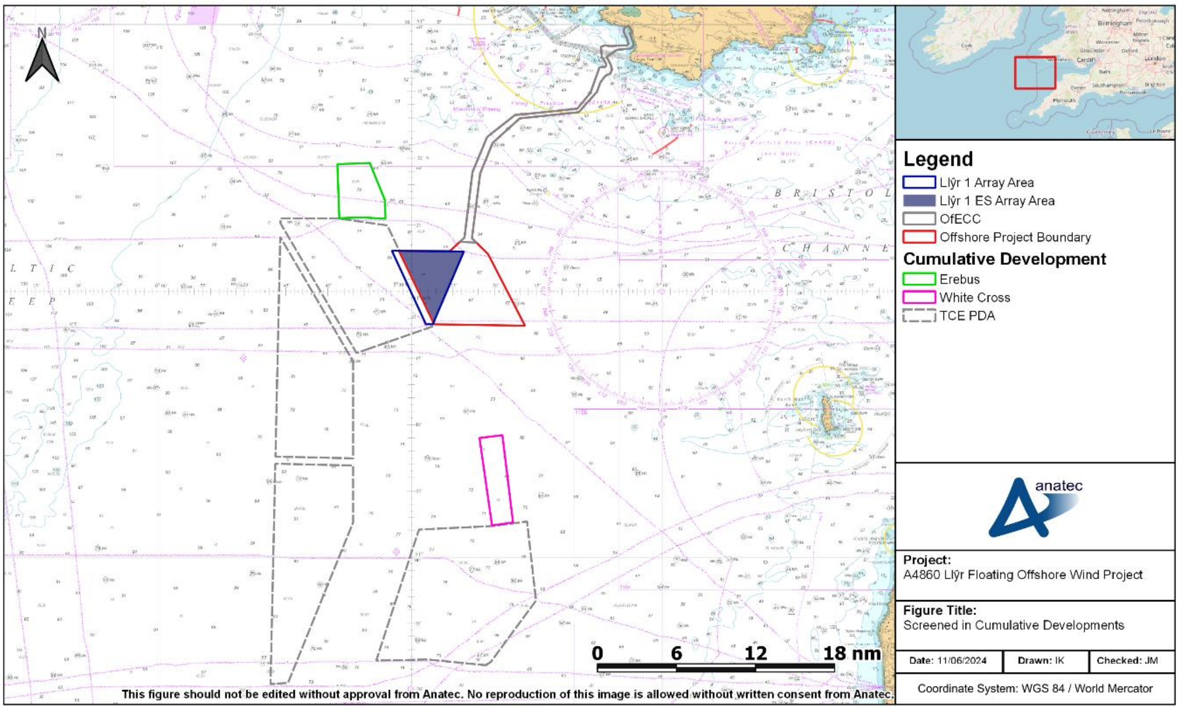

Figure 14.1 Screened in Cumulative Developments

15 Future Case Vessel Traffic

275. 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 17**). However, it is also necessary to consider potential future case vessel traffic, in terms of general volume and size changes, port developments which may influence movements, and changes to movements associated with the presence of the proposed Project (the post wind farm scenario).

276. 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

277. 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 on vessel access. This is particularly relevant in relation to Milford Haven given the influence of seasons and oil prices, with global markets having the potential to cause fluctuations in volumes of tanker movements.

278. However, MHPA acknowledged in the Hazard Workshop (August 2023) that plans are being considered to increase capacity in the next 10 to 15 years. This could be in excess of 30% although there is limited information that can be shared publicly at present. The UK Chamber of Shipping have also noted during a consultation meeting (February 2023) that vessel draughts could increase, although this would be constrained by the nature of any future development at Milford Haven (which has not been determined at this time).

279. Therefore, to account for variation two independent scenarios of potential growth in commercial vessel movements of 10% and 20% have been estimated throughout the lifetime of the proposed Project, noting the lack of certainty over any greater increases.

15.2 Increases in Commercial Fishing Vessel and Recreational Vessel Activity

280. 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.

281. This is epitomised by the effects of Brexit, with MHPA acknowledging in the Hazard Workshop (August 2023) that Belgian fishers are not currently landing at Milford Haven whereas prior to Brexit there were 30 to 40 landings per month. Similarly, the RYA acknowledged that the effects of the COVID-19 pandemic reduced recreational vessel volumes and these have not yet recovered fully (particularly in the case of non-UK yachts).

282. Therefore, two independent scenarios of potential growth in commercial fishing vessel and recreational vessel movements of 10% and 20% has been estimated throughout the lifetime of the proposed Project.

15.3 Increases in Traffic Associated with Offshore Wind Farm Operations

283. During the operation and maintenance phase, up to 120 annual round trips to port would be made by vessels involved in the operation and maintenance of the proposed Project (see **Section 6.5**). However, other cumulative developments may also have associated activities, with the UK Chamber of Shipping noting during the Hazard Workshop (August 2023) that this could indicatively result in 1,000 to 2,000 additional vessel movements per year.

284. Noting the low data confidence associated with a number of the other cumulative developments (see **Section 14**) and uncertainty over base ports which will be used, it is only possible to qualitatively consider future case vessel movements associated with OWF operations.

15.4 Commercial Traffic Routeing (Project in Isolation)

15.4.1 Methodology

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

- All alternative routes maintain a minimum mean distance of 1 nm 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 route positions take into account sandbanks, aids to navigation and known routeing preferences.

286. MGN 654 defines a methodology for assessing passing distance from OWF boundaries but states that it is "*not a prescriptive tool but needs intelligent application*" (MCA, 2021).

287. To date, internal and external studies undertaken by Anatec on behalf of the UK Government and OWF developers show that vessels do pass consistently and safely within 1 nm 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 1 nm off established developments. Evidence also demonstrates that commercial vessels do not transit through arrays.

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

15.4.2 Main Commercial Route Deviations

289. 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 the proposed Project is presented in Figure 15.1. These deviations are based on Anatec's assessment of the worst case scenario and the methodology set out in **Section 15.4.2**.

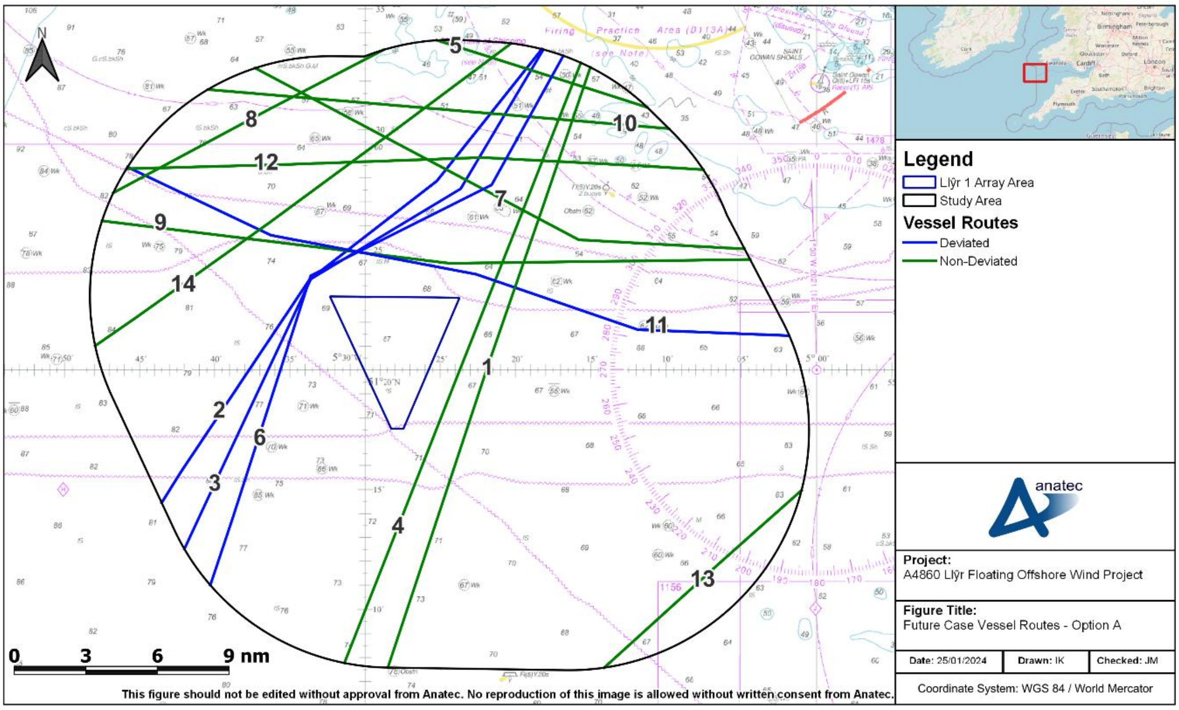

Figure 15.1 Future Case Vessel Routes – Option A

290. Based on discussions in the Hazard Workshop, a secondary option for the shift in the mean positions of the main commercial routes has been developed. This considers a scenario where the primarily tanker routes requiring a deviation (Routes 2, 3 and 6) to pass east of the Array Area rather than west, and is presented in Figure 15.2.

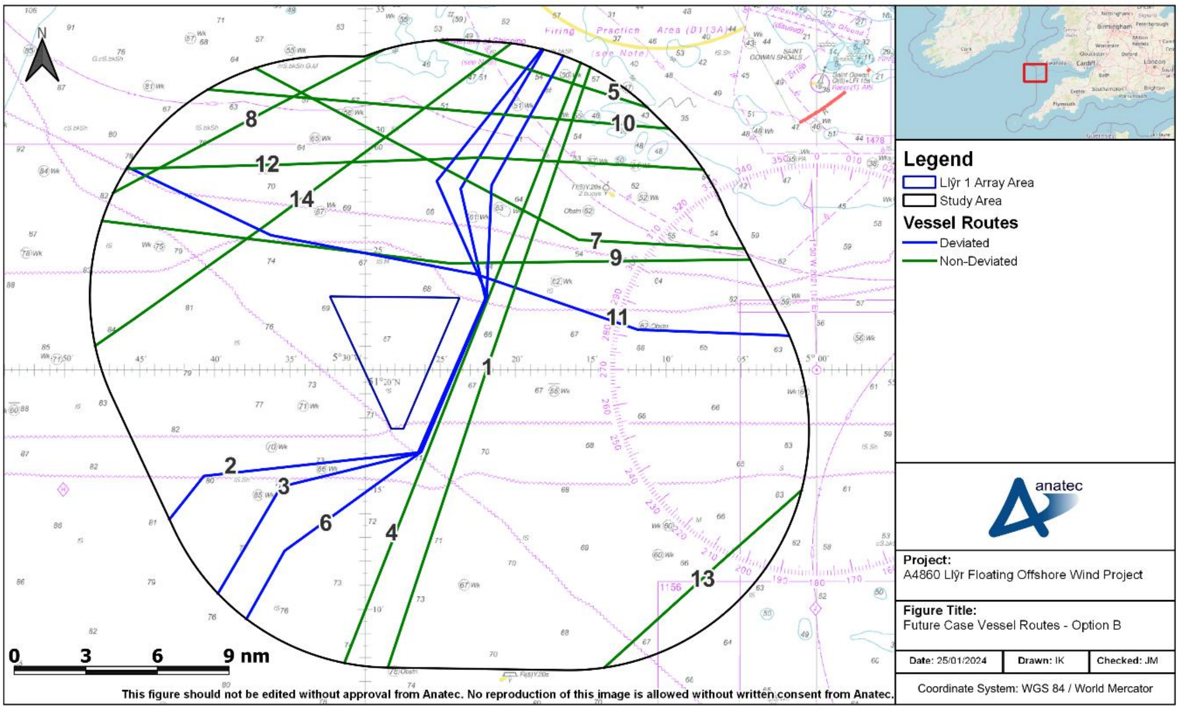

Figure 15.2 Future Case Vessel Routes – Option B

291. Deviations from the pre wind farm scenario would be required for four out of the 14 main commercial routes identified. For the displaced routes, the increase in distance from the pre wind farm scenario is presented in **Table 15.1** for both Options A and B.

Table 15.1 Summary of Post Wind Farm Main Commercial Deviations

Route Number	Option A		Option B	
	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)
2	0.27	0.02	5.74	0.46
3	0.93	0.77	3.11	2.59
6	1.78	1.48	1.20	1.01
11	0.29	0.09	0.29	0.09

15.5 Commercial Routeing (Cumulative)

292. 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 Project, Tier 1, and Tier 2 cumulative developments is presented in **Figure 15.3**. Again, these deviations are based on Anatec's assessment of the worst case scenario and follow the same methodology outlined for deviations

due to the proposed Project in isolation (see **Section 15.4.1**). As with routes considering the proposed Project in isolation (see **Section 15.4.2**), the secondary option for the shift in the mean positions of the main commercial routes, where the tanker routes requiring a deviation (Routes 2, 3 and 6) pass east of the Array Area rather than west, and is presented in **Figure 15.4**.

293. Based on stakeholder feedback, it is assumed that commercial vessels would choose not to transit between the proposed Project and Erebus.

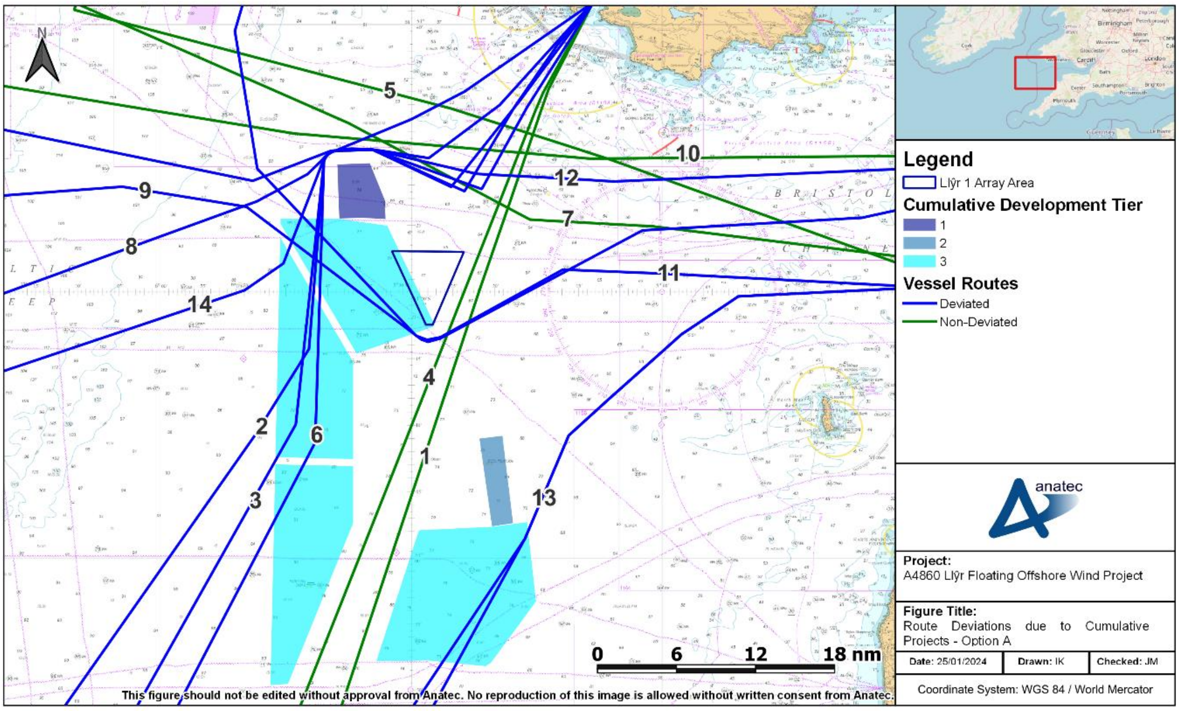

Figure 15.3 Route Deviations due to Cumulative Projects – Option A

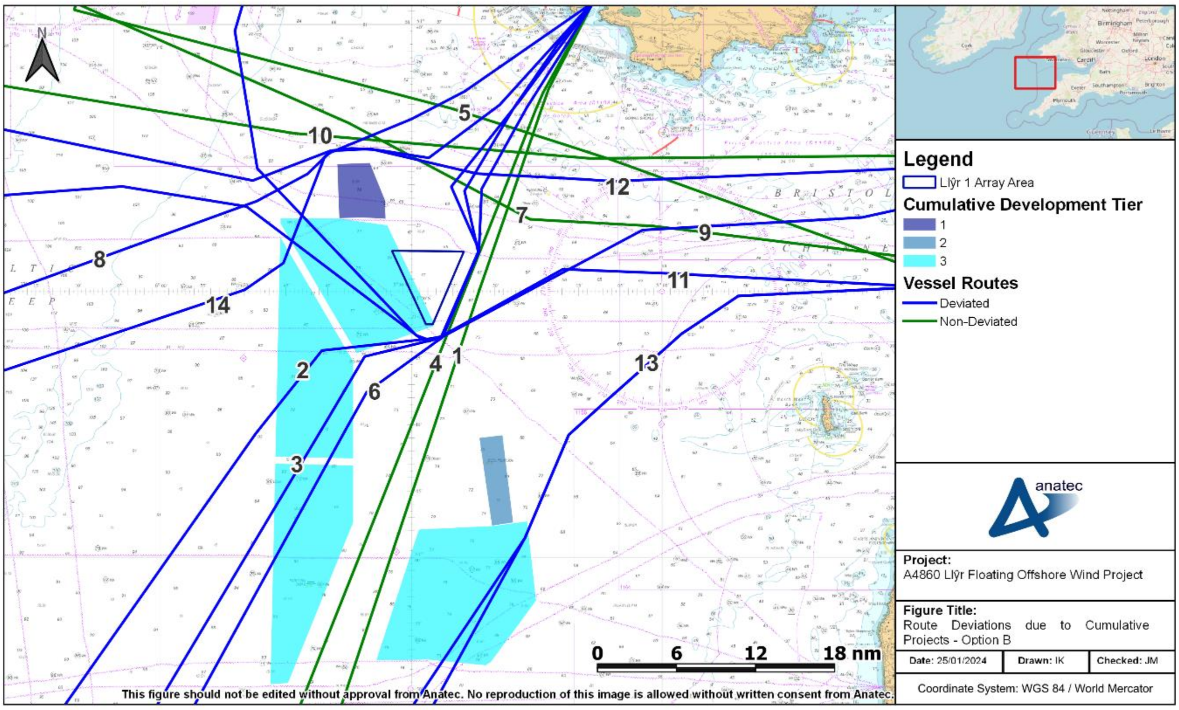

Figure 15.4 Route Deviations due to Cumulative Projects – Option B

294. Based on the cumulative screening, cumulative deviations from the pre wind farm scenario would be required for nine out of the 14 main commercial routes identified. For the displaced routes, the increase in distance from the pre wind farm scenario is presented in **Table 15.2** for both Options A and B.

Table 15.2 Summary of Post Wind Farm Main Commercial Deviations

Route Number	Option A		Option B	
	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)
2	8.55	0.68	5.74	0.46
3	9.90	8.25	3.11	2.59
6	11.14	9.37	1.19	1.01
8	0.12	<0.01	0.12	<0.01
9	5.36	1.40	5.36	1.41
11	5.14	1.66	5.14	1.66
12	0.61	0.34	0.61	0.34
13	0.21	0.04	0.21	0.04
14	3.08	0.12	3.08	0.12

16 Collision and Allision Risk Modelling (in Isolation)

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

16.1 Scenarios Under Consideration

296. 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, the following six distinct scenarios have been modelled:

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

297. The results of the base case scenarios are detailed in full in the following subsections, with the equivalent results for each future case scenario provided in **Section 16.4**. Additionally, both of the post wind farm routeing options outlined in **Section 15.4.2** have been modelled for vessel to vessel collision risk.

16.2 Hazards Under Consideration

298. 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.

299. The pre wind farm assessment has been informed by the vessel traffic survey data (see **Section 10**) and other baseline data sources (such as the long-term vessel traffic data and Anatec's ShipRoutes database). Conservative assumptions have been made with regard to route deviations and future shipping growth over the lifetime of the proposed Project (see **Section 15**).

16.3 Pre Wind Farm Modelling

16.3.1 Vessel to Vessel Encounters

300. An assessment of current vessel to vessel encounters has been undertaken by replaying at high speed the vessel traffic data collected as part of the vessel traffic surveys (see **Section 5.2**). The model defines an encounter as two vessels passing

within 1 nm 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.

301. 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 the Study Area throughout the survey periods, noting that no encounters were recorded within the Array Area itself.

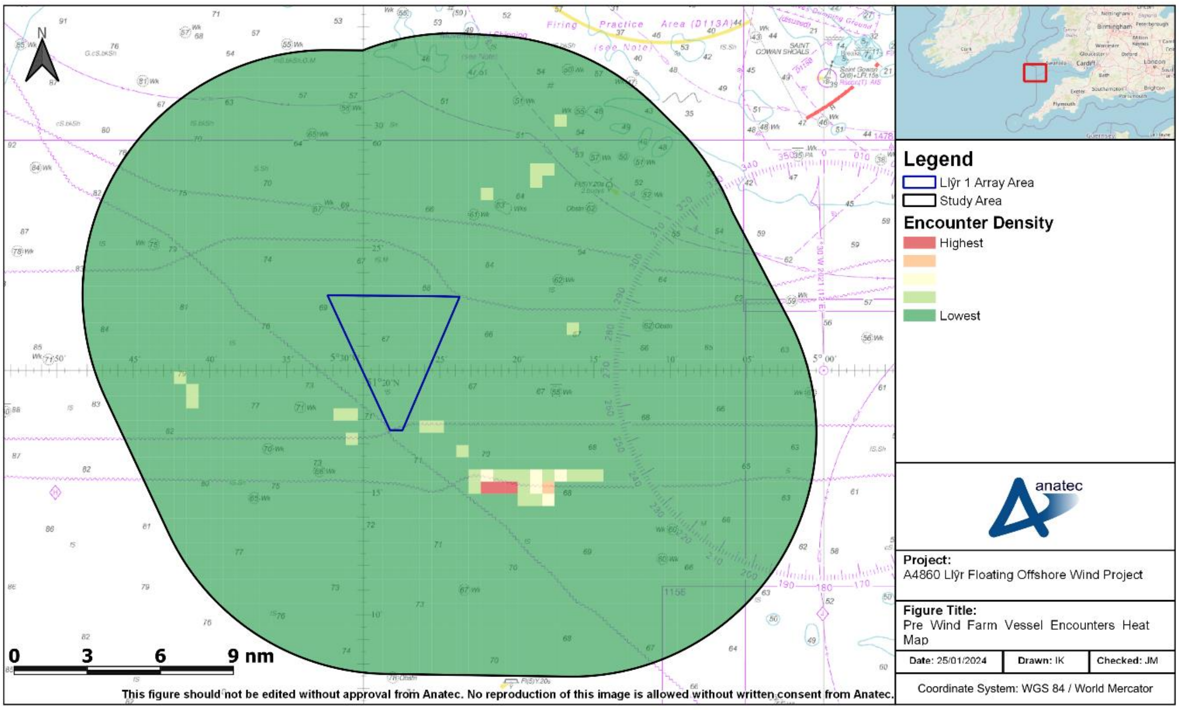

Figure 16.1 Pre Wind Farm Vessel Encounters Heat Map

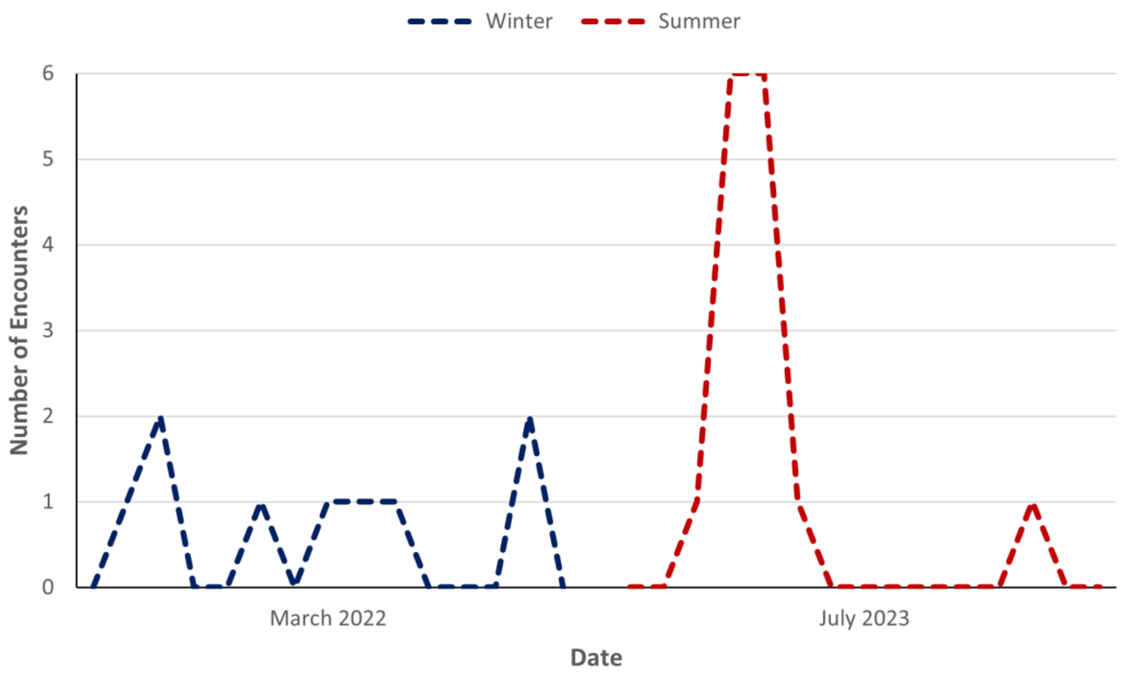

Figure 16.2 Vessel Encounters per Day within the Study Area

302. There was on average one encounter per day within the Study Area throughout the survey periods. The greatest number of encounters recorded in one day was six, on 12 and 13 July 2023, due to a high number of fishing vessels active to the south of the Array Area. Encounter volumes are low relative to other assessments due to relatively low traffic volumes.

303. The most frequent vessel types involved in encounters within the Study Area were tankers (44%) and fishing vessels (38%).

16.3.2 Vessel to Vessel Collision Risk

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

305. 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.

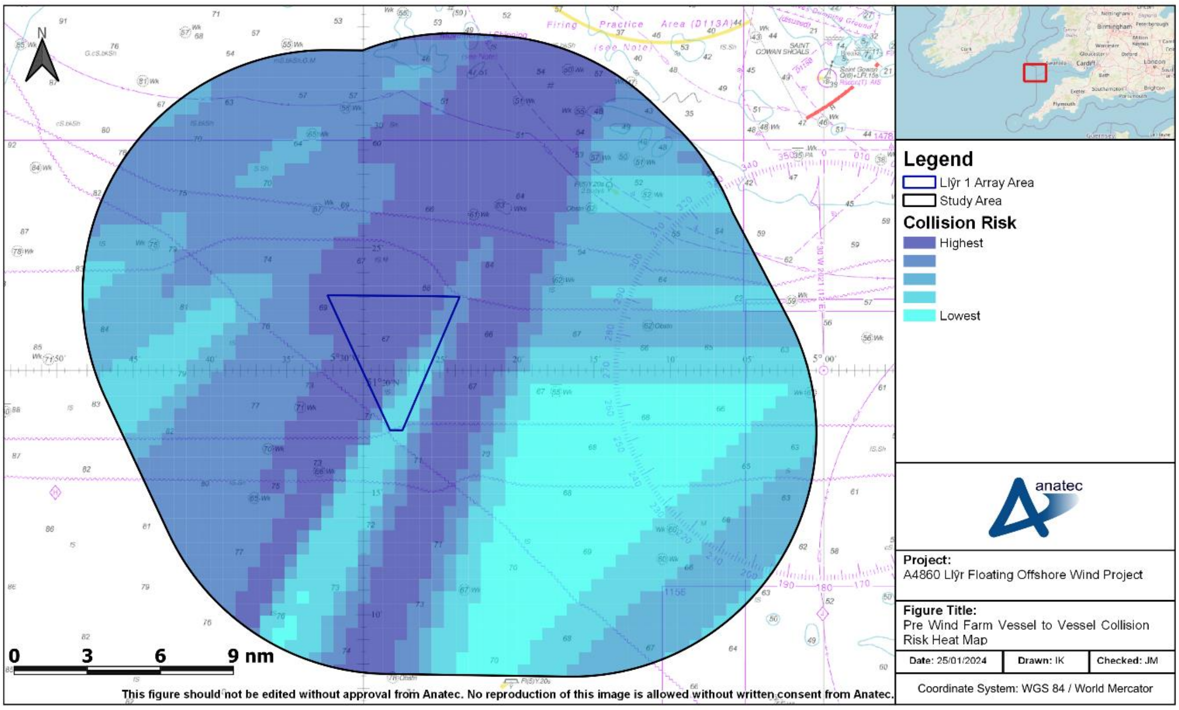

Figure 16.3 Pre Wind Farm Vessel to Vessel Collision Risk Heat Map

306. Assuming base case vessel traffic levels, the annual collision frequency pre wind farm was estimated to be 4.93×10^{-4}, corresponding to a return period of approximately one in 2,030 years. This is below the average for UK OWF developments and is reflective of the relatively low traffic volumes within the Study Area. It is noted that the model is calibrated based upon major incident data at sea which allows for benchmarking but does not cover all incidents. Other incident data, which includes minor incidents, is presented in **Section 9**.

16.4 Post Wind Farm Modelling

307. The methodology for determining the post wind farm routeing is outlined in **Section 15.4.1**.

16.4.1 Alternative Array Layout

308. An alternative layout has been used for allision modelling and is presented in Figure 16.4.

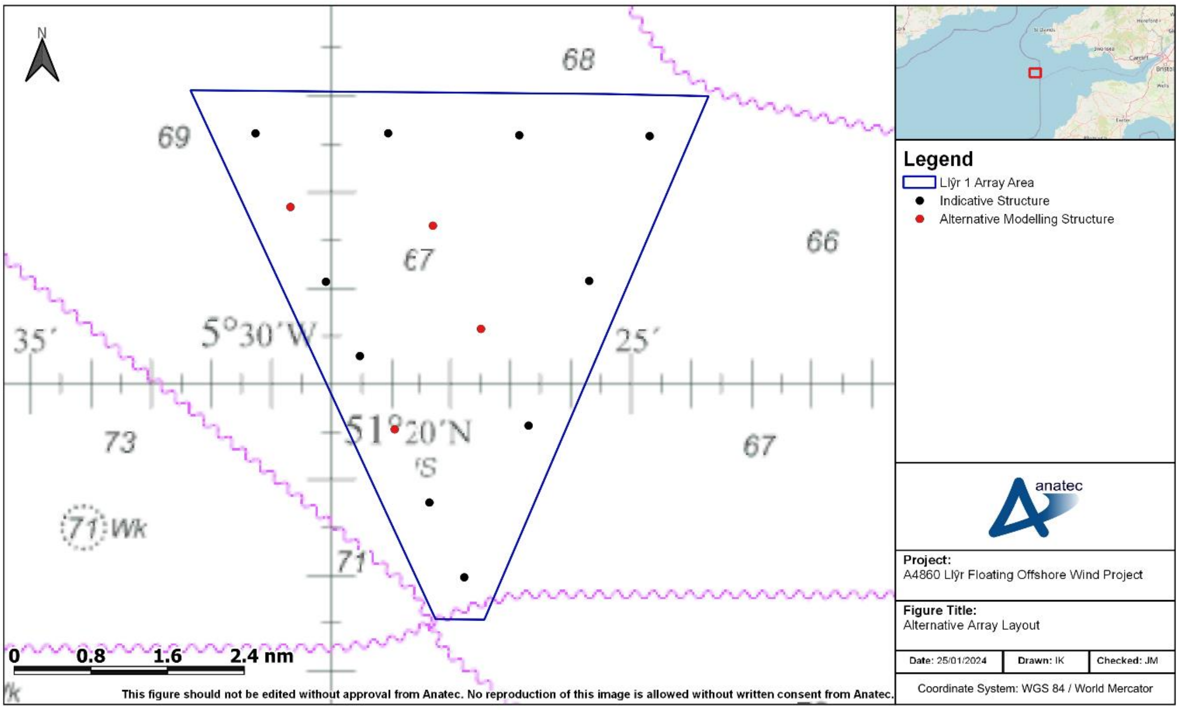

Figure 16.4 Alternative Array Layout

309. The alternative layout includes 14 surface structures, consisting of the 10 locations featured in the indicative array layout (introduced in **Section 6.2.1**) plus four additional locations. The four additional locations are categorised as follows:

- Two internal locations; and
- Two peripheral locations on the western boundary of the Array Area.

310. Given that the indicative array layout contains fewer surface structures and maintains the same northern and eastern boundaries as the alternative array layout (noting that structures on these boundaries have the greatest proximity to deviated post wind farm main commercial routes – see **Section 15.4.2**), it is considered suitable to conservatively use the results of allision risk modelling for the alternative array layout to inform the risk assessment of the indicative array layout in **Section 18.2.4**. This approach has been agreed with the MCA, Trinity House, UK Chamber of Shipping and MHPA during consultation.

16.4.2 Simulated Automatic Identification System

311. 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 Array Area. The AIS Simulator uses the mean positions of the main commercial routes identified within the Study Area and the anticipated shift post wind farm, together with the standard deviations and average number of vessels on each main commercial route to simulate tracks.

16.4.2.1 Option A

312. 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 (Option A), is presented in Figure 16.5.

313. It is noted that the simulated AIS represents a worst case scenario based on commercial routes passing at a minimum mean distance of 1 nm from the Array Area.

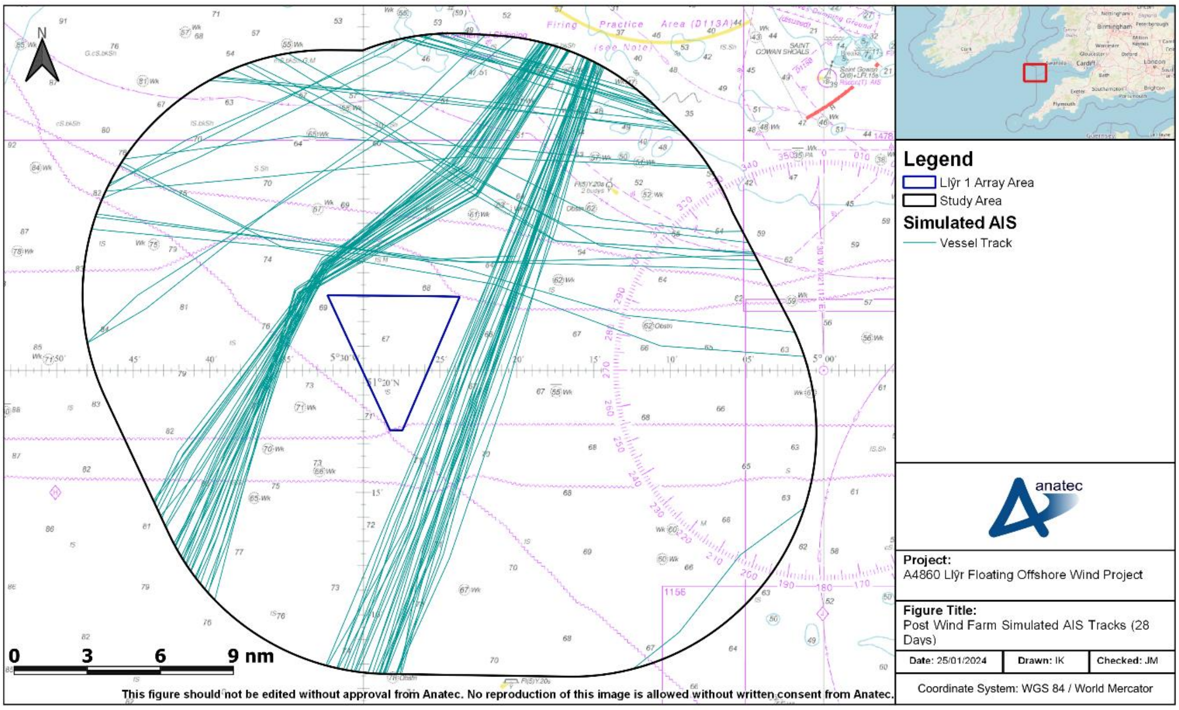

Figure 16.5 Post WF Simulated AIS Tracks (28 Days)

16.4.2.2 Option B

314. A figure of 28 days of simulated AIS within the Study Area, based on the Option B deviated main commercial routes, is presented in Figure 16.6.

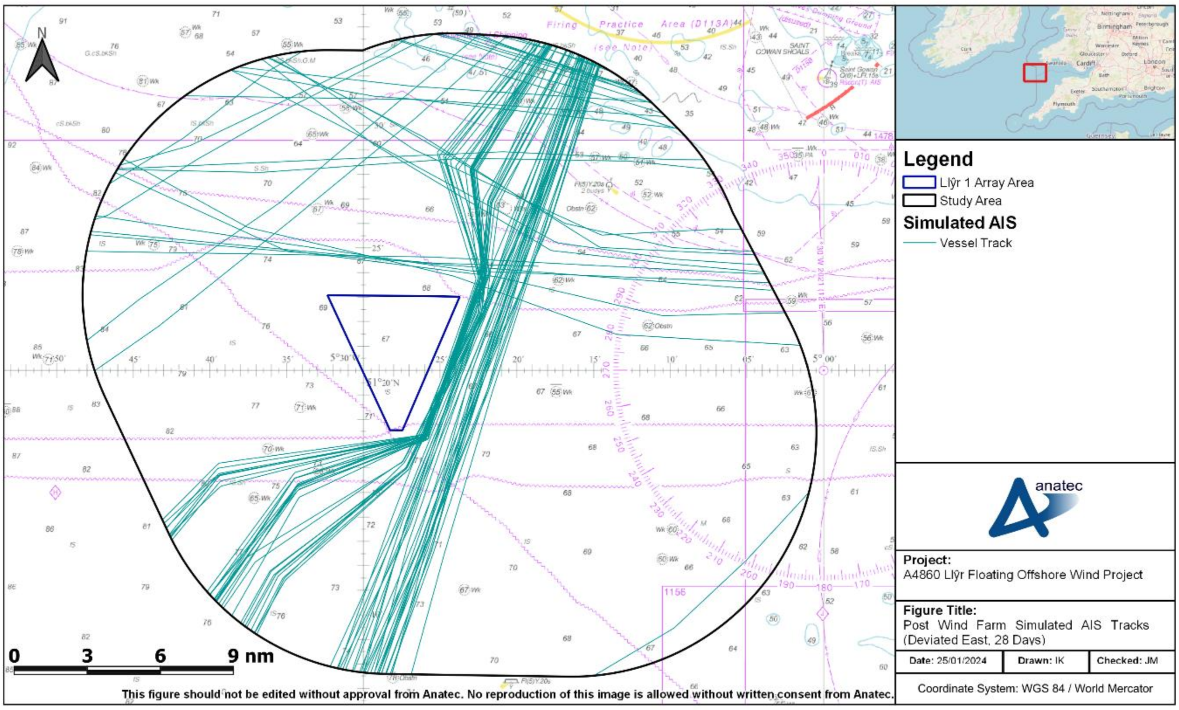

Figure 16.6 Post WF Simulated AIS Tracks (Option B, 28 Days)

16.4.3 Vessel to Vessel Collision Risk

16.4.3.1 Option A

315. Using the post wind farm routeing (Option A) as input, Anatec's COLLRISK model has been run to estimate the anticipated vessel to vessel collision risk within the Study Area.

316. 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 16.7.

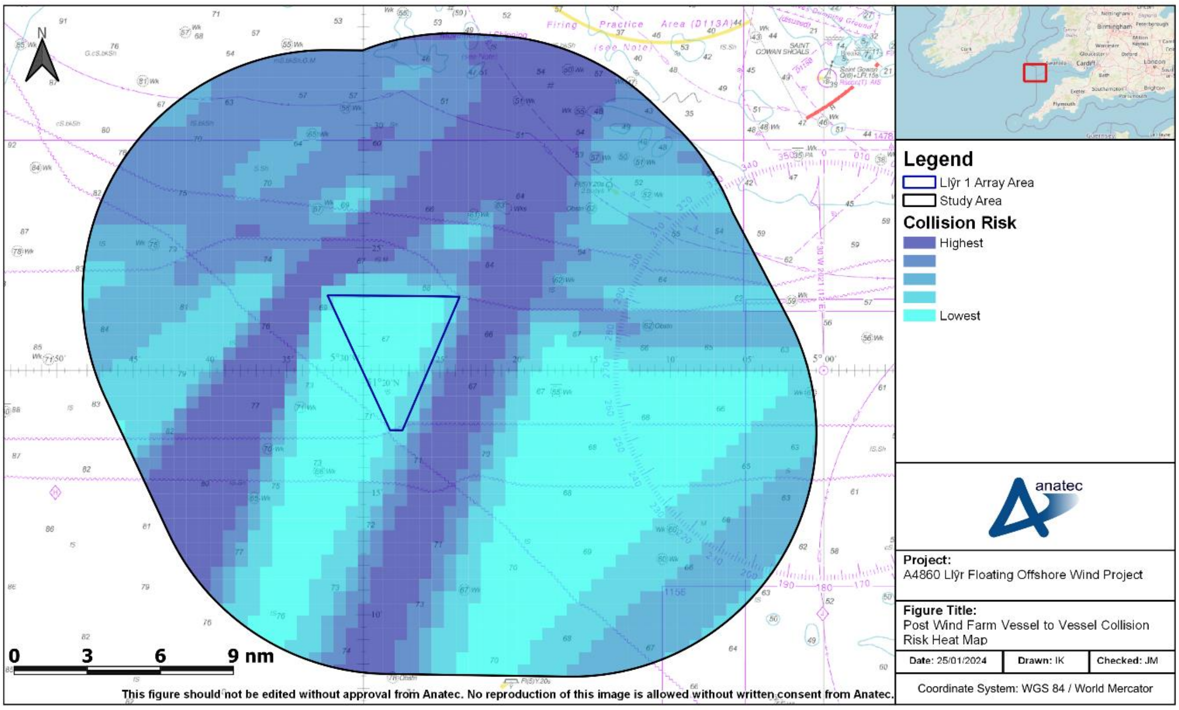

Figure 16.7 Post Wind Farm Vessel to Vessel Collision Risk Heat Map (Option A)

317. Assuming base case traffic levels, the annual collision frequency post wind farm was estimated to be 7.18×10^{-4}, corresponding to a return period of approximately one in 1,392 years. This represents a 46% increase in collision frequency compared to the pre wind farm base case result.

318. The change in vessel-to-vessel collision risk between the base case pre wind farm and post wind farm scenarios is presented in a heat map in Figure 16.8.

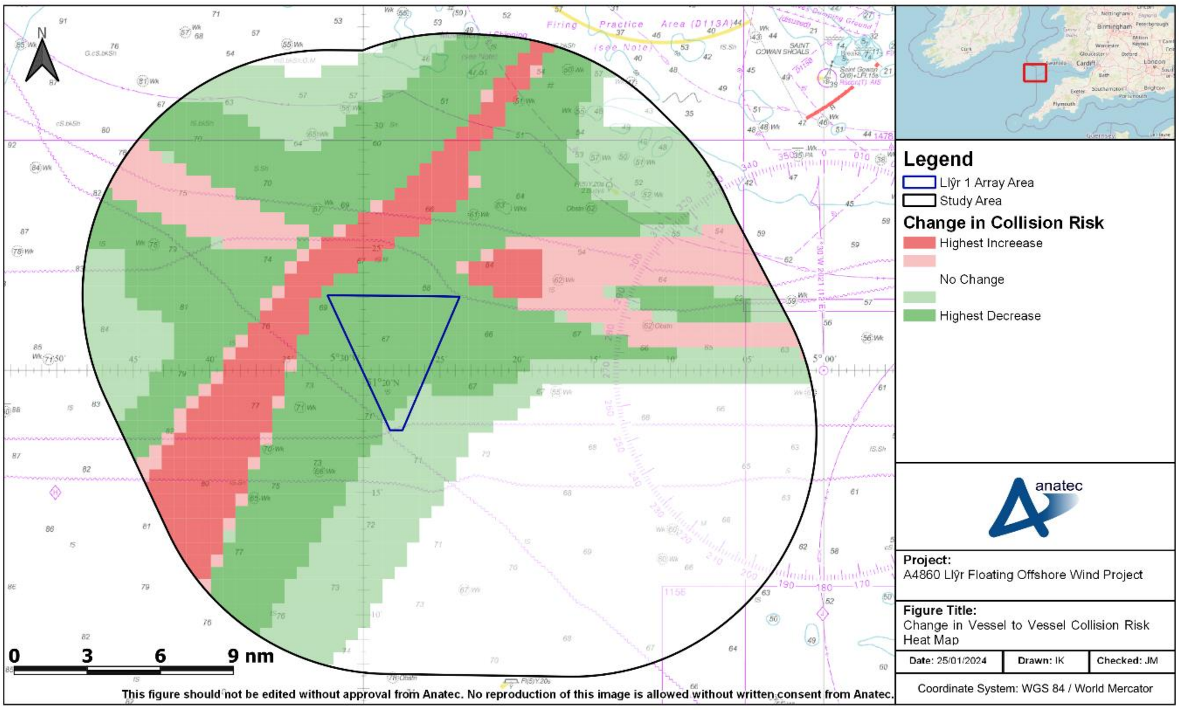

Figure 16.8 Change in Vessel to Vessel Collision Risk (Option A)

319. The greatest changes in vessel to vessel collision risk were recorded to the northwest of the Array Area where it is predicted that multiple routes will deviate, as well as to the northeast, where it is predicted that Routes 9 and 11 will cross.

16.4.3.2 Option B

320. Using the Option B post wind farm routeing as input, Anatec's COLLRISK model has again been run to estimate the anticipated vessel to vessel collision risk for this scenario within the Study Area.

321. A heat map based on the geographical distribution of collision risk for Option B within a density grid for post wind farm base case is presented in Figure 16.9.

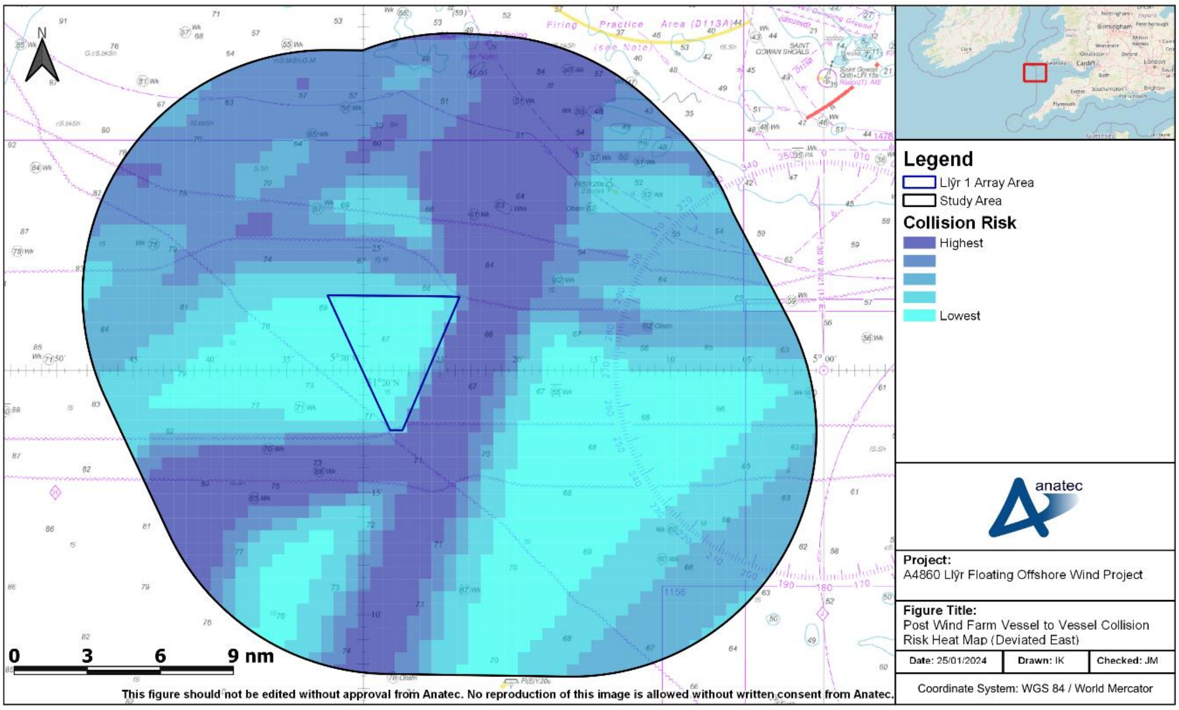

Figure 16.9 Post Wind Farm Vessel to Vessel Collision Risk Heat Map (Option B)

322. Assuming base case traffic levels, the annual collision frequency post wind farm for Option B was estimated to be 9.08×10^{-4}, corresponding to a return period of approximately one in 1,101 years. This represents an 84% increase in collision frequency compared to the pre wind farm base case result.

323. The change in vessel-to-vessel collision risk between the base case pre wind farm and Option B post wind farm scenario is presented in a heat map in Figure 16.10.

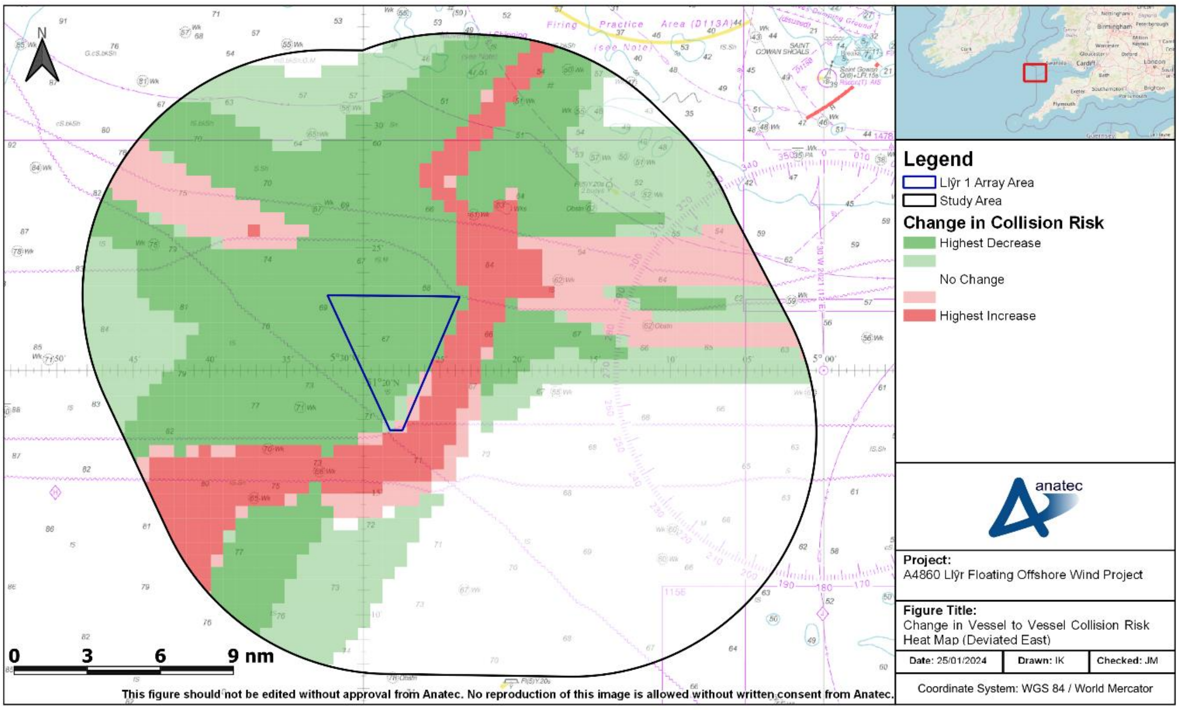

Figure 16.10 Change in Vessel to Vessel Collision Risk

324. The greatest changes in vessel to vessel collision risk for Option B are to the east of the Array Area, where the vessel routes are estimated to be deviated.

16.4.4 Powered Vessel to Structure Allision Risk

325. Based upon the vessel routeing identified in the Study Area, the anticipated re-routeing as a result of the presence of the proposed Project, and assumptions that relevant embedded mitigation measures are in place (see **Section 21**), 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 Project is considered to be low.

326. From extensive consultation with the shipping industry, it is also assumed that commercial vessels would be highly unlikely to navigate between wind farm structures due to the restricted sea room and will instead be directed by the aids to navigation located in the region and those present at the proposed Project (noting this is observed at other UK OWFs). During the construction and decommissioning phases this will primarily consist of the buoyed construction area whilst during the operation and maintenance phase this will primarily consist of the lighting and marking of the wind farm structures.

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

within the Array Area whilst under power. In order to maintain a worst case scenario, the model did not consider one structure shielding another.

328. A plot of the annual powered allision frequency per structure for the base case is presented in Figure 16.11, with the chart background removed to increase the visibility of those structures with lower allision frequencies.

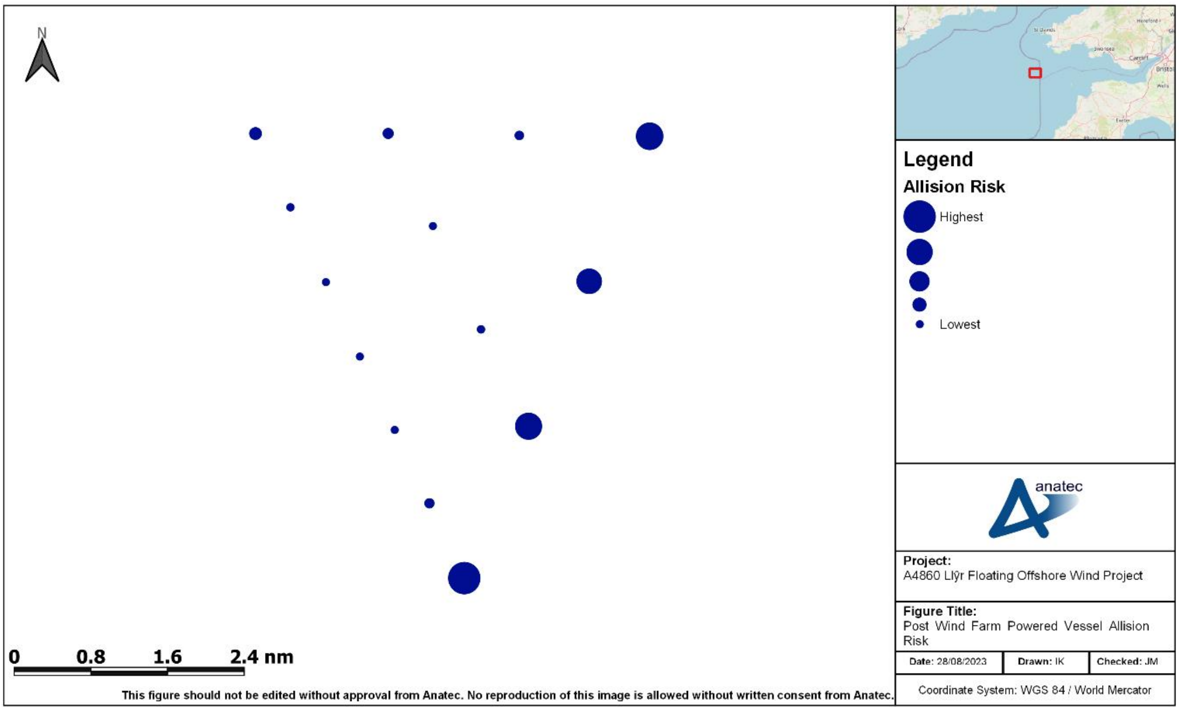

Figure 16.11 Post Wind Farm Powered Vessel Allision Risk

329. Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 2.34×10^{-4}, corresponding to a return period of approximately one in 4,277 years.

330. The greatest powered vessel to structure allision risk was associated with the easternmost WTGs where a high volume of traffic from multiple main commercial routes pass. The greatest individual allision risk was associated with the southernmost structure of the Array Area (approximately 7.78×10^{-5} or one in 12,856 years).

16.4.5 Drifting Vessel to Structure Allision Risk

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

332. The exposure times for a drifting scenario are based upon the vessel hours spent in proximity to the Array Area (up to 10 nm 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.

333. Using this information, the overall rate of mechanical failure in proximity to the Array Area 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.

334. After modelling the three drifting scenarios, it was established that the peak spring ebb 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 16.12**, with the chart background removed to increase the visibility of those structures with a low allision frequency.

335. 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.

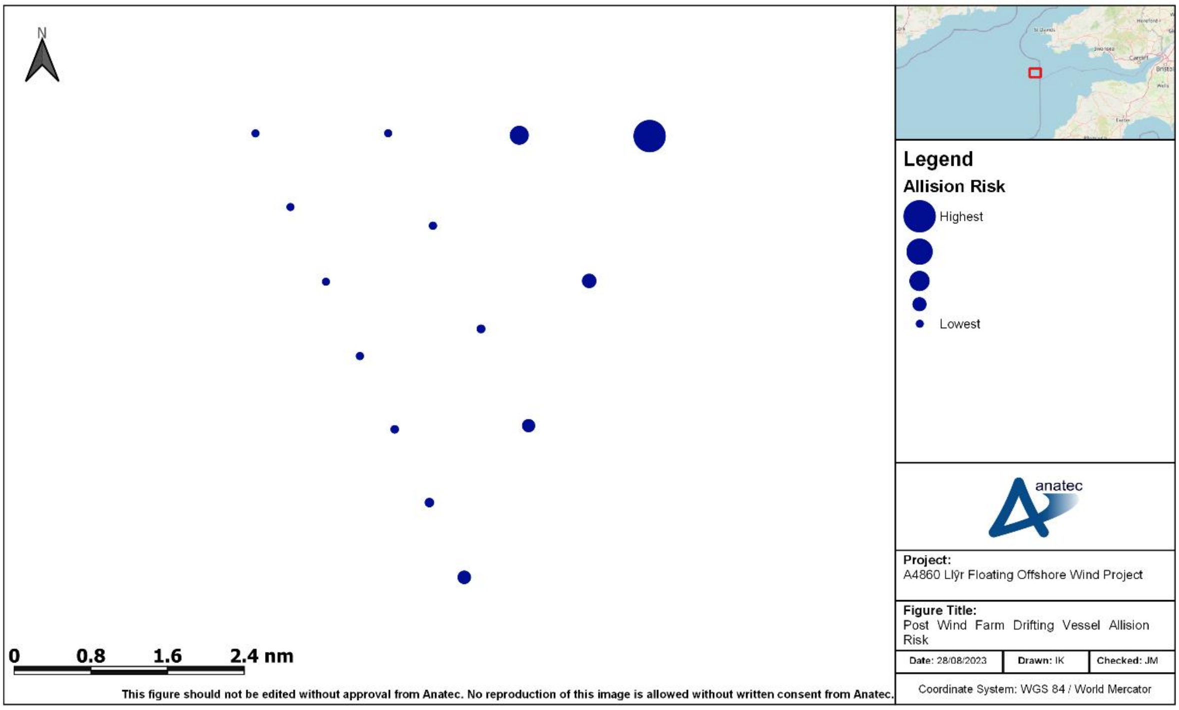

Figure 16.12 Post WF Drifting Vessel Allision Risk per Structure

336. Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 4.79×10^{-5}, corresponding to a return period of approximately one in 20,875 years.

337. The greatest drifting vessel to structure allision risk was associated with structures at the northeastern extent of the Array Area where a high volume of traffic from multiple main commercial routes pass. The greatest individual allision risk was associated with the most northeastern structure of the Array Area (approximately 3.20×10^{-5} or one in 31,245 years).

338. 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).

16.4.6 Fishing Vessel to Structure Allision Risk

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

340. A fishing vessel allision is classified separately from other allisions since fishing vessels may be located internally within the Array Area (unlike the transiting commercial traffic characterised by the main commercial routes). 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 OWF 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.

341. The model 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. This is a highly conservative assumption noting that from consultation undertaken for commercial fisheries, active fishing is not expected to resume following installation of the proposed Project.

342. A plot of the annual fishing vessel allision frequency per structure for the base case is presented in **Figure 16.13**.

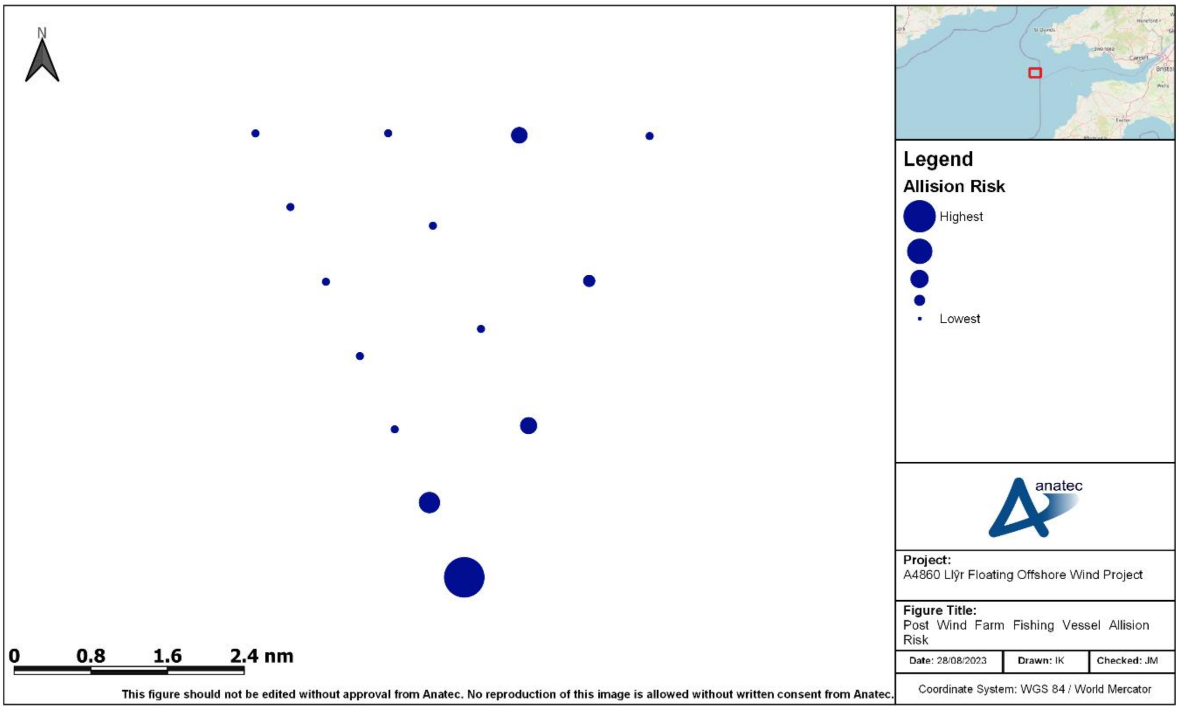

Figure 16.13 Post Wind Farm Fishing Vessel Allision Risk

343. Assuming base case traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 5.96×10^{-2}, corresponding to a return period of approximately one in 16.8 years.

344. The fishing vessel to structure allision risk was highest primarily in the south of the Array Area, reflecting the distribution of fishing vessels recorded in the vicinity of this location. The greatest individual allision risk was associated with the southernmost WTG (approximately $4.15\text{x}10^{-2}$ or one in 24 years).

345. The model is calibrated against known allision incidents within UK OWFs (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 Risk Results Summary

346. The previous sections modelled scenarios encapsulating two deviation options for commercial routeing and both pre and post wind farm cases. Throughout, base case traffic levels were assumed. In order to incorporate the potential for future traffic growth, the various scenarios have also been modelled for future case traffic levels (both 10% and 20% increases). **Table 16.1** summarises the results.

Table 16.1 Summary of Annual Collision and Allision Risk Results

Risk	Routeing Scenario	Traffic Level Scenario	Annual Frequency (Return Period)		
			Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Option A – tankers deviating west of the Array Area	Base case	4.93×10^{-4} (1 in 2,030 years)	7.18×10^{-4} (1 in 1,392 years)	2.25×10^{-4} (1 in 4,444 years)
		Future case (10%)	5.92×10^{-4} (1 in 1,690 years)	8.65×10^{-4} (1 in 1,156 years)	2.73×10^{-4} (1 in 3,663 years)
		Future case (20%)	7.04×10^{-4} (1 in 1,420 years)	1.03×10^{-3} (1 in 971 years)	3.26×10^{-4} (1 in 3,067 years)
	Option B – tankers deviating east of the Array Area	Base case	4.93×10^{-4} (1 in 2,030 years)	9.08×10^{-4} (1 in 1,101 years)	4.15×10^{-4} (1 in 2,409 years)
		Future case (10%)	5.92×10^{-4} (1 in 1,690 years)	1.09×10^{-3} (1 in 913 years)	4.98×10^{-4} (1 in 2,008 years)
		Future case (20%)	7.04×10^{-4} (1 in 1,420 years)	1.30×10^{-3} (1 in 767 years)	5.96×10^{-4} (1 in 1,678 years)
Powered vessel to structure allision	Option A – tankers deviating west of the Array Area	Base case	-	2.34×10^{-4} (1 in 4,277 years)	2.34×10^{-4} (1 in 4,277 years)
		Future case (10%)	-	2.58×10^{-4} (1 in 3,873 years)	2.58×10^{-4} (1 in 3,873 years)
		Future case (20%)	-	2.80×10^{-4} (1 in 3,573 years)	2.80×10^{-4} (1 in 3,573 years)
Drifting vessel to structure allision	Option A – tankers deviating west of the Array Area	Base case	-	4.79×10^{-5} (1 in 20,875 years)	4.79×10^{-5} (1 in 20,875 years)
		Future case (10%)	-	5.27×10^{-5} (1 in 18,968 years)	5.27×10^{-5} (1 in 18,968 years)

Risk	Routeing Scenario	Traffic Level Scenario	Annual Frequency (Return Period)		
			Pre Wind Farm	Post Wind Farm	Change
		Future case (20%)	-	5.74×10^{-5} (1 in 17,414 years)	5.74×10^{-5} (1 in 17,414 years)
Fishing vessel to structure allision	N/A	Base case	-	5.96×10^{-2} (1 in 16.8 years)	5.96×10^{-2} (1 in 16.8 years)
		Future case (10%)	-	6.56×10^{-2} (1 in 15.2 years)	6.56×10^{-2} (1 in 15.2 years)
		Future case (20%)	-	7.15×10^{-2} (1 in 14.0 years)	7.15×10^{-2} (1 in 14.0 years)
Total	Option A – tankers deviating west of the Array Area	**Base case**	**4.93×10^{-4} (1 in 2,030 years)**	**6.06×10^{-2} (1 in 16.5 years)**	**6.01×10^{-2} (1 in 16.6 years)**
		Future case (10%)	**5.92×10^{-4} (1 in 1,690 years)**	**6.68×10^{-2} (1 in 15.0 years)**	**6.62×10^{-2} (1 in 15.1 years)**
		Future case (20%)	**7.04×10^{-4} (1 in 1,420 years)**	**7.29×10^{-2} (1 in 13.7 years)**	**7.22×10^{-2} (1 in 13.9 years)**

16.6 Mooring Lines and Buoyant Inter-Array Cables

347. This section considers the mooring lines and buoyant inter-array cables associated with the floating infrastructure relative to baseline traffic volumes and draughts to determine potential risk associated with under keel interaction. The outputs have been fed into the qualitative risk assessment of under keel interaction undertaken in **Section 18.2.7**.

348. Based on operational experience of existing OWFs and consultation undertaken for the proposed Project, it is likely that commercial vessels will deviate to avoid the Array Area. On this basis, considering the vessel types recorded within the Array Area (see **Section** Error! Reference source not found.), the key vessel type that must be considered is fishing. It is noted that recreational vessels were not recorded regularly within the Array Area in the vessel traffic data (generally located east of the Array Area). The focus of this assessment on fishing vessels is considered appropriate on the basis that they will also typically have larger draughts than recreational vessels, and based on the available information and consultation are more prevalent than other vessel types in the area.

16.6.1 Vessel Draught

349. The distribution of fishing vessel draughts recorded within the Array Area during the 28 days of vessel AIS (see **10.1.2.2**) is presented in **Figure 16.14.**

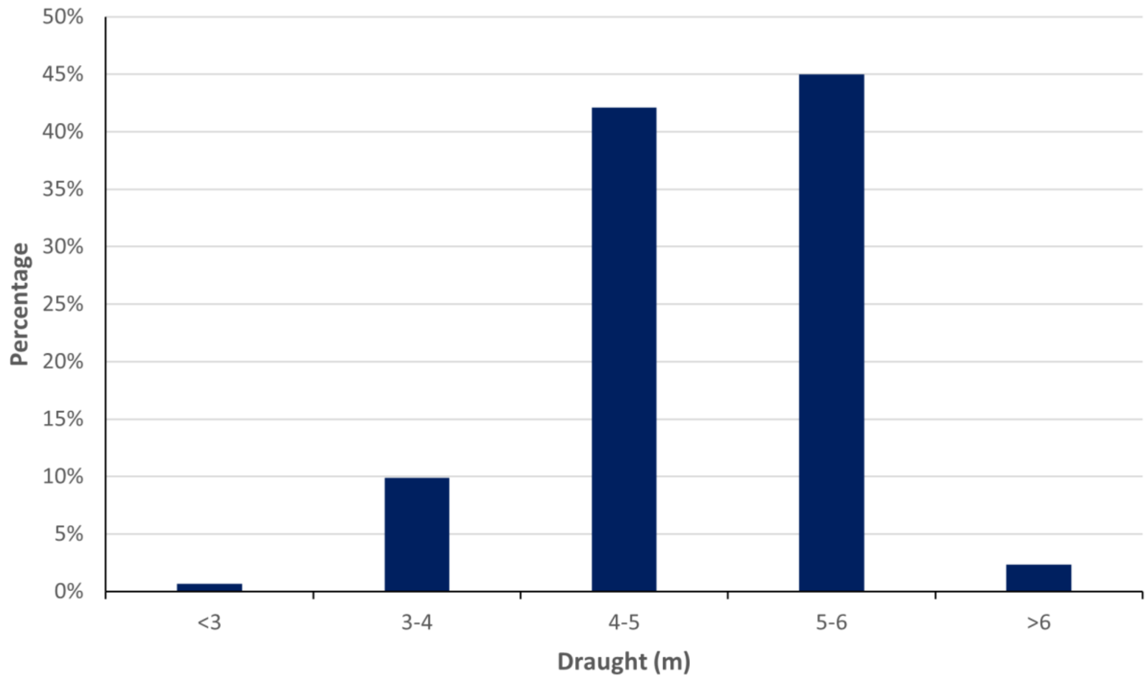

Figure 16.14 Draught Distribution of Fishing Vessels

350. The maximum draught recorded was 7.4 m, with the average being approximately 4.7 m. As shown, the significant majority of fishing vessels within the Study Area had draughts of between 4 and 6 m.

16.6.2 Mooring Line Interaction

351. Based on the substructure types and mooring line arrangements under consideration, the use of barges is considered a worst case from a mooring line perspective. If barge substructures are used, the maximum connection point height for the mooring lines is 15 m above the waterline.

352. On this basis, the approximate descents of the mooring lines in the vicinity of the substructures is shown in **Figure 16.15**. The average and maximum fishing vessel draughts recorded in the Array Area are shown for reference (see **Section 16.6.1**). It is noted that the values detailed above have been assumed for the purposes of this interaction assessment and that it will be necessary to assess final under keel clearance available post installation. This is discussed further in **Sections 18.2.7** and **18.2.8** noting the variations that could occur based on the use of taut or semi-taut mooring lines.

353. The assessment has been undertaken up to 1,100 m from the WTGs, noting that this is the maximum distance of the mooring line terminus from a WTG.

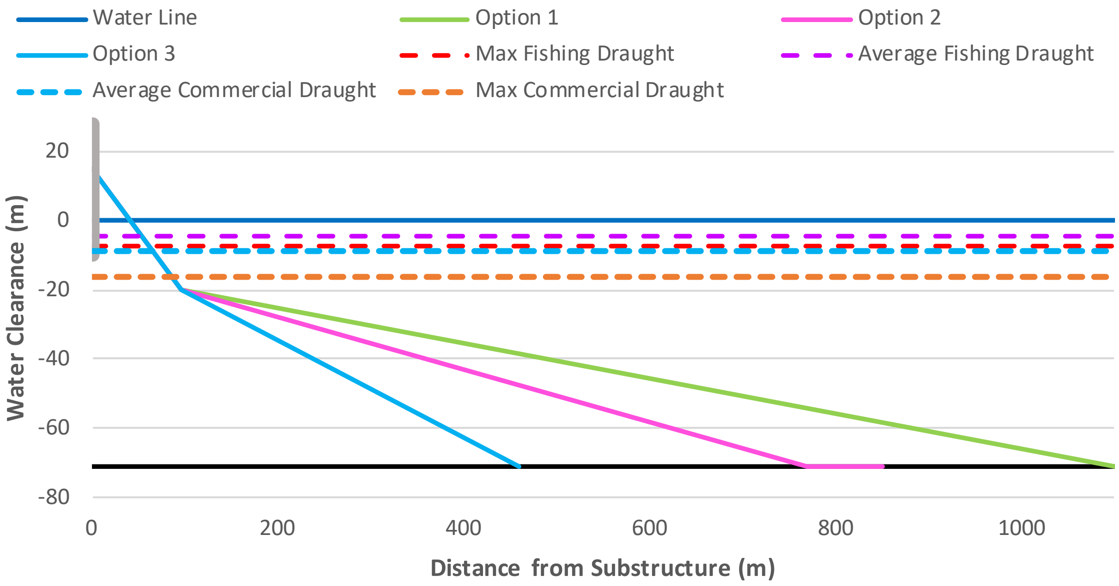

Figure 16.15 Mooring Lines Relative to Maximum Vessel Draught

354. As shown, a fishing vessel with the maximum draught recorded (7.4m) should avoid an under keel interaction beyond approximately 61 m from a floating structure. A fishing vessel of average draught (4.5 m) would achieve this beyond 53 m from a floating structure.

355. For completeness, a commercial vessel with the largest draught recorded (16.4 m) should avoid an under keel interaction beyond approximately 86 m from a floating structure.

356. A summary of the available clearance between the mooring lines and the waterline at 200 m intervals from the mooring line options is provided in **Table 16.2**.

Table 16.2 Mooring Line Clearance Summary

Distance from Floating Structure (m)	Clearance below Mooring Line and Waterline (m)		
	Option 1	Option 2	Option 3
0	+15	+15	+15
200	-25	-28	-35
400	-35	-43	-63
600	-46	-58	N/A
800	-56	N/A	N/A
1000	-66	N/A	N/A

16.6.3 Buoyant Inter-Array Cable Interaction

357. As per **Table 6.3**, the buoyancy aid associated with buoyant inter-array cables will be located between 25 and 55 m below the waterline. Considered against the vessel draught data broken down in **Section 16.6.2**, an under keel interaction between a vessel and buoyant inter-array cable is considered highly unlikely.

16.6.4 Approach to Risk Assessment

358. The potential for interaction with the mooring lines has been assessed within the risk assessment in **Sections 18.2.7** and **18.2.8**. The potential that the mooring system will fail leading to a loss of station incident is assessed in **Section 18.2.6**. It is noted that the relevant hazards have been assessed for the operational phase noting the risk is managed via construction and decommissioning mitigations during those phases.

17 Collision and Allision Risk Modelling (Cumulative)

17.1 Simulated Automatic Identification System

359. A figure of 28 days of simulated AIS within the Study Area, based on the cumulative deviated main commercial routes, is presented in **Figure 17.1**.

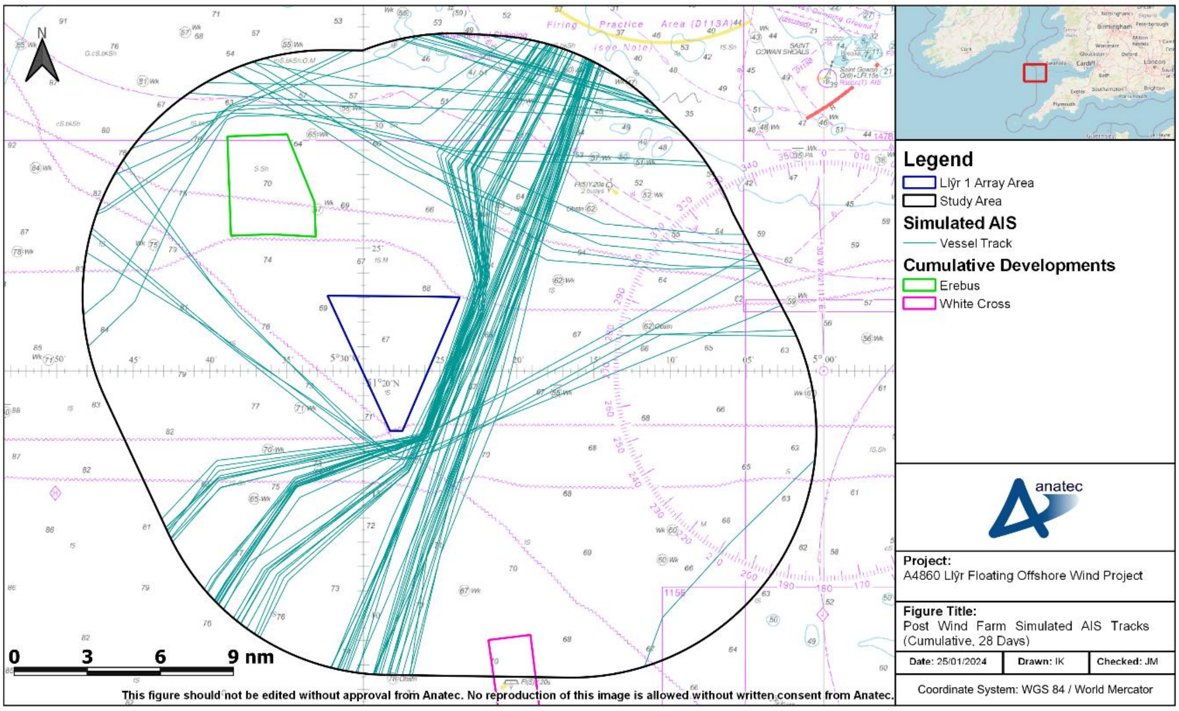

Figure 17.1 Post WF Simulated AIS Tracks (Cumulative, 28 Days)

17.2 Vessel to Vessel Collision Risk

360. Using the deviated post wind farm routeing due to cumulative developments as input, Anatec's COLLRISK model has been run to estimate the existing vessel to vessel collision risk within the Study Area. The route positions and widths are based on the vessel traffic survey data.

361. A heat map based upon the geographical distribution of collision risk within a density grid for the cumulative post wind farm base case is presented in **Figure 17.2**.

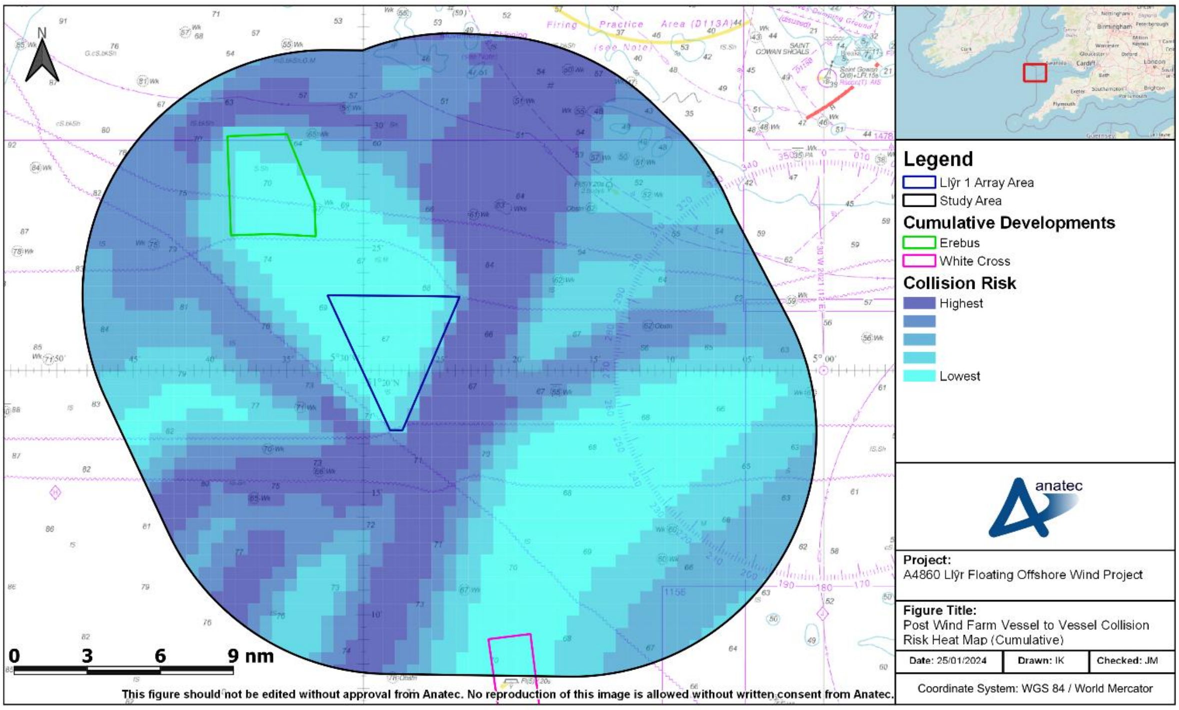

Figure 17.2 Post Wind Farm Vessel to Vessel Collision Risk Heat Map (Cumulative)

362. Assuming base case traffic levels, the annual collision frequency post wind farm was estimated to be 9.28×10^{-4}, corresponding to a return period of approximately one in 1,077 years. This represents an 88% increase in collision frequency compared to the pre wind farm base case result.

363. The annual collision frequency risk rose to a return period of one in 895 years and one in 751 years for the 10% and 20% traffic increase scenarios respectively.

364. The change in vessel-to-vessel collision risk between the base case pre wind farm and cumulative post wind farm scenarios is presented in a heat map in **Figure 17.3**.

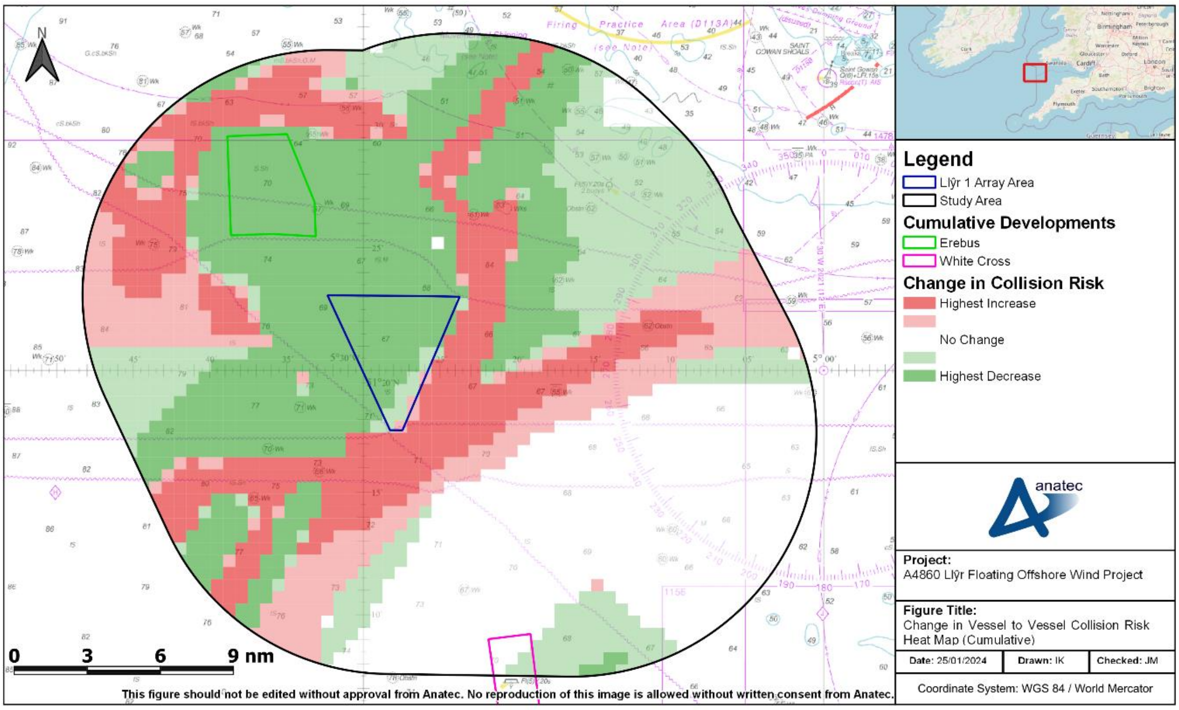

Figure 17.3 Change in Vessel to Vessel Collision Risk (Cumulative)

365. The greatest changes in vessel to vessel collision risk were recorded to immediately the east of the Array Area and to the west of Erebus, where the majority of routes will likely deviate.

18 In Isolation Risk Assessment

366. This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the proposed Project in isolation, 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;
- Increased third-party vessel collision risk;
- Third-party with project vessel collision risk;
- Creation of vessel to structure allision risk;
- Reduced access to local ports and harbours;
- Loss of station;
- Reduction in under keel clearance due to mooring lines, buoyant inter-array cables, or cable protection;
- Anchor interaction with mooring lines or subsea cables; and
- Reduction of emergency response capability including SAR.

367. For each hazard, embedded mitigation measures which have been identified as relevant to reducing risk are listed, with full descriptions provided in **Section 21**. 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**.

368. The risk control log (see **Section 20**) summarises the risk assessment and a concluding risk statement is provided (see **Section 23.4**).

18.1 Construction Phase

18.1.1 Vessel Displacement

369. *Construction activities associated with the installation of structures and cables may displace existing routes/activity.*

18.1.1.1 Commercial Vessels Routeing

370. The volume of vessel traffic passing within or in proximity to the Array Area has been established using vessel traffic data collected during dedicated surveys (28 days over winter 2022 and summer 2023) and from coastal receivers (12 months, 2022) as well as Anatec's ShipRoutes database. These datasets were interrogated to identify main routes using the principles set out in MGN 654 (MCA, 2021) (see **Section 11**).

371. 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 internally within the buoyed construction area and therefore some main route deviations will be required.

372. The full methodology for main route deviations is provided in **Section 15.4**, with deviations established in line with MGN 654 (MCA, 2021). A deviation will be required for four of the 14 main commercial routes identified. For tanker routeing to/from Milford Haven, the size of the deviations will depend on whether such routes pass east or west of the Array Area.

373. For the option of passing west of the Array Area, the largest deviation is anticipated to be 1.78 nm, associated with Route 6 (northbound to Milford Haven and used by an average of two to three vessels per week). This increase equates to a 1.48% increase in route length for the portion of the route from the TSS West of the Scilly Isles.

374. For the option of passing east of the Array Area, the largest deviation is anticipated to be 5.74 nm, associated with Route 2 (between Milford Haven and Mediterranean ports and used by an average of three vessels per week). This increase equates to a 0.46% increase in total route length.

375. Vessel displacement was not raised as a key concern during the Hazard Workshop. However, as described by Trinity House, the nature of the Milford Haven Waterway results in tidal restrictions for large vessels, with disruptions to scheduled passage possible. Given the size of the anticipated deviations, particularly when considered relative to the length of routes as a whole, it is not expected that the presence of the proposed Project will prevent vessels from making current tidal windows. Furthermore, MHPA noted that the potential for two distinct tanker routeing options (east and west of the Array Area) may deconflict tidal constraints. It is also recognised that there is no regular routeing involving RoRo or RoPax vessels in the area, which would be particularly sensitive to any disruption to schedules, including in relation to tides.

376. Given the location of the OfECC, it is considered likely that cable installation will lead to displacement, and this was raised as a concern for Irish Ferries-operated routes to / from Pembroke. However, installation activities will be short-term and temporary in nature and cover only a small extent. Therefore, deviations will be manageable. Moreover, MHPA have indicated that installation activities associated with the OfECC could be managed through the Milford Haven VTS, further limiting potential disruption.

18.1.1.2 Commercial Vessels Awaiting Orders

377. Commercial vessels, and in particular tankers, are noted as awaiting orders prior to entering Milford Haven. The majority of this activity occurs between 5 and 10 nm north of the Array Area and is therefore not expected to be materially impacted by construction activities. Where there is currently interaction, there is considered to

be suitable sea room (and water depths) for this to be displaced, noting that the entrance to the Milford Haven Waterway is some 20 nm northeast of the Array Area.

18.1.1.3 Fishing Vessels and Recreational Vessels

378. Based on experience at previously under construction OWFs, it is anticipated that fishing vessels and recreational vessels will also choose not to routinely navigate internally within the buoyed construction area. There is limited transit activity featuring fishing vessels in proximity to the Array Area (noting that displacement of active commercial fishing activity is assessed separately in **Volume 3 Chapter 26: Commercial Fisheries**). For recreational vessels, the majority of transit activity occurs east of the Array Area between Milford Haven and Padstow or the ITZ off Land's End. Therefore displacement will be limited and there is sufficient sea room east of the Array Area to accommodate any affected recreational vessels.

379. In the case of installation activities associated with the OfECC, fishing vessels transits in / out of Milford Haven in the majority occur clear of the OfECC, and so limited displacement is anticipated. For recreational vessels, there are frequent crossings of the OfECC in the summer, and therefore some potential for displacement around installation activities. However, there is sufficient sea room available for this (east and west) and so disruption will be limited.

18.1.1.4 Consequences

380. The main consequence of vessel displacement associated with the Array Area and OfECC will be increased journey times and distances for affected third-party vessels. The extent of these consequences is expected to be limited, noting that the promulgation of information relating to the proposed Project and marking on relevant nautical charts will allow suitable passage planning and the presence of the buoyed construction area and guard vessels will assist with guiding vessels around the Array Area. No notable effects on navigational safety are anticipated.

18.1.1.5 Embedded Mitigation Measures

381. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Buoyed construction area;
- Charting of infrastructure;
- Guard vessel(s);
- Promulgation of information; and
- Traffic monitoring.

18.1.1.6 Frequency of Occurrence

382. The frequency of occurrence in relation to displacement of vessel traffic is considered **frequent**.

18.1.1.7 Severity of Consequence

383. The severity of consequence in relation to displacement of vessel traffic is considered **negligible** in terms of navigational safety.

18.1.1.8 Significance of Risk

384. Overall, it is predicted that the significance of risk due to vessel displacement is **Tolerable with Mitigation**.

18.1.2 Increased Third-Party to Third-Party Vessel Collision Risk

385. *Construction activities associated with the installation of structures and cables may increase encounters and collision risk with other third-party vessels.*

18.1.2.1 Commercial Vessels

386. It is anticipated that four of the 14 main commercial routes identified will deviate as a result of the construction of the proposed Project. This may lead to increased vessel densities within the area, which could in turn lead to an increase in vessel to vessel encounters and therefore increased collision risk. This was a key discussion point in the Hazard Workshop.

387. Based on the 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 2,030 years. The low level of collision risk is due to the volume of traffic in the area relative to the available sea space.

388. For the option of passing west of the Array Area, the collision frequency was estimated at one in 1,392 years, representing a 46% increase on the pre OWF scenario. Although this is a high increase, the likelihood of a collision incident remains low and this is also reflected when considering future case traffic levels.

389. For the option of passing east of the Array Area, the collision frequency was estimated at one in 1,101 years, representing an 84% increase on the pre OWF scenario. Again, this is a high increase but with the likelihood of a collision incident remaining low.

390. For both options, there is a potential for the creation of hotspots where traffic to/from Milford Haven crosses east-west traffic in/out of the Bristol Channel, as noted by the UK Chamber of Shipping. However, the collision risk modelling indicates such hotspots would be minimal due to the relatively low volumes of traffic present on the relevant routes. It is also noted that routeing in/out of the Bristol Channel is spread over a wide area; four east-west main commercial routes were identified in / out of the Bristol Channel spanning at least 10 nm). Again, with multiple options taken and no single clear option utilised. This further reduces collision densities which could form hotspots where crossing occurs.

391. For the option of passing east of the Array Area, the point at which the various tanker routes to/from Milford Haven meet may constitute a hotspot. At the Hazard Workshop it was felt that this point would likely be directly south of the Array Area rather than any closer to Milford Haven – this is relatively open sea area and accounting for traffic volumes the likelihood of an unacceptable level of risk is low.

392. For the OfECC, any displacement due to installation activities is not anticipated to affect available sea room such that the risk of a collision between third-party vessels is materially increased.

18.1.2.2 Fishing Vessels and Recreational Vessels

393. For fishing vessels and recreational vessels, there remains sufficient open sea room around the Array Area and OfECC installation activities to ensure that collision risk (including with a commercial vessel) is minimal. Additionally, the promulgation of information relating to construction activities, deployment of the buoyed construction area, and charting of infrastructure will allow vessel Masters (across all vessel types) to passage plan in advance, minimising any displacement and subsequent collision risk. Additionally, information for fishing vessels will be promulgated through ongoing liaison with fishing fleets, and fisheries associations via an appointed Fisheries Liaison Officer (FLO).

18.1.2.3 Consequences

394. In the event that a third party to third party vessel encounter does occur, it is likely to be localised and occur for only a short duration, with collision avoidance action implemented by the vessels involved, in line with the COLREGs, thus ensuring that the situation does not develop into a collision incident. This is supported by experience at previous under construction OWFs, where no collision incidents involving two third-party vessels have been reported. Mitigation measures will also minimise the likelihood of encounters including promulgation of information relating to the proposed Project, marking on relevant nautical charts to allow suitable passage planning and the presence of the buoyed construction area and guard vessels which will assist with guiding vessels around the Array Area.

395. Historical collision incident data (see **Section 9.6**) also indicates that the most likely consequences will be low should a collision occur, with minor contact between the vessels resulting in minor damage and no injuries to persons, with both vessels able to resume their respective passages and undertake a full inspection at the next port. As an unlikely worst case scenario, one or more of the vessels could be foundered resulting in a Potential Loss of Life (PLL) and pollution. In such circumstances, project vessels may attend the incident under International Convention for the Safety of Life at Sea (SOLAS) obligations and in liaison with the MCA and the Marine Pollution Contingency Plan (MPCP) would be implemented.

18.1.2.4 Embedded Mitigation Measures

396. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Buoyed construction area;
- Charting of infrastructure;
- Fisheries liaison;
- Guard vessel(s);
- Marine coordination for project vessels;
- Pollution planning;
- Project vessel compliance with international marine regulations;
- Promulgation of information; and
- Traffic monitoring.

18.1.2.5 Frequency of Occurrence

397. The frequency of occurrence in relation to encounters and collision risk is considered **extremely unlikely**.

18.1.2.6 Severity of Consequence

398. The severity of consequence in relation to encounters and collision risk is considered **serious**.

18.1.2.7 Significance of Risk

399. Overall, it is predicted that the significance of risk due to increased vessel to vessel collision risk is **Tolerable with Mitigation**.

18.1.3 Third-Party to Project Vessel Collision Risk

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

401. Up to 17 project vessels may be on site simultaneously during the construction phase. This will include Restricted in Ability to Manoeuvre (RAM) vessels. It is assumed that construction vessels will be on-site throughout the duration of the construction phase.

402. 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 incident, occurring in 2011, moderate vessel damage was reported with no harm to persons. Since then, awareness of offshore wind developments and the application of the mitigation measures outlined below has improved or been refined considerably in the interim, with no further collision incidents reported since.

403. Project vessels will be managed by marine coordination including with MHPA whose VTS area overlaps the OfECC. This will be particularly important for project vessels transiting to and from the Array Area, noting that the base port(s) for construction are not yet known. It is also noted that project vessels will carry AIS and comply with Flag State regulations including the COLREGs and SOLAS.

404. Where project vessels are undertaking construction activities associated with surface structures, safety zones are anticipated. An application for safety zones of 500 m will be sought during the construction phase around structures where construction activity is ongoing (e.g. where a construction vessel is present). These will serve to protect project vessels engaged in construction activities. Minimum advisory passing distances, as defined by risk assessment, may also be applied where safety zones do not apply (e.g., around cable installation vessels).

405. The promulgation of information will ensure mariner awareness of construction activities is maximised, including charting of infrastructure, ongoing liaison with fisheries via an appointed FLO, and advanced warning of safety zones and any minimum advisory safe passing distances, with the latter particularly relevant for OfECC installation activities since safety zones are not permitted. Additionally, appropriate marine lighting and marking during construction including the buoyed construction area will be agreed with Trinity House. These navigational aids will further maximise mariner awareness when in proximity to ongoing construction works in the Array Area.

406. Third-party vessels may experience restrictions on visually identifying project vessels entering and exiting the Array Area during reduced visibility, increasing collision risk; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and use of AIS by project vessels.

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

408. Should a collision occur, the consequences are expected to be similar to that outlined for the case of a collision between two third-party vessels (see **Section 18.1.2**), with a worst-case scenario of foundering, PLL, and pollution. In such circumstances, other project vessels may attend the incident under SOLAS obligations and in liaison with the MCA and the MPCP would be implemented.

18.1.3.1 Embedded Mitigation Measures

409. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Application for safety zones;
- Buoyed construction area;

- Charting of infrastructure;
- Fisheries liaison;
- Guard vessel(s);
- Lighting and marking;
- Marine coordination for project vessels;
- Pollution planning;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

18.1.3.2 Frequency of Occurrence

410. The frequency of occurrence in relation to third-party to project vessel collision risk is considered to be **extremely unlikely**.

18.1.3.3 Severity of Consequence

411. The severity of consequence in relation to third-party to project vessel collision risk is considered to be **serious**.

18.1.3.4 Significance of Risk

412. Overall, it is predicted that the significance of risk due to third-party to project vessel collision risk is **Tolerable with Mitigation**.

18.1.4 Reduced Access to Local Ports and Harbours

413. *Construction activities associated with the installation of structures and cables may reduce access to local ports and harbours.*

414. Up to 38 construction vessels may be utilised across the construction phase and will include vessels which are RAM. Project vessels will be managed by marine coordination including with MHPA whose VTS area overlaps the OfECC.

415. The closest port or harbour to the proposed Project is Milford Haven, located approximately 21 nm to the northeast of the Array Area. There are also various ports and harbours located within the Bristol Channel. 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 due to Array Area construction activities on vessel approaches to and from the local ports beyond the deviations already outlined for impacts on vessel displacement (see **Section 18.1.1**).

416. For OfECC construction activities, there is a greater risk given the proximity to the entrance to the Milford Haven Waterway. Where cable installation is ongoing vessel displacement is possible; however, the shift of the OfECC further east in response to consultation feedback ensures that vessels accessing Milford Haven will not be required to navigate in shallower water than normal and are unlikely to have difficulty berthing on their preferred tidal window.

417. Installation activities will be short-term (export cable installation is anticipated to take up to 100 days) and temporary in nature and cover only a small extent. Moreover, MHPA have indicated that installation activities associated with the OfECC could be managed through the Milford Haven VTS, further limiting access constraints for the port. A key element of the coordination will be in relation to pilotage activities, but it is noted that the pilot boarding station for Milford Haven is located well clear of the OfECC. Nevertheless, information will be promulgated prior to any construction activities to allow mariners to passage plan accordingly.

418. The main consequence will be minor disruption to port access and related services; however, such disruption is not expected to prevent a third-party vessel from making port for any reason, including navigable water depths, tidal windows and pilot services.

18.1.4.1 Relevant Embedded Mitigation Measures

419. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Buoyed construction area;
- Charting of infrastructure;
- Marine coordination for project vessels;
- Project vessel compliance with international marine regulations;
- Promulgation of information; and
- Traffic monitoring.

18.1.4.2 Frequency of Occurrence

420. The frequency of occurrence for reduced access to local ports and harbours is considered to be **reasonably probable**.

18.1.4.3 Severity of Consequence

421. The severity of consequence for reduced access to local ports and harbours is considered to be **negligible**.

18.1.4.4 Significance of Risk

422. Overall, it is predicted that the significance of risk due to changes in access to local ports is **Broadly Acceptable**.

18.2 Operation and Maintenance Phase

18.2.1 Vessel Displacement

423. *The presence of structures may displace existing routes/activity.*

424. Based on experience at existing operational OWFs, it is anticipated that commercial vessels will choose not to navigate internally within the Array Area and therefore the main route deviations established for the equivalent construction phase hazard for vessel displacement in line with MGN 654 (MCA, 2021) are again applicable (see **Section 18.1.1**).

425. Subsequently, the nature of this hazard for commercial vessels is expected to be broadly similar to that considered for the equivalent construction phase hazard for vessel displacement (see **Section 18.1.1**). Although, the buoyed construction area will no longer serve to assist with guiding vessels around the Array Area, the operational lighting and marking of the array will serve this purpose.

426. Additionally, the frequency of maintenance activities associated with the OfECC is expected to be limited, and so potential disruption associated with the OfECC will again be limited.

427. For fishing vessels and recreational vessels, internal navigation within the array is considered feasible during the operation and maintenance phase, noting that the minimum spacing of 1,140 m is sufficient to accommodate transits by smaller vessels. Additionally, there will be no restrictions on entry into the Array Area for any vessel other than through any active 500 m major maintenance safety zones. Nevertheless, the RYA have noted during consultation that internal passages by recreational vessels are not currently common at existing arrays – for small craft choosing to deviate around the Array Area the nature of this hazard is again expected to be broadly similar to that considered for the equivalent construction phase hazard for vessel displacement (**Section 18.1.1)**.

428. Likewise, the main consequences of vessel displacement during the operational phase are also considered to be equivalent to the construction phase, in particular potential for increased journey times and distances. No notable effects on navigational safety are anticipated.

18.2.1.1 Relevant Embedded Mitigation Measures

429. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Charting of infrastructure;
- Guard vessel(s);
- Lighting and marking;
- Promulgation of information; and
- Traffic monitoring.

18.2.1.2 Frequency of Occurrence

430. The frequency of occurrence in relation to displacement of vessel traffic is considered to be **frequent**.

18.2.1.3 Severity of Consequence

431. The severity of consequence in relation to displacement of vessel traffic is considered to be **negligible**.

18.2.1.4 Significance of Risk

432. Overall, it is predicted that the significance of risk due to vessel displacement is **Tolerable with Mitigation**.

18.2.2 Increased Third-Party Vessel to Vessel Collision Risk

433. *The presence of structures may increase encounters and collision risk with other third-party vessels.*

434. Based on experience at existing operational OWFs, it is anticipated that commercial vessels will choose not to navigate internally within the Array Area and therefore the main route deviations established for the equivalent construction phase hazard for vessel displacement in line with MGN 654 (MCA, 2021) are again applicable (see **Section 18.1.2**).

435. Subsequently, the nature of this hazard (increased third-party vessel to vessel collision) for commercial vessels is expected to be broadly similar to that considered for the equivalent construction phase hazard including mitigation measures (see **Section 18.1.1**). Although the buoyed construction area will no longer serve to assist with guiding vessels around the Array Area, the operational lighting and marking of the array will serve this purpose.

436. An additional factor during the operation and maintenance phase is the potential for the view of other vessels to be blocked or hindered due to the presence of structures, particularly for small craft which may choose to navigate internally within the array. However, the minimum spacing between WTGs (1,140 m) is sufficient to ensure that any notable effects – which would likely arise only along a row of WTGs – occur where the vessels involved are far apart, i.e., at opposite ends of the row of WTGs. As the distance between the vessels closes, any blocking effect would quickly reduce.

437. In the event that an encounter or collision does occur, the consequences are expected to be broadly similar to the equivalent construction phase hazard for increased third-party vessel to third-party vessel collision (see **Section 18.1.2**).

18.2.2.1 Relevant Embedded Mitigation Measures

438. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Charting of infrastructure;
- Fisheries liaison;
- Guard vessel(s);

- Lighting and marking;
- Marine coordination for project vessels;
- Pollution planning;
- Project vessel compliance with international marine regulations;
- Promulgation of information; and
- Traffic monitoring.

18.2.2.2 Frequency of Occurrence

439. The frequency of occurrence in relation to encounters and collision risk is considered **extremely unlikely**.

18.2.2.3 Severity of Consequence

440. The severity of consequence in relation to encounters and collision risk is considered **serious**.

18.2.2.4 Significance of Risk

441. Overall, it is predicted that the significance of risk due to vessel displacement is **Tolerable with Mitigation**.

18.2.3 Third-Party to Project Vessel Collision Risk

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

443. Up to 120 return trips per year by operation and maintenance vessels may be made throughout the operation and maintenance phase of the proposed Project, including RAM vessels. It is estimated that project vessel movements will be more frequent during the summer months due to preference for project activities to be scheduled during the summer to avoid inclement weather. It is noted that the movement of project vessels during the operation and maintenance phase represents a decrease in movements in comparison to the construction phase.

444. Much of the mitigation measures outlined for the equivalent construction phase hazard for third-party to project vessel collision risk (see **Section 18.1.3**) are again relevant, although safety zones will be limited to surface structures where major maintenance is ongoing. Additionally, there will be no buoyed construction area to protect project vessels, and small craft may choose to navigate internally within the array, increasing the likelihood of risk.

445. Should an encounter or collision occur between a third-party vessel and a project vessel, the consequences are expected to be broadly similar to the equivalent construction phase hazard for third-party to project vessel collision risk (see **Section 18.1.3**), with a worst-case of foundering, PLL, and pollution. In such circumstances, other project vessels may attend the incident under SOLAS obligations and in liaison with the MCA and the MPCP would be implemented.

18.2.3.1 Relevant Embedded Mitigation Measures

446. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Application for safety zones (major maintenance only);
- Charting of infrastructure;
- Fisheries liaison;
- Guard vessel(s);
- Lighting and marking;
- Marine coordination for project vessels;
- Pollution planning;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

18.2.3.2 Frequency of Occurrence

447. The frequency of occurrence in relation to third-party to project vessel collision risk is considered to be **remote**.

18.2.3.3 Severity of Consequence

448. The severity of consequence in relation to third-party to project vessel collision risk is considered to be **serious**.

18.2.3.4 Significance of Risk

449. Overall, it is predicted that the significance of risk due to third-party to project vessel collision risk is **Tolerable with Mitigation**.

18.2.4 Creation of Vessel to Structure Allision Risk

450. *The presence of structures within the Array Area will lead to the creation of powered, drifting and internal allision risk for vessels.*

451. The spatial extent of the hazard is small given that a vessel must be in close proximity to a surface structure for an allision incident to occur. Each allision element is considered in turn with the frequency of occurrence, severity of consequence, and resulting significance of 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

452. Based on the quantitative assessment undertaken for the alternative array layout (see **Section 16**), the base case annual powered vessel to structure allision frequency

was estimated to be 2.34×10^{-4}, corresponding to a return period of approximately one in 4,277 years. This is a low return period compared to that estimated for other UK OWF developments and is reflective of both the scale of the proposed Project (maximum 14 surface structures for the alternative array layout modelled and 10 for the indicative array layout) and the relatively low volume of vessel traffic intersecting or passing in close proximity to the Array Area. The low return period is also reflected when considering future case traffic levels.

453. 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, with an RNLI lifeboat attending on both occasions and a helicopter deployed in one case.

454. Vessels are expected to comply with national and international flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan a route which minimises risk given the promulgation of information relating to the proposed Project, including the charting of infrastructure on relevant nautical charts. On approach, the operational marine lighting and marking on the structures (which will be agreed with the MCA and Trinity House) will also assist in maximising awareness. Furthermore, the final layout will be agreed post consent in consultation with MCA and Trinity House to ensure it is safe from a surface navigation perspective. It is expected that the final layout will be well aligned with existing routes, most notably tankers routeing to/from Milford Haven.

455. Should a powered allision occur, the consequences will depend on multiple factors including the energy of the contact, structural integrity of the vessel involved, and sea state at the time of the contact. Fishing vessels and recreational vessels are considered most vulnerable to the impact given the potential for a non-steel construction. With consideration of lessons learned the most likely consequences are minor damage with the vessel able to resume passage and undertake a full inspection at the next port of call. As an unlikely worst case, the vessel could founder resulting in a PLL and pollution. If pollution were to occur, then the MPCP would be implemented.

18.2.4.2 Drifting Allision Risk

456. Based on the quantitative assessment undertaken for the alternative array layout (see **Section 16**), the base case annual drifting vessel to structure allision frequency was estimated to be 3.20×10^{-5}, corresponding to a return period of approximately one in 20,875 years. This is a low return period compared to that estimated for other UK OWF developments and is again both the scale of the proposed Project (maximum 14 surface structures for the alternative array layout modelled and 10 for the indicative array layout) and the relatively low volume of vessel traffic intersecting or passing in close proximity to the Array Area. The low return period is also reflected when considering future case traffic levels.

457. Based on historical incident data, there have been no instances of a third-party vessel alliding with an operational OWF structure whilst Not Under Command (NUC) (see **Section 9.6**). However, there is considered to be potential for a vessel to be adrift in the area; this is reflected in the MAIB incident data reviewed in proximity to the proposed Project which indicates that machinery failure[6] is a frequent incident type.

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

459. In circumstances where a vessel drifts towards a structure in the Array Area, there are actions which the vessel may take to prevent the drift incident developing into an allision situation. For powered vessels, the ideal and likely solution would be to regain power prior to reaching the Array Area (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).

460. Noting the considerable water depth within and in proximity to the Array Area, deployment of the anchor may not be possible, particularly for small craft. In such circumstances, any project vessels on-site may be able to render assistance in liaison with the MCA and in line with SOLAS obligations (IMO, 1974), particularly in the summer months when operation and maintenance activities are likely to be more frequent. This response would 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.

461. Should a drifting allision occur, the consequences will be similar to those noted for the case of a powered allision including the unlikely worst-case of foundering, PLL, and pollution. However, a drifting vessel is likely to be moving 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.

18.2.4.3 Internal Allision Risk

462. As noted previously, based on experience at existing operational OWFs, it is anticipated that commercial vessels will be unlikely to navigate internally within the Array Area. Fishing and recreational vessels may be more likely to transit through

[6] An incident reported as a 'machinery failure' may not be so severe as to result in the vessel losing power and becoming NUC.

although are less likely to do so at a floating site such as the proposed Project compared to fixed sites due to the presence of mooring infrastructure associated with floating WTGs.

463. The base case annual fishing vessel to structure allision frequency for the alternative array layout (see **Section 16**) is estimated to be 5.96×10^{-2}, corresponding to a return period of approximately one in 16.8 years. This return period is reflective of the volume of fishing vessel traffic in the area, both in transit and engaged in fishing activities, and the conservative assumptions made within the modelling process. In particular, it has been assumed that the baseline fishing activity in terms of proximity to WTGs will not change. This is a very conservative assumption, particularly for a floating site, with consultation undertaken for commercial fisheries indicating that active fishing is not expected to resume following installation of the proposed Project.

464. The estimated return period also does not take account of the nature of any allision incident. The worst consequences reported for vessels involved in an allision incident involving a UK OWF development has been flooding, with no life-threatening injuries to persons reported (the model is calibrated against known reported incidents).

465. The minimum spacing between structures of 1,140 m is considered sufficient for safe internal navigation, i.e., for vessels to keep clear of the OWF structures within the Array Area. It is noted that this spacing is much greater than that associated with many other operational OWFs in the UK. Moreover, the final layout – agreed with MCA and Trinity House post consent – will be compliant with the requirements of MGN 654 (MCA, 2021).

466. As with any passage, any vessel navigating within the Array Area is expected to passage plan in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information by the proposed Project will ensure that such vessels have good awareness of the presence of surface structures. Operational marine lighting and marking will be in place as required by and agreed with Trinity House and MCA. Given the size of the Array Area, it is unlikely that a mariner would become disoriented when navigating internally; nevertheless, marking will include unique identification marking of each structure in an easily understandable pattern.

467. Should a recreational vessel under sail enter the proximity of a WTG, there is also potential for effects such as wind shear, masking and turbulence to occur. From previous studies of offshore wind developments, it has been concluded that WTGs do reduce wind velocity downwind of a WTG (MCA, 2008) but that no negative effects on recreational craft have been reported on the basis of the limited spatial extent of the effect and its similarity to that experienced when passing a large vessel or close to other large structures (such as bridges) or the coastline. In addition, no practical issues have been raised by recreational users to date when operating in proximity to existing offshore wind developments.

468. For recreational vessels with a mast there is an additional allision risk when navigating internally within the array associated with the WTG blades. However, the minimum blade tip clearance matches the minimum clearance the RYA recommend (22 m above Mean High Water Springs (MHWS)) for minimising allision risk (RYA, 2019 (b)) and which is also noted in MGN 654 (MCA, 2021).

18.2.4.4 Relevant Embedded Mitigation Measures

469. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Application for safety zones (major maintenance only);
- Charting of infrastructure;
- Compliance with MGN 654;
- Layout plan;
- Lighting and marking;
- Marine coordination for project vessels;
- Minimum blade tip clearance;
- Pollution planning;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

18.2.4.5 Risk Summary

470. The frequency of occurrence, severity of consequence, and resulting significance of risk for each element of the hazard is summarised in Table 18.1.

Table 18.1 Risk Summary for Creation of Vessel to Structure Allision Risk

Risk Element	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Powered allision risk	Extremely unlikely	Moderate	**Broadly Acceptable**
Drifting allision risk	Extremely unlikely	Moderate	**Broadly Acceptable**
Internal allision risk	Remote	Moderate	**Tolerable with Mitigation**

471. Overall, it is predicted that the significance of risk due to the creation of vessel to structure allision risk is **Tolerable with Mitigation**.

18.2.5 Reduced Access to Local Ports and Harbours

472. *Operation and maintenance activities and the presence of the proposed Project may reduce access to local ports and harbours.*

473. Up to 120 return trips per year by operation and maintenance vessels may be made throughout the operation and maintenance phase and will include vessels which are RAM. As per the construction phase, Project vessels will be managed by marine coordination including with MHPA whose VTS area overlaps the OfECC.

474. Given the extent of the Array Area will be similar to during the construction phase, this element of the hazard is considered broadly similar.

475. For the OfECC, the frequency of operation and maintenance activities is expected to be limited, and so potential disruption will be further limited with information promulgated in advance to allow mariners to passage plan accordingly.

476. The main consequences will be broadly similar to the equivalent construction phase hazard for reduced access to local ports and harbours (see **Section 18.1.4**), with any access constraints not expected to prevent a third-party vessel from making port.

18.2.5.1 Relevant Embedded Mitigation Measures

477. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Charting of infrastructure;
- Marine coordination for project vessels;
- Project vessel compliance with international marine regulations;
- Promulgation of information; and
- Traffic monitoring.

18.2.5.2 Frequency of Occurrence

478. The frequency of occurrence for reduced access to local ports and harbours is considered to be **reasonably probable**.

18.2.5.3 Severity of Consequence

479. The severity of consequence for reduced access to local ports and harbours is considered to be **negligible**.

18.2.5.4 Significance of Risk

480. Overall, it is predicted that the significance of risk due to impacts on port access is **Broadly Acceptable**.

18.2.6 Loss of Station

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

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

483. On this basis, a loss of station is considered likely to represent a low frequency event, noting that for a total loss of station, all moorings would be required to fail (each WTG will have up to eight).

484. 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. These protocols will also include recovery of deliberate sinking of floating foundations should this be deemed a necessary option in the event of a floating substructure going off station.

18.2.6.1 Relevant Embedded Mitigation Measures

485. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Charting of infrastructure;
- Compliance with MGN 654;
- Compliance with floating foundation guidance;
- Lighting and marking; and
- Promulgation of information.

18.2.6.2 Frequency of Occurrence

486. The frequency of occurrence in relation to loss of station is considered to be **negligible**.

18.2.6.3 Severity of Consequence

487. The severity of consequence in relation to loss of station is considered to be **serious**.

18.2.6.4 Significance of Risk

488. Overall, it is predicted that the significance of risk due to loss of station is **Broadly Acceptable**.

489. Whilst the significance of risk is assessed as Broadly Acceptable and not significant in EIA terms, in order to mitigate the risk of loss of station (ensuring the significance of risk is ALARP), AIS tracking on the floating structures has been specially identified as an additional mitigation measure.

18.2.7 Reduction in Under Keel Clearance due to Mooring Lines, Buoyant Inter-Array Cables, or Cable Protection

490. *The presence of mooring lines, buoyant inter-array cables, or protection over subsea cables may reduce charted water depths leading to increased risk of under keel interaction for passing vessels.*

18.2.7.1 Subsea Cables

491. For all subsea cables relating to the proposed Project, the target burial depth is 1.2 m, noting actual burial depths will be determined via the cable burial risk assessment process undertaken post consent once geotechnical survey data is available. Given existing water depths (between 67 and 71 m below CD), it is not anticipated that there will be any notable changes in navigable depths.

492. Where cable burial is not possible, alternative cable protection methods may be deployed which will be determined within the cable burial risk assessment. The requirements of MGN 654 in relation to cable protection will apply, namely cable protection will not change the charted water depth by more than 5% unless appropriate mitigation is agreed with the MCA. 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 (b)).

493. Given existing water depths within the Array Area, it is not anticipated that the presence of cable protection associated with inter-array cables will reduce charted water depths by more than 5%. For the export cables, the water depth is shallow in the nearshore area, and therefore the likelihood of a reduction in charted water depth by more than 5% is much greater, should cable protection be required. However, from the vessel traffic data limited activity occurs in the nearshore area of the OfECC (off Freshwater West). Nevertheless, as noted above, in such circumstances the MCA will be consulted on appropriate mitigation (if required) to ensure the under keel risk is ALARP.

494. Should an underwater allision occur, minor damage incurred is the most likely consequence, and foundering of the vessel resulting in a PLL and pollution the unlikely worst case consequences, with the environmental risks of the latter minimised by the implementation of the MPCP.

18.2.7.2 Mooring Lines and Buoyant Inter-Array Cables

495. Vessels navigating in proximity to the floating WTGs may be at risk of interaction with either the mooring lines or buoyant inter-array cables associated with floating substructures. The level of risk will depend on the clearance available above the subsea elements of the substructures.

496. There will be up to eight mooring lines per floating WTG used to secure the substructures to the seabed. The highest risk areas in terms of potential under keel clearance interaction will be the areas in the immediate vicinity of the floating substructures where the mooring lines and inter-array cables are closest to the surface. Should barges be selected, the mooring lines will connect above the waterline.

497. As per **Section 4**, it is likely that commercial vessels will not enter the Array Area; moreover, experience indicates that commercial vessels frequently pass 1 nm or more off 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 in sufficient close proximity to the WTGs (86 m based on the draught assessment undertaken in **Section 16.6.2**) and hence be at risk of subsea interaction. This is compounded by the extent of the above surface structure including the WTG blades which may deter a commercial vessel from navigating in proximity to the structure such that an interaction risk arises.

498. Therefore, it is likely that any vessels in close proximity to the substructures will be smaller. From the vessel traffic data, recreational vessels do not regularly navigate within the Array Area (generally passing to the east) and so the key user for interaction risk is fishing vessels, which typically have relatively shallow draughts compared to commercial vessels.

499. An assessment of fishing vessel draughts relative to the predicted mooring line descents showed that a typical fishing vessel in the area should avoid an under keel interaction beyond approximately 53 m from a floating structure. The likelihood of a fishing vessel navigating closer than this distance from a floating structure is low and in such a circumstance it is likely that it would do with caution noting that the surface section of the mooring lines will be visible above the waterline. The infrastructure will also be marked on appropriate nautical charts.

500. It will be necessary to confirm available under keel clearance from the mooring lines post installation, in particular if catenary mooring lines are used. The confirmed available clearance should be discussed with the MCA and Trinity House post installation to determine if any additional mitigation is required.

501. 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.

502. Details of the infrastructure will be promulgated to maximise awareness of the proposed Project and any potential under keel interaction risk, including via the FLO. As noted, 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.

18.2.7.3 Relevant Embedded Mitigation Measures

503. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Cable burial risk assessment;
- Charting of infrastructure;
- Compliance with MGN 654;
- Compliance with floating foundation guidance;
- Fisheries liaison;
- Pollution planning; and
- Promulgation of information.

18.2.7.4 Frequency of Occurrence

504. The frequency of occurrence in relation to changes in under keel clearance is considered to be **negligible**.

18.2.7.5 Severity of Consequence

505. The severity of consequence in relation to changes in under keel clearance is considered to be **moderate**.

18.2.7.6 Significance of Risk

506. Overall, it is predicted that the significance of risk due to changes in under keel clearance is **Broadly Acceptable**.

18.2.8 Anchor Interaction with Mooring Lines or Subsea Cables

507. *The presence of mooring lines and subsea cables may increase the risk of anchor interaction.*

508. The spatial extent of the hazard is small given that a vessel must be in close proximity to an export cable or inter-array cable for an interaction to occur and there will be limited numbers of inter-array cables given the small-scale nature of the proposed Project.

509. 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.

510. 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 (where scale of chart is appropriate) will inform the decision of a vessel to anchor, as per Regulation 34 of SOLAS (IMO, 1974).

511. An average of one anchored vessel per day was observed within the Study Area during the survey periods, with these all being tankers. Risk of interaction with an inter-array cable or mooring line on a planned anchoring or dragged anchoring basis is therefore anticipated to be very 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 (e.g., structures, rocks, shallows). Given the open sea room in proximity to the inter-array cables the likelihood of this scenario arising is very low.

512. An average of one anchored vessel per day was observed within the OfECC Study Area, with the majority of these being tankers. None of these anchoring instances occurred within the OfECC itself, although some instances did occur in close proximity. For such instances, the burial of the export cables and use of external cable protection – as informed by the cable burial risk assessment with a target burial depth of 1.2 m – will minimise the likelihood of an interaction occurring. The cable burial risk assessment will also account for traffic volume and sizes.

513. Additionally, as per Regulation 34 of SOLAS (IMO, 1974), it is anticipated that mariners will take account of the presence of the export cables via nautical charts prior to dropping the anchor. With this good practice and mitigation, it is considered unlikely that an anchor interaction will occur.

514. Nevertheless, should a vessel anchor over a subsea cable the most likely consequence (based on historical anchor interaction incidents) is that no interaction occurs given the burial/protection of the cable. As an unlikely worst case, a snagging incident could occur and / or the vessel's anchor and the cable could be damaged, with potential for loss of stability for a small vessel. For an interaction with a buoyant inter-array cable, a further consequence could be the breaking of the cable, which may have implications for the stability of the floating substructure, depending upon the particular design. This scenario is highly unlikely given that this section of the cable will be in close proximity to the WTG (50 to 100 m), with vessels unlikely to navigate at such a distance from a surface structure.

18.2.8.1 Relevant Embedded Mitigation Measures

515. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Cable burial risk assessment;
- Charting of infrastructure;
- Compliance with MGN 654; and
- Promulgation of information.

18.2.8.2 Frequency of Occurrence

516. The frequency of occurrence is considered to be **extremely unlikely**.

18.2.8.3 Severity of Consequence

517. The severity of consequence is considered to be **minor**.

18.2.8.4 Significance of Risk

518. Overall, it is predicted that the significance of risk due to anchor interaction with mooring lines or subsea cables is **Broadly Acceptable**.

18.2.9 Reduction of Emergency Response Capability Including SAR

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

520. Given the distances that may be covered by air-based SAR support (the SAR helicopter base at St Athan is located approximately 67 nm from the Array Area), the spatial extent of this hazard is considered reasonably large. The Array Area covers

approximately 16 nm^2 which represents a relatively small area to search compared to other OWFs.

521. Up to 120 return trips per year by operation and maintenance vessels may be made throughout the operation and maintenance phase. It is estimated that project vessel movements will be more frequent during the summer months. The presence of such vessels will increase the likelihood of an incident and subsequently increase the likelihood of multiple incidents occurring simultaneously in the region as a whole, diminishing emergency response capability. As an unlikely worst case, the consequences of such a situation could include a failure of emergency response to an incident, resulting in PLL and pollution.

522. However, with project vessels to be managed through marine coordination and in compliance with Flag State regulations, the likelihood of an incident is minimised. Additionally, should an incident occur, project vessels would likely be well equipped to assist, either through self-help capability or through SOLAS obligations (IMO, 1974), noting this would be undertaken in liaison with the MCA. For a pollution incident, the MPCP will also be implemented.

523. From recent SAR helicopter taskings data, the frequency of SAR operations in proximity to the proposed Project is low, with no SAR helicopter incidents occurring within the Array Area. The frequency of SAR operations in proximity to the Array Area is not anticipated to change markedly from the current level given the measures noted above which will be in place. However, in the event that a SAR operation is required internally within the Array Area, its small-scale and the minimum spacing of 1,140 m between WTGs should ensure that access risks are minimal.

524. An Emergency Response Cooperation Plan (ERCoP) will be submitted to the MCA post consent in line with the requirements of MGN 654 (MCA, 2021), and a SAR checklist will be completed and agreed with the MCA. Furthermore, the final array layout will be agreed with the MCA and Trinity House post consent and be MGN 654 compliant.

18.2.9.1 Relevant Embedded Mitigation Measures

525. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Compliance with MGN 654;
- Guard vessel(s);
- Layout plan;
- Lighting and marking;
- Marine coordination;
- Pollution planning; and
- Project vessel compliance with international marine regulations.

18.2.9.2 Frequency of Occurrence

526. The frequency of occurrence in relation to reduction of emergency response capability including SAR is considered **extremely unlikely**.

18.2.9.3 Severity of Consequence

527. The severity of consequence in relation to reduction of emergency response capability including SAR is considered **serious**.

18.2.9.4 Significance of Risk

528. Overall, it is predicted that the significance of risk due to reduction of emergency response capability including SAR is **Tolerable with Mitigation**.

18.3 Decommissioning Phase

18.3.1 Vessel Displacement

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

530. Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, the risk pathway for this hazard is expected to be similar in nature to the equivalent construction phase hazard for vessel displacement (see **Section 18.1.1**). This includes the use of a buoyed decommissioning area.

531. Given the broadly similar nature of decommissioning activities when compared to construction activities, the main consequences of vessel displacement during the decommissioning phase are considered to be equivalent to that highlighted for the construction phase hazard for vessel displacement (see **Section 18.1.1**), in particular potential for increased journey times and distances. No notable effects on navigational safety are anticipated.

18.3.1.1 Relevant Embedded Mitigation Measures

532. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Buoyed decommissioning area;
- Charting of infrastructure;
- Decommissioning plan;
- Guard vessel(s); and
- Promulgation of information.

18.3.1.2 Frequency of Occurrence

533. The frequency of occurrence in relation to displacement of vessel traffic is considered to be **frequent**.

18.3.1.3 Severity of Consequence

534. The severity of consequence in relation to displacement of vessel traffic is considered to be **negligible**.

18.3.1.4 Significance of Risk

535. Overall, it is predicted that the significance of risk due to vessel displacement is **Tolerable with Mitigation**.

18.3.2 Increased Third-Party Vessel to Vessel Collision Risk

536. *Decommissioning activities associated with the removal of structures and cables may increase encounters and collision risk with other third-party vessels.*

537. Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, the risk pathway for this hazard is expected to be similar in nature to the equivalent construction phase hazard for increased third-party vessel to vessel collision risk (see **Section 18.1.2**). This includes the use of a buoyed decommissioning area.

538. Given the broadly similar nature of decommissioning activities when compared to construction activities, the main consequences of collision risk during the decommissioning phase are considered to be equivalent to that highlighted for the construction phase hazard for increased third-party vessel to vessel collision risk (see **Section 18.1.2**), in particular the unlikely worst-case of foundering resulting in PLL and pollution.

18.3.2.1 Relevant Embedded Mitigation Measures

539. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Buoyed decommissioning area;
- Charting of infrastructure;
- Decommissioning plan;
- Fisheries liaison;
- Guard vessel(s);
- Marine coordination for project vessels;
- Pollution planning;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

18.3.2.2 Frequency of Occurrence

540. The frequency of occurrence in relation to encounters and collision risk is considered **extremely unlikely**.

18.3.2.3 Severity of Consequence

541. The severity of consequence in relation to encounters and collision risk is considered to be **serious**.

18.3.2.4 Significance of Risk

542. Overall, it is predicted that the significance of risk due to vessel displacement is **Tolerable with Mitigation**.

18.3.3 Third-Party to Project Vessel Collision Risk

543. *Project vessels associated with decommissioning activities may increase encounters and collision risk for other vessels already operating in the area.*

544. 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, the risk pathway for this hazard is expected to be similar in nature to the equivalent construction phase hazard for third-party to project vessel collision risk (see **Section 18.1.3**), including the number of return trips by project vessels and the use of a buoyed decommissioning area.

545. Given the broadly similar nature of decommissioning activities when compared to construction activities, the main consequences in the event of an encounter or collision are considered to be equivalent to that highlighted for the construction phase hazard for third-party to project vessel collision risk (see **Section 18.1.3**), including a worst-case of foundering, PLL, and pollution.

18.3.3.1 Relevant Embedded Mitigation Measures

546. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Application for safety zones;
- Buoyed decommissioning area;
- Charting of infrastructure;
- Decommissioning plan;
- Fisheries liaison;
- Guard vessel(s);
- Lighting and marking;
- Marine coordination for project vessels;
- Pollution planning;
- Project vessel compliance with international marine regulations; and

- Promulgation of information.

18.3.3.2 Frequency of Occurrence

547. The frequency of occurrence in relation to third-party to project vessel collision risk is considered to be **extremely unlikely**.

18.3.3.3 Severity of Consequence

548. The severity of consequence in relation to third-party to project vessel collision risk is considered to be **serious**.

18.3.3.4 Significance of Risk

549. Overall, it is predicted that the significance of risk due to third-party to project vessel collision risk is **Tolerable with Mitigation**.

18.3.4 Reduced Access to Local Ports and Harbours

550. *Decommissioning activities associated with the removal of structures and cables may reduce access to local ports and harbours.*

551. Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, the risk pathway for this hazard is expected to be similar in nature to the equivalent construction phase hazard for reduced access to local ports and harbours (see **Section 18.1.4**), including the number of return trips by decommissioning vessels.

552. Given the broadly similar nature of decommissioning activities when compared to construction activities, the main consequences during the decommissioning phase are considered to be equivalent to that highlighted for the construction phase hazard for reduced access to local ports and harbours (see **Section 18.1.4**), in particular minor disruption to port access.

18.3.4.1 Relevant Embedded Mitigation Measures

553. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Buoyed decommissioning area;
- Charting of infrastructure;
- Decommissioning plan;
- Marine coordination for project vessels;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

18.3.4.2 Frequency of Occurrence

554. The frequency of occurrence for reduced access to local ports and harbours is considered to be **reasonably probable**.

18.3.4.3 Severity of Consequence

555. The severity of consequence for reduced access to local ports and harbours is considered to be **negligible**.

18.3.4.4 Significance of Risk

556. Overall, it is predicted that the significance of risk due to reduced access to local ports is **Broadly Acceptable**.

19 Cumulative Risk Assessment

557. This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the proposed Project cumulatively with those other developments identified from the cumulative screening (see **Section 14**). The same inputs outlined for the in isolation risk assessment are applicable.

558. The hazards assessed are as per the in isolation risk assessment, with the exception of loss of station which has been scoped out of the cumulative risk assessment due to the local nature of the hazard which results in a limited pathway by which the hazard could become cumulative in nature.

559. Again, the risk control log (see **Section 20**) summarises the risk assessment and a concluding risk statement is provided (see **Section 23.4**).

19.1 Vessel Displacement

560. *Construction/decommissioning activities associated with the installation of structures and cables and the presence of structures may displace existing routes/activity on a cumulative level.*

19.1.1 Tier 1/2

561. Based on the cumulative assessment of vessel routeing (see **Section 15.5**), a deviation will be required for nine of the 14 main commercial routes identified. It is anticipated that eight of these routes will deviate around Erebus, with the other avoiding White Cross. The largest deviation is anticipated to be 11.14 nm, associated with Route 6 (northbound to Milford Haven and used by an average of two to three vessels per week). This increase equates to a 9.4% increase in route length and relates to the option of passing west of Erebus.

562. Although the increase in route length is substantial for tanker routeing to/from Milford Haven (Routes 2, 3 and 6), these deviations are a conservative worst-case, with vessels on these routes likely to take a more direct approach between the TSS Off the Scilly Isles and the west of Erebus, particularly given that there is sea room available to do so. There is also potential that a more direct route between the west of Erebus and Milford Haven may be taken, further reducing the level of deviation.

563. Additionally, there is an option to pass east of the Array Area which has been considered. This option would also reduce the level of deviation for the tanker routeing to/from Milford Haven (maximum of 5.7 nm associated with Route 2) and may be considered feasible given the favourable angle of the eastern boundary of the Array Area.

564. The size of deviations for commercial vessels would also be reduced if navigation between the Array Area and Erebus was considered. However, such a routeing option is not considered realistic given the sea room available for alternative options.

For small craft, use of the sea room between the Array Area and Erebus is considered more feasible, and this has been acknowledged by the RYA during the Hazard Worksop in August 2023, with the ability to avoid tanker routeing an additional incentive for this option.

565. It is noted that the route deviation associated with White Cross is not affected by the presence of the proposed Project, either directly or indirectly (by sharing sea room with routes which are directly affected). Therefore, no cumulative risk is considered with respect to this route.

566. For tankers awaiting orders, the additional presence of Erebus may further restrict available sea room. However, the majority of this activity occurs east of Erebus and so is not expected to be materially impacted by the cumulative presence of multiple developments.

567. The same main consequences (increased journey times and distances) and mitigation measures relevant for each phase of the equivalent hazard for the proposed Project in isolation are again applicable, including promulgation of information and marking on relevant nautical charts. Given the greater length of deviations compared with the in isolation scenario, the severity of consequence is greater, although remains relatively low given the increased distances relative to the length of routes as a whole.

19.1.2 Tier 3

568. The TCE PDAs will significantly influence commercial routeing in the area if built out in full. The Array Area has been refined in response to stakeholder feedback so as to align with the gap between PDA 3 and 4 (as seen in Figure 14.1), thus minimising any further disruption to the tanker routeing to/from Milford Haven. For other routes on a similar heading, the presence of the PDAs may serve to ‘shelter’ the Array Area – their location means that vessels will not transit in proximity to the Array Area from the southwest. For east-west routes anticipated to pass south of the Array Area and Erebus in the Tier 1/2 scenario, it may be necessary to pass north of both developments, although there is sea room available to do so.

569. The Pembrokeshire Demonstration Zone may also cumulatively affect deviations, although as with the TCE PDAs there is alignment to allow tanker routeing to/from Milford Haven to continue. There is also adequate sea room available south of the Pembrokeshire Demonstration Zone to allow east-west routes to continue as described above.

19.1.3 Frequency of Occurrence

570. For all phases the frequency of occurrence in relation to cumulative vessel displacement of vessel traffic is considered **frequent**.

19.1.4 Severity of Consequence

571. For all phases the severity of consequence in relation to cumulative vessel displacement of vessel traffic is considered **minor**.

19.1.5 Significance of Risk

572. Overall, for all phases it is predicted that the significance of risk due to cumulative vessel displacement is **Tolerable with Mitigation**.

19.2 Increased Third-Party Vessel to Vessel Collision Risk

573. *Construction/decommissioning activities associated with the installation/removal of structures and cables and the presence of structures any increase encounters and collision risk with other third-party vessels on a cumulative level.*

19.2.1 Tier 1/2

574. The same cumulative vessel routeing considered for the vessel displacement hazard is again applicable.

575. The deviation of multiple routes around the west of Erebus may further increase collision risk given that a greater number of routes will be passing west of Erebus than was the case passing west of the Array Area for the in isolation assessment. However, given the volumes of traffic associated with these routes, the increase is anticipated to be limited and there is sea room available to ensure vessels are able to pass each other safely should an encounter arise.

576. For the option of passing east of the Array Area, quantitative modelling has been undertaken (noting that this option provided the greater collision frequency for the in isolation scenario). The collision frequency was estimated at one in 895 years, representing an 88% increase on the pre OWF scenario. Although this is a high increase, the likelihood of a collision incident remains moderate and this is also reflected when considering future case traffic levels.

577. For small craft, the option to pass between the Array Area and Erebus is feasible, as acknowledged by the RYA during the Hazard Workshop in August 2023. This may allow small craft to avoid tanker routeing and thus minimise collision risk, noting that the consequences should a small craft collide with a larger vessel would likely be exacerbated.

19.2.2 Tier 3

578. The TCE PDAs may exacerbate collision risk further to the west of Erebus, due to the resulting less sea room. This is particularly relevant should PDA 1 and 2 be built out in full given the sharp corner at the northwestern extent. Additionally, the presence of the Pembrokeshire Demonstration Zone may reduce available sea room for passing vessels.

579. However, in both cases, the volumes of traffic in the area are again noted. The cumulative collision risk would likely remain at a manageable level, noting that the embedded mitigation measures for the proposed Project are expected to also apply to the cumulative developments.

19.2.3 Frequency of Occurrence

580. For all phases the frequency of occurrence in relation to cumulative encounters and collision risk is considered **remote**.

19.2.4 Severity of Consequence

581. For all phases the severity of consequence in relation to cumulative encounters and collision risk is considered **serious**.

19.2.5 Significance of Risk

582. Overall, for all phases it is predicted that the significance of risk due to cumulative encounters and collision risk is **Tolerable with Mitigation**.

19.3 Increased Third-Party to Project Vessel Collision Risk

583. *Project vessels associated with construction, operation and maintenance, and decommissioning activities may increase encounters and collision risk for other vessels already operating in the area on a cumulative level.*

19.3.1 Tier 1/2/3

584. There is the potential that the same base port(s) or similarly located ports could be used by cumulative developments for construction, operation and maintenance, 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, details of base ports are not currently available (across all cumulative tiers) and so a detailed risk assessment is not possible.

585. However, all developers are expected to establish appropriate marine coordination and vessel management systems with project vessels complying with Flag State regulations including the COLREGs and SOLAS. Coordination with MHPA will likely also be important on a cumulative basis.

19.3.2 Frequency of Occurrence

586. For the construction and decommissioning phases, the frequency of occurrence in relation to cumulative third-party to project vessel collision risk is considered to be **extremely unlikely**.

587. For the operation and maintenance phase, the frequency of occurrence in relation to cumulative third-party to project vessel collision risk is considered to be **remote**.

19.3.3 Severity of Consequence

588. For all phases the severity of consequence in relation to cumulative third-party to project vessel collision risk is considered to be **serious**.

19.3.4 Significance of Risk

589. Overall, for all phases it is predicted that the significance of risk due to cumulative third-party to project vessel collision risk is **Tolerable with Mitigation**.

19.4 Creation of Vessel to Structure Allision Risk

590. *The presence of structures within the Array Area and other cumulative developments will lead to the creation of powered, drifting and internal allision risk for vessels.*

19.4.1 Tier 1

591. Given the localised nature of vessel to structure allision risk, cumulative risk is limited. However, given that small craft may choose to navigate between the Array Area and Erebus (located approximately 3 nm to the northwest), there is some potential cumulative allision risk. This sea room is considered adequate to allow safe navigation by small craft, noting that Trinity House will give due consideration to cumulative lighting and marking requirements across both the proposed Project and Erebus.

19.4.2 Tier 2/3

592. The distance between the Array Area and White Cross and the Pembrokeshire Demonstration Zone is sufficient that no potential cumulative allision risk is considered.

593. Although the TCE PDAs are located in close proximity to the Array Area, there is limited information currently available in relation to the nature of any layout which may be taken forward. However, as with Erebus, it is expected that Trinity House will give due consideration to cumulative lighting and marking requirements across the proposed Project and any developments within the TCE PDAs when they are taken forward.

594. The nearest screened in cumulative development is the Erebus OWF, located 3 nm northwest of the Array Area. White Cross is located 9 nm south of the Array Area. Given this available sea space between the Array Area and the screened in developments, it is unlikely that vessels will experience increased allision risk beyond the localised risk when passing any given development.

595. All developments will be required to implement marine lighting and marking in agreement with Trinity House and in compliance with IALA G1162 (IALA, 2021), meaning the localised risk is managed.

19.4.3 Risk Summary

596. The frequency of occurrence, severity of consequence, and resulting significance of risk for each element of the cumulative hazard is summarised in Table 18.1.

Table 19.1 Risk Summary for Creation of Cumulative Vessel to Structure Allision Risk

Component	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Powered allision risk	Remote	Moderate	Tolerable with Mitigation
Drifting allision risk	Extremely unlikely	Moderate	Broadly Acceptable
Internal allision risk	Remote	Moderate	Tolerable with Mitigation

597. Overall, it is predicted that the significance of risk due to the creation of cumulative vessel to structure allision risk is **Tolerable with Mitigation**.

19.5 Reduced Access to Local Ports and Harbours

598. *Construction, operation and maintenance, and decommissioning activities and the presence of the proposed Project alongside other cumulative developments may reduce access to local ports and harbours.*

19.5.1 Tier 1/2

599. 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 Tier 1 and Tier 2 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 Project.

600. Based on current known programmes of construction, cable installation activities associated with Erebus will not overlap temporally with the proposed Project. However, in the event this did occur, it is anticipated that the two developments would coordinate activities in liaison with MHPA so as to ensure that access constraints to Milford Haven are minimised. As is the case for the assessment of the proposed Project in isolation, promulgation of information to allow mariners to passage plan accordingly is key.

19.5.2 Tier 3

601. Again, it is not anticipated that there will be any substantial effect due to activities associated with Tier 3 cumulative developments beyond the deviations already outlined for hazards relating to vessel displacement.

19.5.3 Frequency of Occurrence

602. For all phases, the frequency of occurrence in relation to cumulative reduced access to local ports and harbours is considered to be **reasonably probable**.

19.5.4 Severity of Consequence

603. For all phases the severity of consequence in relation to cumulative reduced access to local ports and harbours is considered to be **negligible**.

19.5.5 Significance of Risk

604. Overall, for all phases it is predicted that the significance of risk due to cumulative reduced access to local ports and harbours is **Broadly Acceptable**.

19.6 Reduction in Under Keel Clearance due to Mooring Lines, Buoyant Inter-Array Cables, or Cable Protection

605. *The presence of mooring lines, buoyant inter-array cables, or protection over subsea cables may reduce charted water depths leading to increased risk of under keel interaction for passing vessels on a cumulative level.*

19.6.1 Tier 1

606. Given the localised nature of under keel clearance risk, cumulative risk is limited. However, given the potential for the export cable route corridors for the proposed Project and Erebus to be in relatively close proximity, there is some potential cumulative under keel clearance risk associated with the presence of cable protection.

607. Portions of the OfECC which may be shared with the Erebus export cable route are outside of the nearshore area such that the likelihood of a reduction in charted water depth greater than 5% is low. Nevertheless, as per the assessment of the proposed Project in isolation, in such circumstances the MCA will be consulted on appropriate mitigation (if required) to ensure the under keel risk is ALARP.

19.6.2 Tier 2/3

608. Given the distance between the proposed Project and White Cross, and the low data confidence associated with Tier 3 cumulative developments (particularly in relation to export cable routes), no cumulative risk associated with under keel clearance is identified.

19.6.3 Frequency of Occurrence

609. The frequency of occurrence in relation to cumulative changes in under keel clearance is considered to be **extremely unlikely**.

19.6.4 Severity of Consequence

610. The severity of consequence in relation to cumulative changes in under keel clearance is considered to be **moderate**.

19.6.5 Significance of Risk

611. Overall, it is predicted that the significance of risk due to cumulative changes in under keel clearance is **Broadly Acceptable**.

19.7 Anchor Interaction with Mooring Lines or Subsea Cables

612. *The presence of mooring lines and subsea cables may increase the risk of anchor interaction on a cumulative level.*

19.7.1 Tier 1

613. Given the localised nature of anchor interaction risk, cumulative risk is limited. However, given the potential for the export cable route corridors for the proposed Project and Erebus to be in relatively close proximity, there is some potential cumulative anchor interaction risk.

614. The overall footprint of export cables across the proposed Project and Erebus will be small, such that vessels are expected to be able to avoid anchoring over the cables. It is noted that cables associated with Erebus will be marked on nautical charts similarly to the proposed Project.

615. Additionally, a cable burial risk assessment will also be undertaken for Erebus, as well as for the proposed Project and inform the burial/protection of cables. Therefore, should an anchor interaction occur, the consequences are expected to be broadly similar for the cumulative scenario to that determined for the assessment of the Project in isolation.

19.7.2 Tier 2/3

616. Given the distance between the proposed Project and White Cross, and the low data confidence associated with Tier 3 cumulative developments (particularly in relation to export cable routes), no cumulative risk associated with anchor interaction is identified.

19.7.3 Frequency of Occurrence

617. The frequency of occurrence in relation to cumulative anchor interaction is considered to be **extremely unlikely**.

19.7.4 Severity of Consequence

618. The severity of consequence in relation to cumulative anchor interaction is considered to be **minor**.

19.7.5 Significance of Risk

619. Overall, it is predicted that the significance of risk due to cumulative anchor interaction is **Broadly Acceptable**.

19.8 Reduction of Emergency Response Capability Including SAR

620. *Presence of structures, increased vessel activity, and personnel numbers on a cumulative level may reduce emergency response capability by increasing the number of incidents, increase consequences or reducing access for the responders.*

19.8.1 Tier 1/2/3

621. As for the proposed Project in isolation, it is assumed that cumulative developments will have mitigation measures in place to reduce the likelihood of emergency response capability being compromised. This includes marine coordination for project vessels and compliance with Flag State regulations. SOLAS obligations will also be applicable to all cumulative developments and may have a positive effect, e.g., a project vessel for Erebus may be able to assist with an incident associated with the proposed Project, or vice-versa. Nevertheless, the presence of structures and associated activities across multiple developments will increase the likelihood of an incident occurring that requires an emergency response.

622. Given that the Array Area is not immediately adjacent to Erebus or any other cumulative development, there is not considered to be any cumulative risk associated with SAR access, noting that a 1nm separation is required by MGN 654.

19.8.2 Frequency of Occurrence

623. The frequency of occurrence in relation to cumulative reduction of emergency response capability including SAR is considered to be **remote**.

19.8.3 Severity of Consequence

624. The severity of consequence in relation to cumulative reduction of emergency response capability including SAR is considered to be **serious**.

19.8.4 Significance of Risk

625. Overall, it is predicted that the significance of risk due to cumulative reduction of emergency response capability including SAR is **Tolerable with Mitigation**.

20 Risk Control Log

626. **Table 20.1** presents a summary of the risk assessment of shipping and navigation hazards. This includes (per hazard) the proposed embedded mitigation measures, frequency of occurrence, severity of consequence, and resulting significance of risk.

627. Any additional mitigation measures proposed are then listed per hazard alongside the residual risk.

Table 20.1 Risk Control Log

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel displacement (in isolation)	Construction	▪ Buoyed construction area; ▪ Charting of infrastructure; ▪ Decommissioning plan; ▪ Guard vessel(s); ▪ Lighting and marking; ▪ Promulgation of information; and ▪ Traffic monitoring.	Frequent	Negligible	**Tolerable with Mitigation**	None identified	**Tolerable with Mitigation**
	Operation and maintenance		Frequent	Negligible	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Decommissioning		Frequent	Negligible	**Tolerable with Mitigation**		**Tolerable with Mitigation**
Vessel displacement (cumulative)	Construction		Frequent	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Operation and maintenance		Frequent	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Decommissioning		Frequent	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**
Increased third-party vessel collision risk (in isolation)	Construction	▪ Buoyed construction area; ▪ Charting of infrastructure; ▪ Decommissioning plan; ▪ Fisheries liaison; ▪ Guard vessel(s); ▪ Lighting and marking; ▪ Marine coordination for project vessels; ▪ Pollution planning;	Extremely Unlikely	Serious	**Tolerable with Mitigation**	None identified	**Tolerable with Mitigation**
	Operation and maintenance		Extremely Unlikely	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Decommissioning		Extremely Unlikely	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Construction		Remote	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Increased third-party vessel collision risk (cumulative)	Operation and maintenance	▪ Project vessel compliance with international marine regulations; ▪ Promulgation of information; and ▪ Traffic monitoring.	Remote	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Decommissioning		Remote	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**
Third-party with project vessel collision risk (in isolation)	Construction	▪ Application for safety zones; ▪ Buoyed construction area; ▪ Charting of infrastructure; ▪ Decommissioning plan; ▪ Fisheries liaison; ▪ Guard vessel(s); ▪ Lighting and marking; ▪ Marine coordination for project vessels; ▪ Pollution planning; ▪ Project vessel compliance with international marine regulations; and ▪ Promulgation of information.	Extremely Unlikely	Serious	**Tolerable with Mitigation**	None identified	**Tolerable with Mitigation**
	Operation and maintenance		Remote	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Decommissioning		Extremely Unlikely	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**
Third-party with project vessel collision risk (cumulative)	Construction		Extremely Unlikely	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Operation and maintenance		Remote	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Decommissioning		Extremely Unlikely	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Creation of vessel to structure allision risk (in isolation)	Operation and maintenance	▪ Application for safety zones; ▪ Charting of infrastructure; ▪ Compliance with MGN 654; ▪ Layout plan; ▪ Lighting and marking; ▪ Marine coordination for project vessels; ▪ Minimum blade tip clearance; ▪ Pollution planning; ▪ Project vessel compliance with international marine regulations; and ▪ Promulgation of information.	Remote[7]	Moderate	**Tolerable with Mitigation**	None identified	**Tolerable with Mitigation**
Creation of vessel to structure allision risk (cumulative)	Operation and maintenance		Remote[8]	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
Reduced access to local ports and harbours (in isolation)	Construction	▪ Buoyed construction area; ▪ Charting of infrastructure; ▪ Decommissioning plan;	Reasonably Probable	Negligible	**Broadly Acceptable**	None identified	**Broadly Acceptable**
	Operation and maintenance		Reasonably Probable	Negligible	**Broadly Acceptable**		**Broadly Acceptable**

[7] Relating to internal allision risk element of the in isolation hazard.
[8] Relating to powered and internal allision risk elements of the cumulative hazard.

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
	Decommissioning	▪ Marine coordination for project vessels; ▪ Project vessel compliance with international marine regulations; ▪ Promulgation of information; and ▪ Traffic monitoring.	Reasonably Probable	Negligible	**Broadly Acceptable**		**Broadly Acceptable**
Reduced access to local ports and harbours (cumulative)	Construction		Frequent	Negligible	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Operation and maintenance		Reasonably Probable	Negligible	**Broadly Acceptable**		**Broadly Acceptable**
	Decommissioning		Frequent	Negligible	**Tolerable with Mitigation**		**Tolerable with Mitigation**
Loss of station (in isolation)	Operation and maintenance	▪ Charting of infrastructure; ▪ Compliance with MGN 654; ▪ Compliance with floating foundation guidance; ▪ Lighting and marking; and ▪ Promulgation of information.	Negligible	Serious	**Broadly Acceptable**	AIS tracking on floating structures	**Broadly Acceptable**
Reduction in under keel clearance due to mooring lines, buoyant inter-array cables, or cable protection (in isolation)	Operation and maintenance	▪ Cable burial risk assessment; ▪ Charting of infrastructure; ▪ Compliance with MGN 654;	Negligible	Moderate	**Broadly Acceptable**	None identified	**Broadly Acceptable**

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Reduction in under keel clearance due to mooring lines, buoyant inter-array cables, or cable protection (cumulative)	Operation and maintenance	▪ Compliance with floating foundation guidance; ▪ Fisheries liaison; ▪ Pollution planning; and ▪ Promulgation of information.	Extremely unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
Anchor interaction with mooring lines or subsea cables (in isolation)	Operation and maintenance	▪ Cable burial risk assessment; ▪ Charting of infrastructure; ▪ Compliance with MGN 654; and ▪ Promulgation of information.	Extremely unlikely	Minor	**Broadly Acceptable**	None identified	**Broadly Acceptable**
Anchor interaction with mooring lines or subsea cables (cumulative)	Operation and maintenance		Extremely unlikely	Minor	**Broadly Acceptable**		**Broadly Acceptable**
Reduction of emergency response capability including SAR (in isolation)	Operation and maintenance	▪ Compliance with MGN 654; ▪ Guard vessel(s); ▪ Layout plan; ▪ Lighting and marking; ▪ Marine coordination; ▪ MPCP; and ▪ Project vessel compliance with international marine regulations.	Extremely Unlikely	Serious	**Tolerable with Mitigation**	None identified	**Tolerable with Mitigation**
Reduction of emergency response capability including SAR (cumulative)	Operation and maintenance		Remote	Serious	**Tolerable with Mitigation**		**Tolerable with Mitigation**

21 Mitigation Measures

21.1 Embedded Mitigation Measures

628. As part of the design process for the proposed Project, 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 include project design measures, compliance with elements of good practice and use of standard protocols. They will continue to evolve over the development process.

629. 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 Project.

630. The embedded mitigation measures within the design relevant to shipping and navigation are outlined in **Table 21.1**.

Table 21.1 Embedded Mitigation Measures Relevant to Shipping and Navigation

Embedded Mitigation Measure	Details
Application for safety zones	An application will be made for safety zones post consent including up to 500 m around ongoing activities during construction, major maintenance, and decommissioning and up to 50 m for installed structures pre commissioning.
Cable burial risk assessment	Where possible, cable burial will be the preferred option for cable protection with the cable burial depth to be informed by a cable burial risk assessment and detailed within the Cable Specification Plan. Any damage, destruction or decay of cables must be notified to MCA, Trinity House, Kingfisher and UKHO no later than 24 hours after discovered.
Charting of infrastructure	There will be appropriate marking of all offshore infrastructure associated with the proposed Project on UKHO admiralty charts.
Compliance with MGN 654	The Applicant will ensure compliance with MGN 654 and its annexes, where applicable, including completion of a SAR checklist.
Compliance with floating foundation guidance	The Applicant will ensure compliance with Regulatory Expectations on Moorings for Floating Wind and Marine Devices (MCA and HSE, 2017).
Decommissioning plan	A Decommissioning plan will be developed prior to decommissioning.
Fisheries Liaison	Ongoing liaison with fishing fleets will be maintained during construction, maintenance, and decommissioning operations via an appointed FLO.
Guard vessel(s)	Where appropriate, guard vessels will be used to ensure adherence with safety zones or advisory passing distances.

Embedded Mitigation Measure	Details
Layout plan	A layout plan (including subsea cables) for the proposed Project will be agreed with the MMO following appropriate consultation with Trinity House and the MCA setting out proposed details of the offshore development areas.
Lighting and marking	Lights, marks, sounds, signals and other aids to navigation will be exhibited as required by Trinity House, MCA, and Civil Aviation Authority (CAA) including a buoyed construction area around the Array Area.
Marine coordination for project vessels	Marine coordination will be implemented to manage project vessels throughout construction and maintenance periods.
Minimum blade clearance	There will be a minimum blade tip clearance (air draft height) of at least 22 m above MSL.
Pollution planning	An MPCP will be developed outlining procedures to protect personnel working and to safeguard the marine environment.
Project vessel compliance with international marine regulations	Project vessels will ensure compliance with Flag State regulations including the COLREGs and SOLAS.
Promulgation of information	The proposed Project will ensure that local Notifications to Mariners are updated and reissued at weekly intervals during construction activities and at least five days before any planned operation and maintenance works and supplemented with VHF radio broadcasts agreed with the MCA in accordance with the construction and monitoring programme approved under the Marine Licence condition.
	Advance warning and accurate location details of construction, maintenance and decommissioning operations (including details of vessel routes, timings and locations), associated safety zones, and advisory passing distances will be given via Kingfisher Bulletins at least 14 days prior where possible.
Traffic monitoring	Monitoring of vessel traffic will be undertaken for the duration of the construction phase and during the first three years of the operation and maintenance phase.
Under keel clearance	Where scour protection is required, MGN 654 will be adhered to with respect to changes greater than 5% to the charted depths referenced to CD in consultation with the MCA and Trinity House.

21.2 Additional Mitigation Measures

631. The following additional mitigation measure has been identified relevant to shipping and navigation within the risk assessment undertaken in **Section 17**:

- AIS tracking on floating structures.

21.3 Marine Aids to Navigation

632. Throughout all phases, aids to navigation will be provided in accordance with Trinity House and MCA requirements, with consideration being given to IALA

Recommendation O-139 (IALA, 2021 (a)) and G1162 (IALA, 2021 (b)), as well as MGN 654 (MCA, 2021).

21.3.1 Construction and Decommissioning Phases

633. During the construction and decommissioning phases, buoyed construction and decommissioning areas will be established and marked, where required, in accordance with Trinity House requirements based on the IALA Maritime Buoyage System.

21.3.2 Operation and Maintenance Phase

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

21.3.2.1 Marking of Individual Array Structures

635. As per IALA Guideline G1162, each surface structure within the Array Area will be painted yellow from the level of Highest Astronomical Tide (HAT) to at least 15 m 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.

636. 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 3 m above sea level and at a distance of at least 150 m from the WTG. The light will be either hooded or baffled so as to avoid unnecessary light pollution or confusion with navigational marks.

21.3.2.2 Marking of Array as a Whole

637. The marking of the array as a whole will be agreed with Trinity House 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 Trinity House, it will be ensured that:

- All corner structures will be marked as a Significant Peripheral Structure (SPS) and where necessary, to satisfy the spacing requirements between SPSs, additional periphery structures may also be marked as SPSs;
- Structures designated as an SPS will exhibit a flashing yellow five second (flash yellow every five seconds) light of at least 5 nm nominal range and

omnidirectional fog signals as appropriate and where prescribed by Trinity House, and will be sounded at least when the visibility is 2 nm 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 2 nm 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 6 m 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 aids to navigation;
- Aviation lighting will be as per CAA requirements; however, will likely be synchronised Morse “W” at the request of Trinity House; and
- All lighting will be considered cumulatively with existing aids to navigation to avoid the potential for light confusion to passing traffic.

638. Consideration will also be given to the use of marking via AIS, or other electronic means (such as Radar Beacons (Racon)) to assist safe navigation particularly in reduced visibility. AIS transmitters or virtual buoys could also be considered internally to assist with safe navigation within the Array Area.

21.3.2.3 Marking of Export Cables

639. No lighting or physical marking will be required during the O&M phase for the export cables.

21.4 Design Specifications Noted in Marine Guidance Note 654

640. 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).

22 Through Life Safety Management

22.1 Quality, Health, Safety and Environment

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

642. 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.

22.2 Incident Reporting

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

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

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

645. All investigations shall be performed in a timely manner.

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

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

22.3 Review of Documentation

648. 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.

649. 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.

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

22.4 Inspection of Resources

651. 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 aids to navigation to determine compliance with the performance standards specified by Trinity House.

22.5 Audit Performance

652. 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.

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

22.6 Safety Management System

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

22.7 Cable Monitoring

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

656. If exposed cables or ineffective cable 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 adequately mitigated.

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

22.8 Hydrographic Surveys

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

22.9 Decommissioning Plan

659. 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 Project) which is considered to be a danger to navigation and which it has not proved possible to remove. Such an obstruction may result is a requirement for the Applicant or Operator of the proposed Project to implement marking until such time as it is either removed or no longer considered a danger to navigation.

23 Summary

23.1 Consultation

660. 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. Stakeholders which were consulted include the following:

- MCA;
- Trinity House;
- UK Chamber of Shipping;
- MHPA;
- MOD;
- RYA;
- UK Major Ports Group (UKMPG);
- GP Shipping;
- Irish Ferries; and
- Stena Line.

23.2 Existing Environment

23.2.1 Navigational Features

661. Key navigational features in the area include the Port of Milford Haven located 21 nm northeast of the Array Area, as well as several subsea cables in the vicinity and PEXA areas. The Port of Milford Haven is the largest energy port in the UK, with routeing tanker traffic to / from the port of high importance. The Array Area lies approximately 21 nm southeast of the TSS Off Smalls, and approximately 60 nm northeast of the TSS Off Land's End. Along with the TSS West of the Scilly Isles (18 nm west of the TSS Off Land's End) these routeing measures influence traffic in the region. There are no charted wrecks or obstructions located within the Array Area.

23.2.2 Maritime Incidents

662. From DfT SAR helicopter taskings data recorded between April 2015 and March 2023, there were a total of six SAR taskings within the Study Area. There were approximately one to two SAR taskings per year within the OfECC Study Area.

663. Within the Study Area there was an average of one to two unique RNLI incidents per year with machinery failure (50%) the most frequently recorded incident type. One incident was located within the Array Area itself – a powered recreational vessel experiencing machinery failure.

664. Within the OfECC Study Area there was an average of seven unique RNLI incidents per year, with machinery failure (39%) and person in danger (21%) the most

frequently recorded incident types. One incident per year was responded to by the RNLI within the OfECC itself.

665. Within the Study Area there was an average of one unique MAIB incident per year with ‘accident to person’ (44%) and ‘machinery failure’ (22%) the most frequently recorded incident types. Again, no incidents were recorded by the MAIB within the Array Area itself.

666. Within the OfECC Study Area there was an average of two unique MAIB incidents per year, with ‘*machinery failure*’ (52%) and ‘*accident to person*’ (14%) the most frequently recorded incident types. The most common casualty types were fishing (38%), cargo (24%), and tanker (14%). No incidents were recorded by the MAIB within the OfECC itself.

23.2.3 Vessel Traffic Movements

23.2.3.1 Array Area

667. From the 28-days of vessel traffic survey data recorded in March 2022 and July 2023 within the Study Area, there was an average of 10 unique vessels per day recorded within the Study Area during the winter survey period, with an average of three unique vessels recorded within the Array Area. During the summer survey period, an average of 19 unique vessels were recorded within the Study Area per day with an average of two vessels per day within the Array Area. Approximately 18% of all vessel traffic across the 28-days intersected the Array Area.

668. The main vessel types within the Study Area during the winter survey period were tankers (66%) and cargo vessels (26%). The main vessel types within the Study Area during the summer survey period were fishing vessels (30%), tankers (28%), and recreational vessels (27%).

669. A total of 14 main commercial routes were identified from the vessel traffic survey data. The highest use main commercial route was northbound to Milford Haven, featuring tankers utilising the TSS Off Land’s End. Approximately five vessels per week were recorded on this route.

23.2.3.2 OfECC

670. During the 28-days of AIS-only vessel traffic data from March 2022 and July 2023 within the OfECC Study Area, there was an average of 27 unique vessels per day recorded within the OfECC Study Area during the winter data period, with an average of eight to nine unique vessels recorded within the OfECC. During the summer survey period, an average of 39 unique vessels were recorded within the OfECC Study Area per day with an average of 13 per day within the OfECC. Approximately 33% of all vessel traffic across the 28-days intersected the OfECC.

671. The main vessel types within the OfECC Study Area during the winter data period were tankers (34%) and tugs (25%). The main vessel types within the OfECC Study Area during the summer data period were recreational vessels (36%) and tankers (23%).

23.3 Collision and Allision Risk Modelling

672. Of the 14 main routes identified, it is anticipated that four will deviate as a result of the proposed Project. Assuming that tanker routeing to/from Milford Haven deviates west of the Array Area, the largest increase was to Route 6, with a 1.78 nm increase – however, the percentage increase to this route was 1.48%, and so relatively small. Assuming that tanker routeing to/from Milford Haven deviates east of the Array Area, the largest increase was to Route 2, with a 5.74 nm increase but a percentage change of 0.46%.

673. The NRA process included quantitative modelling of the change in allision and collision frequency as a result of the proposed Project, with consideration given to future cases in terms of potential future traffic increases. For allision modelling, a layout including 14 locations was used, noting that this provides conservative results for consideration with the indicative array layout.

674. Assuming that tanker routeing to/from Milford Haven deviates west of the Array Area, it was estimated that the return period of a vessel being involved in a collision post wind farm was 1,392 years assuming base case traffic levels. This represents a 46% increase in collision frequency compared to the pre wind farm base case result.

675. Assuming that tanker routeing to/from Milford Haven deviates east of the Array Area, it was estimated that the return period of a vessel being involved in a collision post wind farm was 1,101 years, representing an 84% increase in collision frequency compared to the pre wind farm base case result

676. The powered allision return period post wind farm was estimated at 4,277 years assuming base case traffic levels. The corresponding drifting allision return period post wind farm was estimated at 20,875 years. The fishing vessel allision return period was estimated at 16.8 years, noting that this conservatively assumes that there is no change in baseline fishing activity.

23.4 Risk Statement

677. Overall, the risk assessment of both the proposed Project in isolation and cumulatively with other developments concluded that there will be no significant risks arising from the proposed Project with embedded mitigation measures in place during the construction, operation and maintenance or decommissioning phases. The significance of risk for all hazards across the in isolation and cumulative risk assessments were predicted to be of **Broadly Acceptable** or **Tolerable with**

Mitigation and ALARP assuming the implementation of additional mitigation measures where identified.

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Appendix A Marine Guidance Note 654 Checklist

678. 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.

679. The checklist for the main MGN 654 guidance document is presented in **Table A.1**. Following this, the checklist for the MCA's methodology annex is presented in **Table A.2**. For both checklists, references to where the relevant information and / or assessment is provided in the NRA is given.

Table A.1 MGN 654 Checklist

Issue	Compliance	Comments
Site and Installation Coordinates. Developers are responsible for ensuring that formally agreed coordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as 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 analysis by vessel type given within the Study Area.
At least 28 days duration, within either 12 or 24 months prior to submission of the ES.	✓	**Section 5: Data Sources** A total of 28 full days of vessel traffic survey data from March 2022 and July 2023 has been assessed within the Study Area. Although this data is outwith the 24-month period required under MGN 654, as per **Section 5.1**, the MCA have agreed that the data period used is sufficient.
Multiple data sources.	✓	**Section 5: Data Sources** The vessel traffic survey data includes AIS, Radar and visual observations to maximise coverage of vessels not broadcasting on AIS. Geophysical survey data consisting of non-AIS visual observations and long-term vessel traffic data recorded on AIS have also been considered.
Seasonal variations.	✓	**Section 5: Data Sources** A total of 28 full days of vessel traffic survey data from March 2022 and July 2023 has been assessed within the study area. Error! Reference source not found.**: Long-Term Marine Traffic Movements** To assist with the assessment of seasonal variation a long-term AIS dataset covering 12 months in 2022 has also been assessed.

Issue	Compliance	Comments
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** Trinity House has been consulted as part of the NRA process including through the Hazard Workshop.
UK Chamber of Shipping consultation.	✓	**Section 4: Consultation** The UK Chamber of Shipping has been consulted as part of the NRA process including through the Hazard Workshop.
Recreational and fishing vessel organisations consultation.	✓	**Section 4: Consultation** The RYA has been consulted as part of the NRA process including through the Hazard Workshop.
Port and navigation authorities consultation, as appropriate.	✓	**Section 4: Consultation** MHPA have been consulted as part of the NRA process including through 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** Marine traffic data in proximity to the proposed Project has been broken down. **Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase. **Section 19: Cumulative Risk Assessment** The hazards due to the proposed Project and cumulative developments have been assessed for each phase.
ii. Numbers, types and sizes of vessels presently using such areas.	✓	**Section 10: Vessel Traffic Movements** Marine traffic data in proximity to the proposed Project has been broken down and includes analysis of daily vessel count, vessel type and vessel size.
iii. Non-transit uses of the areas, e.g., fishing, day cruising of leisure craft, racing, aggregate dredging, personal watercraft, etc.	✓	**Section 10: Vessel Traffic Movements** Non-transit users were identified in the vessel traffic survey data and included fishing vessels engaged in fishing activities, vessels awaiting orders, and anchoring activities.
iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓	**Section 11: Base Case Vessel Routeing** Main commercial routes have been identified using the principles set out in MGN 654 in proximity to the proposed Project, with these routes taking into account coastal, deep-draught and internationally scheduled vessels.
v. Alignment and proximity of the site relative to adjacent shipping lanes.	✓	**Section 7: Navigational Features** **Section 7.2** identifies IMO routeing measures in proximity to the proposed Project.

Issue	Compliance	Comments
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓	**Section 7: Navigational Features** **Section 7.2** identifies the IMO routeing measures in proximity to the proposed Project and **Section 7.10** identifies military PEXAs in proximity to the proposed Project.
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 7.3** identifies port approaches and pilot boarding stations in proximity to the proposed Project and **Section 7.6** identifies anchorage areas in proximity to the proposed Project.
viii. Whether the site lies within the jurisdiction of a port and / or navigation authority.	✓	**Section 7: Navigational Features** **Section 7.3** identifies the locations of ports in proximity to the proposed Project.
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	**Section 10: Marine Traffic Movements** Fishing vessel movements are considered within the study area. Detailed analysis of dedicated fishing vessel activities is undertaken in **Volume 3 Chapter 26: Commercial Fisheries**.
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	**Section 7: Navigational Features** **Section 7.10** identifies military PEXAs in proximity to the proposed Project.
xi. Proximity of the site to existing or proposed submarine cables or pipelines, offshore oil/gas platforms, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Areas or other exploration/exploitation sites.	✓	**Section 7: Navigational Features** **Section 7.11** identifies the marine aggregate dredging areas in proximity to the proposed Project and **Section 7.9** identifies the charted wrecks in proximity to the proposed Project.
xii. Proximity of the site to existing or proposed OREI developments, in cooperation with other relevant developers, within each round of lease awards.	✓	**Section 7: Navigational Features** **Section 7.1** Identifies other OWF developments in proximity to the proposed Project. **Section 14: Cumulative Screening** Considers other OREI sites in proximity to the proposed Project cumulatively.
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground.	✓	**Section 7: Navigational Features** Identifies spoil and dumping grounds in proximity to the proposed Project.
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 7.5** identifies VTS areas and aids to navigation in proximity to the proposed Project.

Issue	Compliance	Comments
xv. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of 'choke points' in areas of high traffic density and nearby or consented OREI sites not yet constructed.	✓	**Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the proposed Project including choke points in proximity to the proposed Project.
xvi. With reference to xv. above, the number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation.	✓	**Section 9: Emergency Response and Incident Overview** Historical vessel incident data published by DfT (**Section 9.3**), RNLI (**Section 9.4**), and MAIB (**Section 9.5**) in proximity to the proposed Project 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 recreational activities.
Predicted effect of OREI on traffic and interactive boundaries. Where appropriate, the following should be determined:		
a. The safe distance between a shipping route and OREI boundaries.	✓	**Section 15: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes a minimum distance of 1 nm from offshore installations and existing OWF boundaries.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	**Section 19: Cumulative Risk Assessment** Not directly applicable to the proposed Project although the refinement of the Array Area has ensured alignment with the gap between PDA 3 and 4.
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** Provides quantification of collision and allision risk resulting from the proposed Project. **Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase and include consideration of users such as commercial vessels, commercial fishing vessels in transit, recreational vessels, anchored vessels and emergency responders.

Issue	Compliance	Comments
b. Clearances of fixed or floating WTG blades above the sea surface are not less than 22 m (above MHWS for fixed). Floating WTGs allow for degrees of motion.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** **Section 6.2.2** outlines the shipping and navigation worst case scenario for WTGs including the minimum air gap above MSL.
c. Underwater devices: i. Changes to charted depth; ii. Maximum height above seabed; and iii. Under keel clearance.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** **Section 6.2.2.1** and **Section 6.3.1** outline the shipping and navigation worst case scenario for subsea cables including the cable burial specifications and floating substructures.
d. Whether structures block or hinder the view of other vessels or other navigational features.	✓	**Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase and include consideration of the potential for vessels navigating in proximity to structures to be visually obscured or inhibit the use of existing aids to navigation.
The effect of tides, tidal streams and weather. It should be determined whether:		
a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide, i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** **Section 6.1** outlines the shipping and navigation worst case scenario for the Array Area and includes the range of existing water depths. **Section 8: Meteorological Ocean Data** **Section 8.4** provides meteorological data in proximity to the proposed Project relating to various states of the tide. **Section 10: Vessel Traffic Movements** Marine traffic data in proximity to the proposed Project has been broken down including vessel draught. **Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the proposed Project including accounting for tidal conditions.
b. The set and rate of the tidal stream, at any state of the tide, has a significant effect on vessels in the area of the OREI site.	✓	**Section 8: Meteorological Ocean Data** **Section 8.4** provides meteorological data in proximity to the proposed Project relating to various states of the tide. **Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the proposed Project including accounting for tidal conditions.
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	
d. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓	

Issue	Compliance	Comments
e. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream, including unpowered vessels and small, low speed craft.	✓	**Section 8: Meteorological Ocean Data** **Section 8.4** provides meteorological data in proximity to the proposed Project relating to various states of the tide. **Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the proposed Project including accounting for tidal conditions and assessment of 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** **Section 8.4** provides meteorological data in proximity to the proposed Project relating to various states of the tide and notes that no effects are anticipated.
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the wind farm area or adjacent to the area.	✓	**Section 8: Meteorological Ocean Data** **Section 8.4** provides meteorological data in proximity to the proposed Project relating to various states of the tide. **Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase and include consideration of the potential for reduction in under keel clearance.
h. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✓	**Section 8: Meteorological Ocean Data** Provides meteorological data in proximity to the proposed Project relating to weather and visibility. **Section 10: Vessel Traffic Movements** Marine traffic data in proximity to the proposed Project has been broken down including recreational vessels. **Section 12: Adverse Weather Routeing** **Section 12.2** identifies alternative vessel routeing in proximity to the proposed Project in adverse weather. **Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase and include consideration of adverse weather routeing.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	**Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase and include consideration of internal allision risk for vessels under sail.

Issue	Compliance	Comments
j. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above.	✓	**Section 8: Meteorological Ocean Data** Provides meteorological data in proximity to the proposed Project relating to wind direction and various states of the tide. **Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the proposed Project including accounting for weather conditions and assessment of whether machinery failure could cause vessels to be set into danger. **Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase and include consideration of drifting allision risk.
Assessment of access to and navigation within, or close to, an OREI. To determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:		
a. Navigation within or close to the site would be safe:		
i. For all vessels.	✓	**Section 4: Consultation** **Section 4.1** outlines Regular Operator consultation undertaken following the vessel traffic surveys. **Section 12: Adverse Weather Routeing** **Section 12.2** identifies alternative vessel routeing in proximity to the proposed Project in adverse weather. **Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the proposed Project including accounting for weather and tidal conditions. **Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase and include consideration of internal allision risk.
ii. For specified vessel types, operations and / or sizes.		
iii. In all directions or areas.		
iv. In specified directions or areas.		
v. In specified tidal, weather or other conditions.		
b. Navigation in and / or near the site should be prohibited or restricted:		
i. For specified vessel types, operations and / or sizes.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Assesses potential hazards on navigation of the different communications and position fixing devices used in and around OWFs.
ii. In respect of specific activities.	✓	
iii. In all areas or directions.	✓	
iv. In specified areas or directions.	✓	

Issue	Compliance	Comments
v. In specified tidal or weather conditions.	✓	**Section 15: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes a minimum distance of 1 nm from offshore installations and existing OWF boundaries, i.e., it is assumed that commercial vessels will avoid the Array Area. **Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase and include consideration of vessel displacement.
c. Where it is not feasible for vessels to access or navigate through the site it could cause navigational, safety or routeing problems for vessels operating in the area, e.g., by preventing vessels from responding to calls for assistance from persons in distress.	✓	**Section 17: In Isolation Risk Assessment** The hazards due to the proposed Project have been assessed for each phase and include consideration of vessel displacement and emergency response capability.
d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered.	✓	**Section 15: Future Case Vessel Traffic** A methodology for post wind farm routeing is outlined and includes consideration of the Shipping Route Template.
SAR, maritime assistance service, counter pollution and salvage incident response.		
The MCA, through HM Coastguard, is required to provide SAR and emergency response within the sea area occupied by all OREIs in UK waters. To ensure that such operations can be safely and effectively conducted, certain requirements must be met by developers and operators.		
a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.	✓	**Section 21: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including compliance with MGN 654 which includes the provision of an ERCoP.
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 2: Guidance and Legislation** Outlines the guidance and legislation used within the NRA including Annex 5 of MGN 654. **Section 21: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including compliance with MGN 654 and its annexes.

Issue	Compliance	Comments
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 21: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including compliance with MGN 654 which includes the completion of the SAR checklist.
6. Hydrography. In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
i. Pre construction: The proposed generating assets area and proposed cable route.	✓	**Section 22: Through Life Safety Management** Confirms that hydrographic surveys will be undertaken in agreement with the MCA.
ii. On a pre-established periodicity during the life of the development.	✓	
iii. Post construction: Cable route(s).	✓	
iv. Post decommissioning of all or part of the development: the installed generating assets area and cable route.	✓	
Communications, Radar and positioning systems. To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:		
a. The structures could produce radio interference such as shadowing, reflections or phase changes, and emissions with respect to any frequencies used for marine positioning, navigation and timing (PNT) or communications, including GMDSS and AIS, whether ship borne, ashore or fitted to any of the proposed structures, to:		
i. Vessels operating at a safe navigational distance.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the proposed Project including in relation to radio interference.
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.	✓	
ii. Vessel to shore.	✓	
iii. VTS Radar to vessel.	✓	

Issue	Compliance	Comments
iv. Racon to / from vessel.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the proposed Project including in relation to marine Radar.
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** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the proposed Project including in relation to SONAR.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the proposed Project including in relation to noise.
e. Generators and the seabed cabling within the site and onshore might produce EMFs affecting compasses and other navigation systems.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the proposed Project including in relation to electromagnetic interference.
Risk mitigation measures recommended for OREI during construction, operation and decommissioning.		
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the EIA. The specific measures to be employed will be selected in consultation with the MCA and will be listed in the developer's ES. These will be consistent with international standards contained in, for example, SOLAS Chapter V (IMO, 1974), and could include any or all of the following:		
i. Promulgation of information and warnings through notices to mariners and other appropriate MSI dissemination methods.	✓	**Section 21: Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including promulgation of information.
ii. Continuous watch by multi-channel VHF, including DSC.	✓	**Section 21: Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including marine coordination.
iii. Safety zones of appropriate configuration, extent and application to specified vessels[9].	✓	**Section 21: 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.
iv. Designation of the site as an ATBA.	✓	There are no plans to designate the proposed Project as an ATBA.

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

Issue	Compliance	Comments
v. Provision of aids to navigation as determined by the GLA.	✓	**Section 21: Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including lighting and marking in accordance with Trinity House and MCA requirements.
vi. Implementation of routeing measures within or near to the development.	✓	There are no plans to implement any new routeing measures in proximity to the proposed Project.
vii. Monitoring by Radar, AIS, Closed Circuit Television (CCTV) or other agreed means.	✓	**Section 21: Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including traffic monitoring.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of Safety Zones.	✓	**Section 21: 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 and use of guard vessels, which will be considered in further detail in the Safety Zone Application, submitted post consent.
ix. Creation of an ERCoP with the MCA's SAR Branch for the construction phase onwards.	✓	**Section 21: Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including compliance with MGN 654 which include the provision of an ERCoP.
x. Use of guard vessels, where appropriate.	✓	**Section 21: Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including the use of guard vessels.
xi. Update NRAs every two years, e.g. at testing sites.	✓	Not applicable to the proposed Project.
xii. Device-specific or array-specific NRAs.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** All offshore elements of the proposed Project have been considered in this NRA including all infrastructure (surface and subsea) within the Array Area and OfECC.
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 21: Mitigation Measures** Outlines the mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards, including those embedded and additional. **Section 22: Through Life Safety Management** Outlines how QHSE documentation will be maintained and reviewed.

Table A.2 MGN 654 Annex 1 Checklist

Item	Compliance	Comments
A risk claim is included that is supported by a reasoned argument and evidence.	✓	**Section 17: In Isolation Risk Assessment** Risk assessment for a range of hazards based on a number of inputs including (but not limited to) baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments. **Section 23: Summary** **Section 23.4** provides a concluding risk statement.
Description of the marine environment.	✓	**Section 7: Navigational Features** Relevant navigational features in proximity to the proposed Project have been described. **Section 14: Cumulative and Transboundary Overview** Potential future developments have been screened in to the cumulative risk assessment where a cumulative or in combination activity has been identified based upon the location and distance from the proposed Project, including consideration of other OWFs.
SAR overview and assessment.	✓	**Section 9: Emergency Response and Incident Overview** Existing SAR resources in proximity to the proposed Project are summarised including the UK SAR operations contract, RNLI stations and assets and HMCG stations. **Section 17: In Isolation Risk Assessment** The risk assessment includes an assessment of how activities associated with the proposed Project may restrict emergency response capability of existing resources.
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 Project for which any shipping and navigation hazards are assessed is provided. **Section 15: Future Case Vessel Traffic** Worst case alternative routeing for commercial traffic has been considered.
Analysis of the vessel traffic, including base case and future traffic densities and types.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the proposed Project has been analysed and includes vessel density and analysis of vessel type. **Section 15: Future Case Vessel Traffic** Future vessel traffic levels have been considered, broken down as increases in commercial vessel activity, commercial fishing vessel and recreational vessel activity, and increases in traffic associated with project operations. Additionally, worst case alternative routeing for commercial traffic has been considered.

Item	Compliance	Comments
Status of the hazard log: ▪ Hazard identification; ▪ Risk assessment; ▪ Influences on level of risk; ▪ Tolerability of risk; and ▪ Risk matrix.	✓	**Section 3: Navigational Risk Assessment Methodology** A tolerability matrix has been defined to determine the tolerability (significance) of risks. Error! Reference source not found.**: Hazard Log** The complete hazard log is presented and includes a description of the hazards considered, possible causes, consequences (most likely and worst case) and relevant embedded mitigation measures. Using this information, each hazard is then ranked in terms of frequency of occurrence and severity of consequence to give a tolerability (significance) level.
NRA: ▪ Appropriate risk assessment; ▪ MCA acceptance for assessment techniques and tools; ▪ Demonstration of results; and ▪ Limitations.	✓	**Section 2: Guidance and Legislation** MGN 654 and the IMO's FSA guidelines are the primary guidance documents used for the assessment alongside MGN 372. **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the with the results outlined numerically and graphically, where appropriate.
Risk control log	✓	**Section 20: Risk Control Log** Provides the risk control log which summarises the assessment of shipping and navigation hazards scoped into the risk assessment. This includes the proposed embedded mitigation measures, frequency of occurrence, severity of consequence and significance of risk, per hazard.

Appendix B Hazard Log

680. As per **Section 4.3**, a Hazard Workshop was held for the proposed Project on 22 August 2023. Following this, a Hazard Log was drafted and distributed to attendees for agreement. The OfECC presented at the Hazard Workshop was a previous iteration which has since been refined to that presented in **Section** Error! Reference source not found.. As described, this originally passed closer to the approaches to Milford Haven and so this is reflected in relevant hazard rankings.

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

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

682. The Hazard Log is shown below.

Table B.1 Hazard Log

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
Vessel Displacement and Increased Vessel to Vessel Collision Risk Between Third-Party Vessels (Including Adverse Weather Routeing)																						
Commercial vessels	Array Area	C/D	• Application for safety zones • Buoyed construction/ decommissioning area • Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information • Traffic Monitoring	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM • The presence of Erebus (under construction, operational or decommissioning)	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	3	2	2.3	Broadly Acceptable	Displacement, including due to the presence of Erebus, with effects on schedule and high impact collision event occurs involving vessel damage, Potential Loss of Life (PLL), and/or pollution	2	3	4	4	4	3.8	Broadly Acceptable	None	MHPA indicated that commercial traffic collision risk post construction would likely be highest to the south of the Array Area, where routes would meet Trinity House considered that with Erebus and the Llŷr Project in situ the chances of tanker routes passing east of the Array Area are low MHPA noted that with two distinct routeing options (east and west of the Array Area), tidal constraints may be deconflicted MHPA considered a shift in waiting tankers to the east post-Erebus unlikely, but some of the larger loops observed would no longer occur
		O	• Application for safety zones (major maintenance only) • Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM • The presence of Erebus (under construction, operational or decommissioning)		1	2	2	3	2	2.3	Broadly Acceptable		3	5	4	4	4	4.3	Tolerable with Mitigation		
	OfECC	C/D	• Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information	• Installation vessel which is RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	2	2	3	2	2.3	Broadly Acceptable	Displacement with effects on schedule and high impact collision event occurs involving vessel damage, PLL, and/or pollution	1	3	4	4	4	3.8	Broadly Acceptable	None	
		O		• Maintenance vessel which is RAM		2	2	2	3	2	2.3	Broadly Acceptable		1	3	4	4	4	3.8	Broadly Acceptable		

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Commercial fishing vessels in transit	Array Area	C/D	• Application for safety zones • Buoyed construction/ decommissioning area • Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information • Traffic Monitoring	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	3	3	1	3	1	2.0	Broadly Acceptable	Displacement with effects on schedule and high impact collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	5	3.8	Broadly Acceptable	None	
		O	• Application for safety zones (major maintenance only) • Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		2	3	1	3	1	2.0	Broadly Acceptable		1	4	2	4	5	3.8	Broadly Acceptable		
	OfECC	C/D	• Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information	• Installation vessel which is RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	2	3	1	3	1	2.0	Broadly Acceptable	Displacement with effects on schedule and high impact collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	3	3.3	Broadly Acceptable	None	
		O		• Maintenance vessel which is RAM		1	3	1	3	1	2.0	Broadly Acceptable		1	4	2	4	3	3.3	Broadly Acceptable		
Recreational vessels (2.5 to 24m length)	Array Area	C/D	• Application for safety zones • Buoyed construction/ decommissioning area • Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information • Traffic Monitoring	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM • The presence of Erebus (under construction, operational or decommissioning)	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	2	3	1	3	1	2.0	Broadly Acceptable	Displacement with effects on schedule and high impact collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	None	RYA indicated that yachtsmen will pass between the Llŷr Project and Erebus particularly where this may allow the avoidance of tanker routeing

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
				with navigation between the Array Area and Erebus																		
		O	• Application for safety zones (major maintenance only) • Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM • The presence of Erebus (under construction, operational or decommissioning)		2	3	1	3	1	2.0	Broadly Acceptable		1	4	2	4	2	3.0	Broadly Acceptable		RYA noted that currently it is not common for recreational craft to transit within an array RYA indicated that yachtsmen will pass between the Llŷr Project and Erebus particularly where this may allow the avoidance of tanker routeing
	OfECC	C/D	• Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information	• Installation vessel which is RAM	Displacement with effects on schedule and low impact collision event occurs involving minor vessel damage	2	3	1	3	1	2.0	Broadly Acceptable	Displacement with effects on schedule and high impact collision event occurs involving vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable	None	
		O		• Maintenance vessel which is RAM		1	3	1	3	1	2.0	Broadly Acceptable		2	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	Array Area	C/D	• Application for safety zones • Charting of infrastructure • Guard vessels • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (COLREGs)	• Project vessels in transit • Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	4	1	1	1	2	1.3	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	3	4	4	4	3.8	Broadly Acceptable	None	
		O				3	1	1	1	2	1.3	Broadly Acceptable		1	3	4	4	4	3.8	Broadly Acceptable	None	

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
						Frequency	Consequences					Risk		Frequency	Consequences					Risk		
							People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence			
			• Promulgation of information																			
	OfECC	C/D	• Charting of infrastructure • Guard vessels • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (COLREGs) • Promulgation of information	• Project vessels in transit • Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	2	1.3	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	4	4	5	5	4.5	Broadly Acceptable	None	MHPA confirmed that installation activities could be managed through the Milford Haven Vessel Traffic Service
		O				2	1	1	1	2	1.3	Broadly Acceptable		1	4	4	5	5	4.5	Broadly Acceptable	None	
Commercial fishing vessels in transit	Array Area	C/D	• Application for safety zones • Charting of infrastructure • Guard vessels • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (COLREGs) • Promulgation of information	• Project vessels in transit • Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	2	1.3	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	5	3.8	Broadly Acceptable	None	
		O				2	1	1	1	2	1.3	Broadly Acceptable		1	4	2	4	5	3.8	Broadly Acceptable	None	
	OfECC	C/D	• Charting of infrastructure • Guard vessels • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (COLREGs) • Promulgation of information	• Project vessels in transit • Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	2	1	1	1	2	1.3	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	3	3.3	Broadly Acceptable	None	MHPA confirmed that installation activities could be managed through the Milford Haven Vessel Traffic Service
		O				1	1	1	1	2	1.3	Broadly Acceptable		1	4	2	4	3	3.3	Broadly Acceptable	None	

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
Recreational vessels (2.5 to 24m length)	Array Area	C/D	• Application for safety zones • Charting of infrastructure • Guard vessels • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (COLREGs) • Promulgation of information	• Project vessels in transit • Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	None	
		O				2	1	1	1	1	1.0	Broadly Acceptable		2	4	2	4	2	3.0	Broadly Acceptable	None	
	OfECC	C/D	• Charting of infrastructure • Guard vessels • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (COLREGs) • Promulgation of information	• Project vessels in transit • Lack of third-party awareness	Increased encounters resulting in increased alertness but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	2	3.0	Broadly Acceptable	None	MHPA confirmed that installation activities could be managed through the Milford Haven Vessel Traffic Service
		O				3	1	1	1	1	1.0	Broadly Acceptable		1	4	2	4	2	3.0	Broadly Acceptable	None	
Creation of Vessel to Structure Allision Risk (Including Powered, Drifting and Internal)																						
Commercial vessels	Array Area	O	• Application for safety zones (major maintenance only) • Charting of infrastructure • Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (SOLAS)	• Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, PLL, and/or pollution	2	4	4	5	5	4.5	Tolerable with Mitigation	None	

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
			• Promulgation of information																			
Commercial fishing vessels in transit	Array Area	O	• Application for safety zones (major maintenance only) • Charting of infrastructure • Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (SOLAS) • Promulgation of information	• Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, PLL, and/or pollution	1	4	2	4	4	3.5	Broadly Acceptable	None	
Recreational vessels (2.5 to 24m length)	Array Area	O	• Application for safety zones (major maintenance only) • Charting of infrastructure • Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels • Minimum blade tip clearance • Pollution planning • Project vessel compliance with international marine regulations (SOLAS)	• Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, PLL, and/or pollution	2	4	2	4	3	3.3	Broadly Acceptable	None	

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
			• Promulgation of information																			
Anchor Interaction with Mooring Lines or Subsea Cables																						
Commercial vessels	Sub-sea cables and mooring lines	O	• MGN 654 compliance • Marking on charts • Promulgation of information • Lighting and marking • Cable Burial Risk Assessment (undertaken post submission)	• Presence of mooring lines • Presence of subsea cables • Mooring line design • Human error or navigational error • Mechanical or technical failure resulting in a vessel drifting • Adverse weather	Vessel drops or drags anchor in vicinity of an installed cable or mooring lines but no interaction occurs	4	1	1	1	1	1.0	Broadly Acceptable	Vessel drops or drags anchor in vicinity of an installed cable or mooring line resulting in damage to the cable/mooring line and/or anchor	3	3	2	3	3	2.8	Broadly Acceptable	None	UK Chamber of Shipping noted that routeing vessels may interact with the OfECC including should emergency anchoring occur
Commercial fishing vessels in transit	Sub-sea cables and mooring lines	O	• MGN 654 compliance • Marking on charts • Promulgation of information • Lighting and marking • Cable Burial Risk Assessment (undertaken post submission)	• Presence of mooring lines • Presence of subsea cables • Mooring line design • Human error or navigational error • Mechanical or technical failure resulting in a vessel drifting • Adverse weather	Vessel drops or drags anchor in vicinity of an installed cable or mooring lines but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel drops or drags anchor in vicinity of an installed cable or mooring line resulting in damage to the cable/mooring line and/or anchor	2	3	2	3	3	2.8	Broadly Acceptable	None	UK Chamber of Shipping noted that routeing vessels may interact with the OfECC including should emergency anchoring occur
Recreational vessels (2.5 to 24m length)	Sub-sea cables and mooring lines	O	• MGN 654 compliance • Marking on charts • Promulgation of information • Lighting and marking • Cable Burial Risk Assessment	• Presence of mooring lines • Presence of subsea cables • Mooring line design • Human error or navigational error • Mechanical or	Vessel drops or drags anchor in vicinity of an installed cable or mooring lines but no interaction occurs	3	1	1	1	1	1.0	Broadly Acceptable	Vessel drops or drags anchor in vicinity of an installed cable or mooring line resulting in damage to the cable/mooring line and/or anchor	2	3	2	3	3	2.8	Broadly Acceptable	None	UK Chamber of Shipping noted that routeing vessels may interact with the OfECC including should emergency anchoring occur

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
			(undertaken post submission)	technical failure resulting in a vessel drifting • Adverse weather																		
Loss of Station																						
All vessels	Array Area	O	• MGN 654 compliance • Compliance with floating foundation guidance • Promulgation of information • Lighting and marking • COLREGs / SOLAS • Minimum 22m blade clearance • Guard vessel (via risk assessment)	• Damage to or failure of mooring line(s)	Failure of a single mooring line leads to temporary increase in the maximum excursion of the floating structure but not full loss of station	3	2	2	2	1	1.8	Broadly Acceptable	Total failure of mooring system leads to drifting of floating structure with risk of allision with vessels	2	4	4	4	4	4.0	Tolerable with Mitigation	AIS tracking on floating structures	MCA noted that additional mitigation could include recovery arrangements and response times
Reduction of Under-Keel Clearance due to Mooring Lines, Buoyant Inter-array Cables or Cable Protection																						
All vessels	Sub-sea cables and mooring lines	O	• Compliance with floating foundation guidance • Cable Burial Risk Assessment (undertaken post submission) • Guard vessels • Pollution planning	• Reduced navigable depth due to buoyant inter-array cables, mooring lines, or cable protection	Vessel transits close to or over a buoyant inter-array cable, mooring line, or cable protection but does not make contact	5	1	1	1	1	1.0	Tolerable with Mitigation	Interaction with buoyant inter-array cable, mooring line, or cable protection resulting in vessel damage, injury to person and/or pollution (including spillage of potential hazardous cargo)	2	3	4	4	4	3.8	Broadly Acceptable	None	RYA noted that under keel clearance needs to be considered but greater than 3m should largely be sufficient UK Chamber of Shipping indicated that export cables crossing the routeing at 90° would be preferable to minimise interaction
Reduction in Port Access																						
Commercial vessels	Array area	C/D	• Application for safety zones • Buoyed construction/ decommissioning area • Compliance with MGN 654	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning	Displacement with limited effects on port schedule	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule	3	1	1	1	5	2.0	Broadly Acceptable	None	MHPA confirmed that installation activities could be managed through the Milford Haven Vessel Traffic Service noting that there is a statutory duty to keep the port open

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
			• Charting of infrastructure • Promulgation of information • Traffic monitoring	vessels which are RAM																		
		O	• Application for safety zones (major maintenance only) • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		2	1	1	1	1	1.0	Broadly Acceptable		2	1	1	1	5	2.0	Broadly Acceptable	None	
	OfECC	C/D	• Cable Burial Risk Assessment (undertaken post submission) • Compliance with MGN 654 • Charting of infrastructure • Pollution planning • Promulgation of information	• Installation vessel which is RAM blocking access channel	Displacement with limited effects on port schedule	5	1	1	1	1	1.0	Tolerable with Mitigation	Displacement with effects on port schedule causing congestion and potential for subsequent safety risks	4	2	4	3	5	3.5	Tolerable with Mitigation	None	
		O		• Maintenance vessel which is RAM blocking access channel		4	1	1	1	1	1.0	Broadly Acceptable		3	2	4	3	5	3.5	Tolerable with Mitigation	None	
Commercial fishing vessels in transit	Array area	C/D	• Application for safety zones • Buoyed construction/ decommissioning area • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information • Traffic monitoring	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with limited effects on port schedule	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule	1	4	2	3	2	2.8	Broadly Acceptable	None	MHPA noted that Belgian fishers are not currently landing at Milford Haven MHPA confirmed that installation activities could be managed through the Milford Haven Vessel Traffic Service noting that there is a statutory duty to keep the port open
		O	• Application for safety zones (major maintenance only) • Compliance with MGN 654 • Charting of infrastructure	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	2	2.8	Broadly Acceptable	None	

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
			• Promulgation of information																			
	OfECC	C/D	• Cable Burial Risk Assessment (undertaken post submission) • Compliance with MGN 654 • Charting of infrastructure • Pollution planning • Promulgation of information	• Installation vessel which is RAM blocking access channel	Displacement with limited effects on port schedule	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule causing congestion and potential for subsequent safety risks	2	4	2	3	2	2.8	Broadly Acceptable	None	
	OfECC	O		• Maintenance vessel which is RAM blocking access channel		1	1	1	1	1	1.0	Broadly Acceptable		2	4	2	3	2	2.8	Broadly Acceptable	None	
Recreational vessels (2.5 to 24m length)	Array area	C/D	• Application for safety zones • Buoyed construction/ decommissioning area • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information • Traffic monitoring	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Displacement with limited effects on port schedule	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule	2	4	2	3	2	2.8	Broadly Acceptable	None	MHPA confirmed that installation activities could be managed through the Milford Haven Vessel Traffic Service noting that there is a statutory duty to keep the port open
Recreational vessels (2.5 to 24m length)	Array area	O	• Application for safety zones (major maintenance only) • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		1	1	1	1	1	1.0	Broadly Acceptable		2	4	2	3	2	2.8	Broadly Acceptable	None	
Recreational vessels (2.5 to 24m length)	OfECC	C/D	• Cable Burial Risk Assessment (undertaken post submission) • Compliance with MGN 654 • Charting of infrastructure • Pollution planning	• Installation vessel which is RAM blocking access channel	Displacement with limited effects on port schedule	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on port schedule causing congestion and potential for subsequent safety risks	3	4	2	3	2	2.8	Broadly Acceptable	None	
Recreational vessels (2.5 to 24m length)	OfECC	O		• Maintenance vessel which is RAM blocking access channel		2	1	1	1	1	1.0	Broadly Acceptable		3	4	2	3	2	2.8	Broadly Acceptable	None	

User	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Further Mitigation Required	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
			• Promulgation of information																			
Interference with Marine Navigation, Communication and Position Fixing Equipment																						
All vessels	Array Area	O	• Cable Burial Risk Assessment (undertaken post submission)	• Human error relating to adjustment of Radar controls • Presence of surface structures	Structures have no material effect upon the Radar, communications and navigation equipment on a vessel	4	1	1	1	1	1.0	Broadly Acceptable	Very low level of Radar interference due to the structures	3	1	1	1	1	1.0	Broadly Acceptable	None	
	OfECC	O	• Cable Burial Risk Assessment (undertaken post submission)	• EMF from cables	Cables have no material effect upon the Radar, communications and navigation equipment on a vessel	4	1	1	1	1	1.0	Broadly Acceptable	Very low level of EMF interference due to the wind farm infrastructure	3	1	1	1	1	1.0	Broadly Acceptable	None	
Reduction in Emergency Response Capability (Including SAR Access)																						
Emergency responders	Array Area	O	• Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (SOLAS)	• Array does not facilitate responder access • Limited resource capability • Adverse weather	Delay to response request	3	1	1	1	2	1.3	Broadly Acceptable	Delay to response request leading to vessel damage, injury to person, PLL, and/or pollution	1	5	5	5	5	5.0	Tolerable with Mitigation	None	
	OfECC	O	• Cable Burial Risk Assessment (undertaken post submission) • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (SOLAS)	• Limited resource capability	Delay to response request	2	1	1	1	2	1.3	Broadly Acceptable	Delay to response request leading to vessel damage, injury to person, PLL, and/or pollution	1	5	5	5	5	5.0	Tolerable with Mitigation	None	

Appendix C Consequences Assessment

683. This appendix presents an assessment of the consequences of collision and allision incidents, in terms of people and the environment, due to the presence of the wind farm structures.

684. The significance of risk of the hazards due to the presence of the Array Area are also assessed based upon risk evaluation criteria and comparison with historical accident data in UK waters[10].

C.1 Risk Evaluation Criteria

C.1.1 Risk to People

685. With regard to the assessment of risk to people two measures are considered, namely:

- Individual risk; and
- Societal risk.

C.1.2 Annual Individual Risk

686. Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of the proposed Project. Individual risk considers not only the frequency of the accident and the consequences (e.g., likelihood of death), but also the individual's fractional exposure to that risk, i.e., the probability of the individual being in the given location at the time of the incident.

687. The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the proposed Project are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of the proposed Project relative to the background individual risk levels.

688. Annual risk levels to crew (the annual risk to an average crew member) for different vessel types are presented in **Figure C.1**, which also includes the upper and lower bounds for risk acceptance criteria as suggested in IMO MSC 72/16 (IMO, 2001). The annual individual risk to crew falls within the ALARP region for each of the vessel types presented.

[10] For the purposes of this assessment, UK waters is defined as the UK EEZ and UK territorial waters refers to the 12 nm limit from the British Isles, excluding the Republic of Ireland.

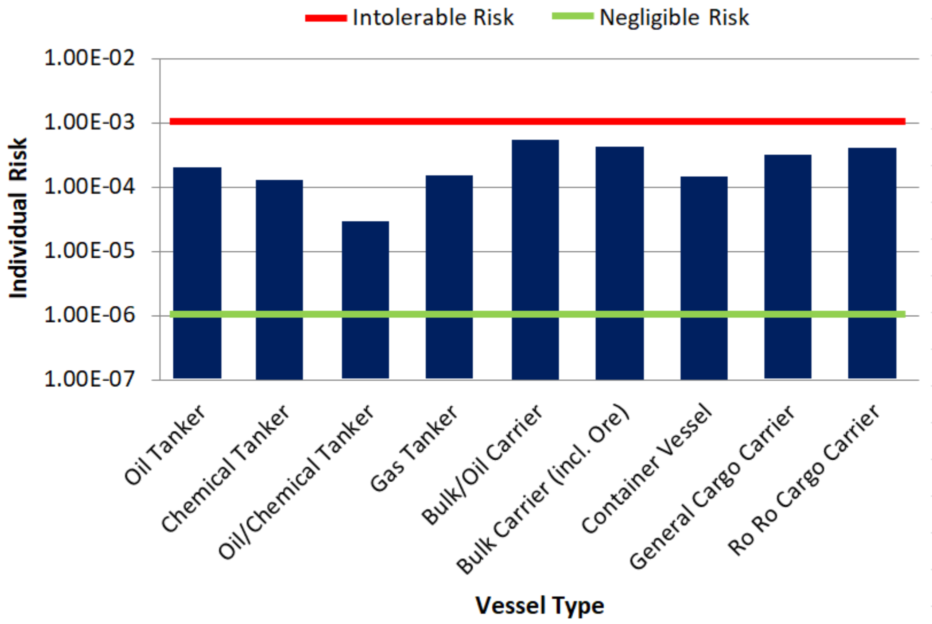


Figure C.1 Individual Risk Levels and Acceptance Criteria per Vessel Type

689. Typical bounds defining the ALARP regions for decision making within shipping are presented in **Table C.1**. It can be seen that for a new vessel the target upper bound for ALARP is set lower since new vessels are expected to be safer.

Table C.1 Individual Risk ALARP Criteria

Individual	Lower Bound for ALARP	Upper Bound for ALARP
To crew member	10^{-6}	10^{-3}
To passenger	10^{-6}	10^{-4}
Third party	10^{-6}	10^{-4}
New vessel target	10^{-6}	Above values reduced by one order of magnitude

690. On a UK basis, the MCA website presents individual risks for various UK industries based upon Health, Safety, and Environment (HSE) data from 1987 to 1991. The risks for different industries are presented in **Figure C.2**.

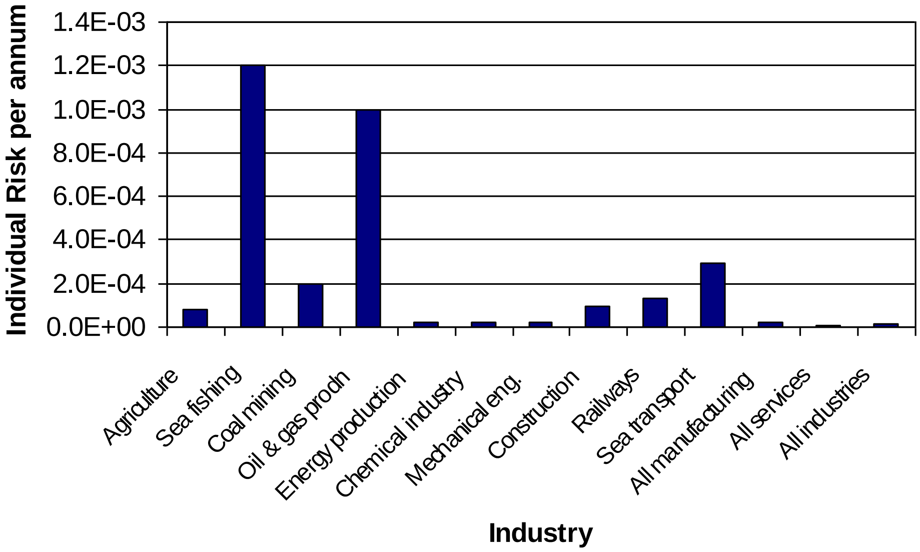


Figure C.2 Individual Risk per Year for Various UK Industries

691. The individual risk for sea transport of 2.9×10^{-4} per year is consistent with the worldwide data presented in **Figure C.2**, whilst the individual risk for sea fishing of 1.2×10^{-3} per year is the highest across all of the industries included.

C.1.3 Societal Risk

692. Societal risk is used to estimate risks of accidents affecting many persons (catastrophes) and acknowledging risk adverse or neutral attitudes. Societal risk includes the risk to every person, even if a person is only exposed to risk on one brief occasion. For assessing the risk to a large number of affected people societal risk is desirable because individual risk is insufficient in evaluating risks imposed on large numbers of people.

693. Within this assessment, societal (navigation-based) risk can be assessed within the Array Area, giving account to the change in risk associated with each accident scenario caused by the introduction of the wind farm structures. Societal risk may be expressed as:

- Annual fatality rate where frequency and fatality are combined into a convenient one-dimensional measure of societal risk (also known as PLL); and
- F-N diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

694. When assessing societal risk this study focuses on PLL, which takes into account the number of people likely to be involved in an incident (which is higher for certain vessel types) and assesses the significance of the change in risk compared to the background risk levels.

C.1.4 Risk to Environment

695. For risk to the environment the key criteria considered in terms of the risk due to the proposed Project is the potential quantity of oil spilled from a vessel involved in an incident.

696. 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 Project to background pollution risk levels for the UK.

C.2 Marine Accident Investigation Branch Incident Analysis

C.2.1 All UK Waters Incidents

697. All British flagged commercial vessels are required to report incidents to the MAIB. Non-British flagged vessels do not have to report an incident to the MAIB unless located at a UK port or within 12 nm territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report incidents to the MAIB; however, a significant proportion of such incidents are reported to and investigated by the MAIB.

698. 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.

699. 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 Project.

700. 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).

701. The location of all incidents in proximity to the UK are presented in **Figure C.3**, colour-coded by incident type. The distribution of unique incidents by year in UK waters is presented in **Figure C.4**.

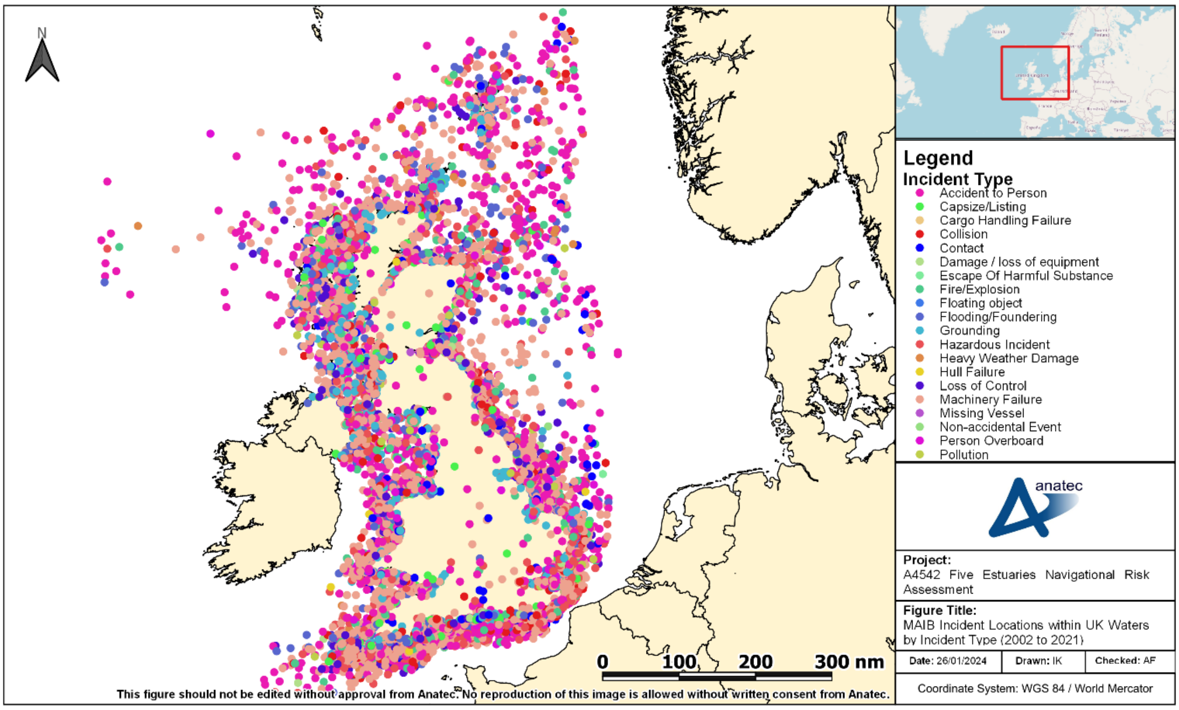


Figure C.3 MAIB Incident Locations within UK Waters by Incident Type (2002 to 2021)

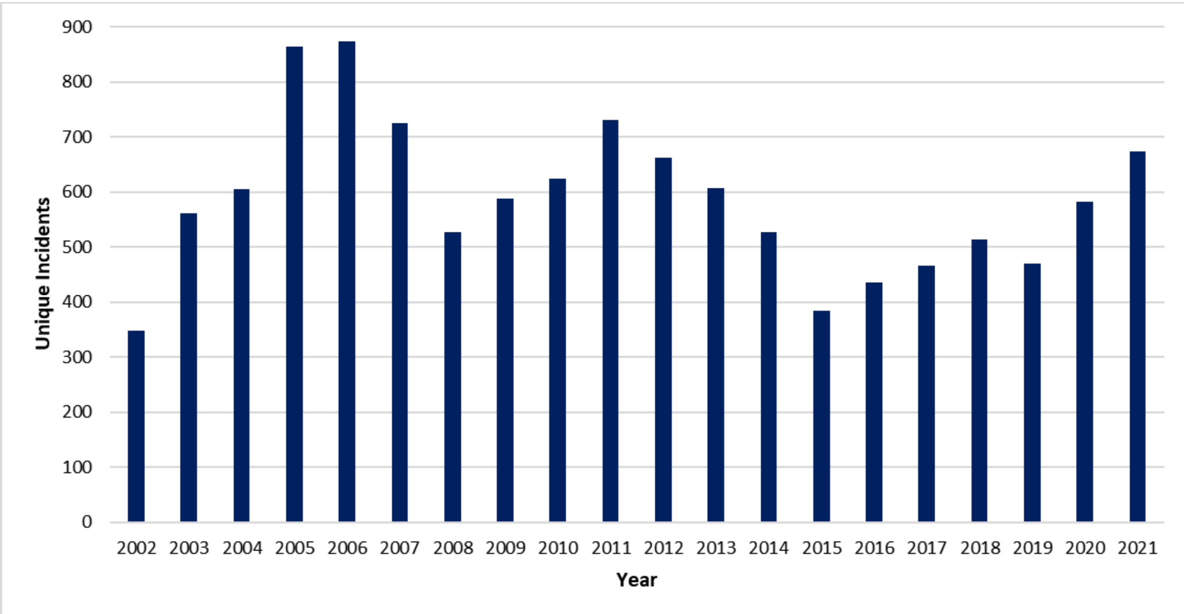


Figure C.4 MAIB Unique Incidents per Year within UK Waters (2002 to 2021)

702. The average number of unique incidents per year was 589. There has generally been a fluctuating trend in incidents over the 20-year period.

703. The distribution of incidents in UK waters by incident type is presented in **Figure C.5**.

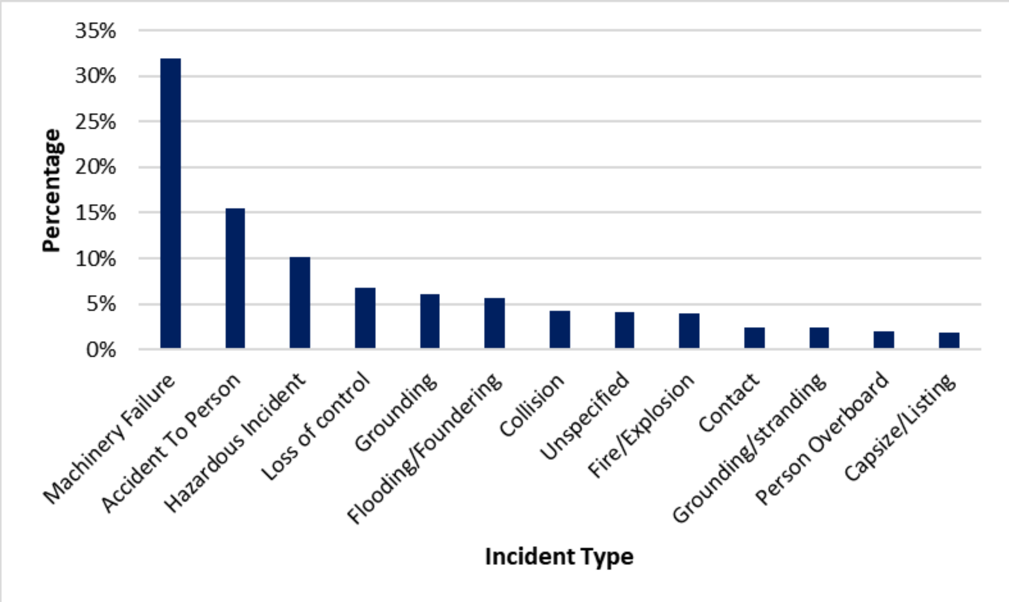


Figure C.5 MAIB Incident Types Analysis within UK Waters (2002 to 2021)

704. 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.

705. The distribution of incidents in UK waters by vessel type is presented in **Figure C.6**.

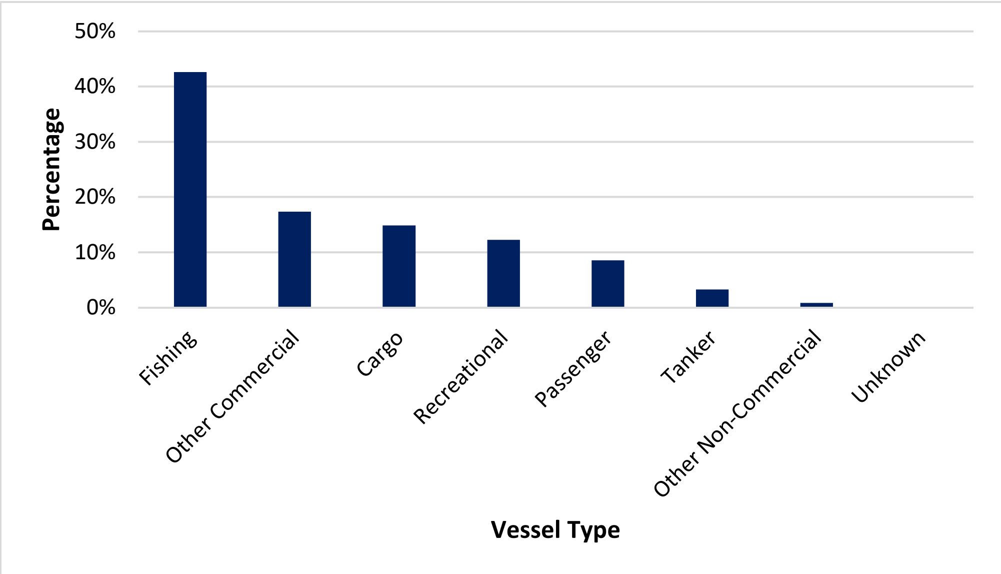


Figure C.6 MAIB Incident Types Analysis within UK Waters (2002 to 2021)

706. 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%).

707. 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.

708. The distribution of fatalities in UK waters by vessel type and person category (crew, passenger and other) is presented in **Figure C.7**.

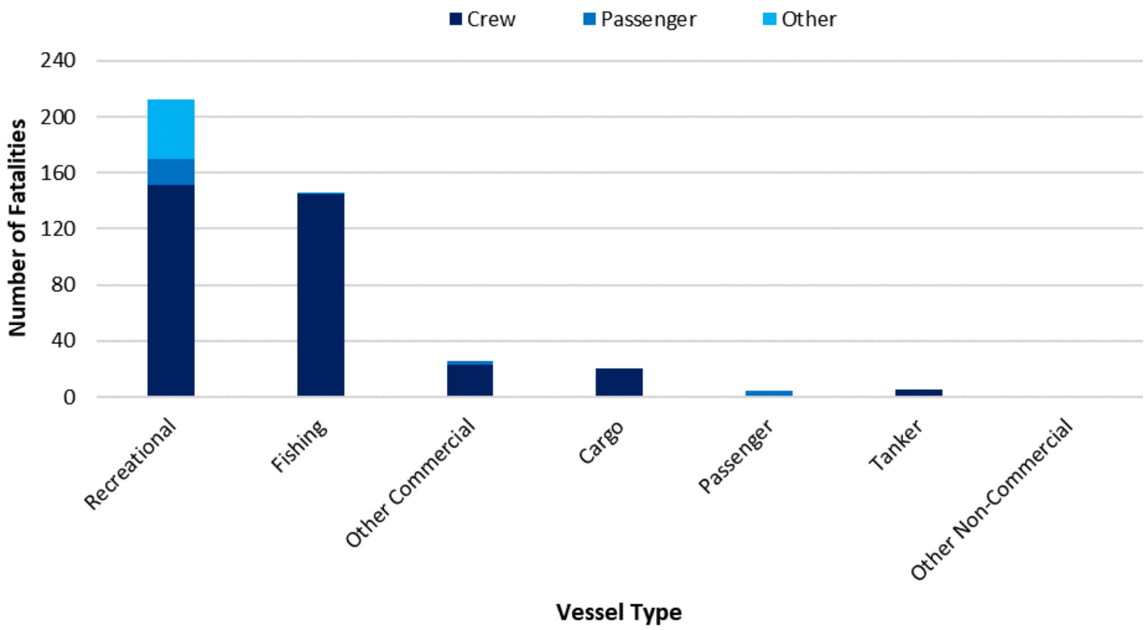


Figure C.7 MAIB Fatalities by Vessel Type within UK Waters (2002 to 2021)

709. 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

710. 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).

711. 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).

712. The locations of collision incidents reported in proximity to the UK are presented in **Figure C.8**. The distribution of collision incidents per year is presented in **Figure C.9**.

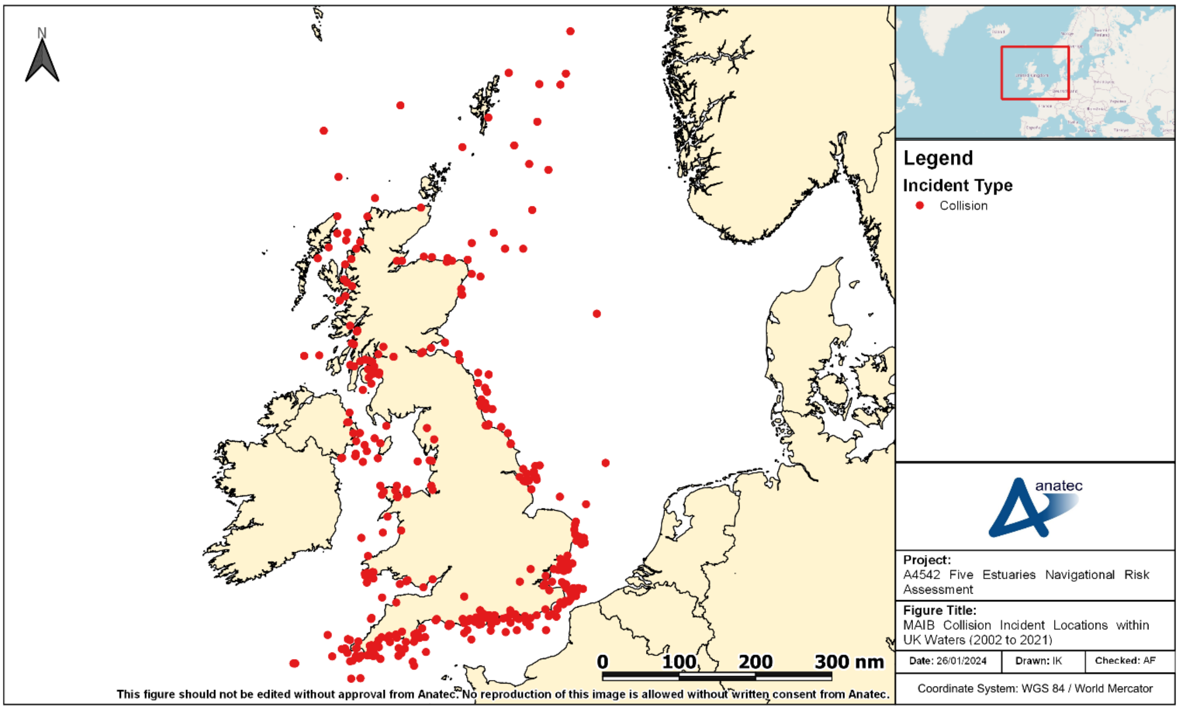


Figure C.8 MAIB Collision Incident Locations within UK Waters (2002 to 2021)

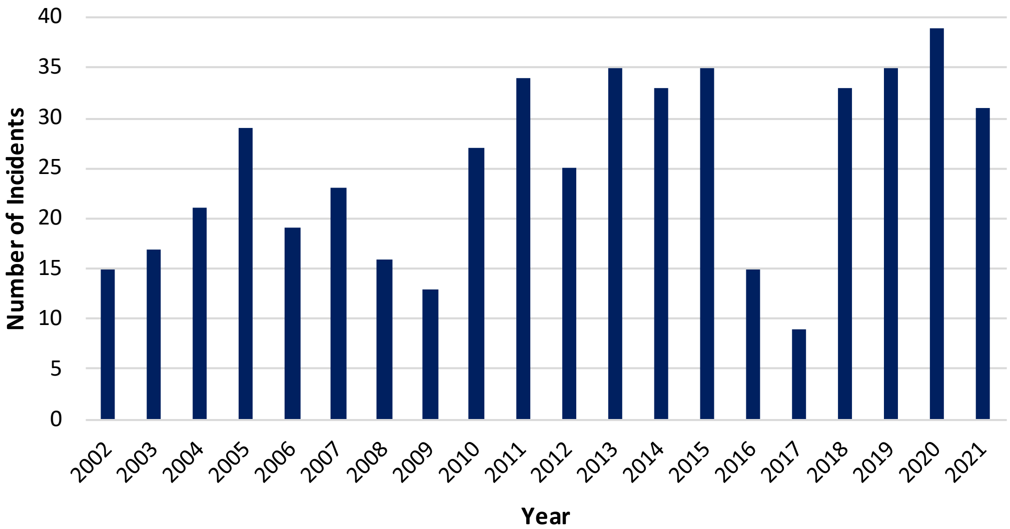
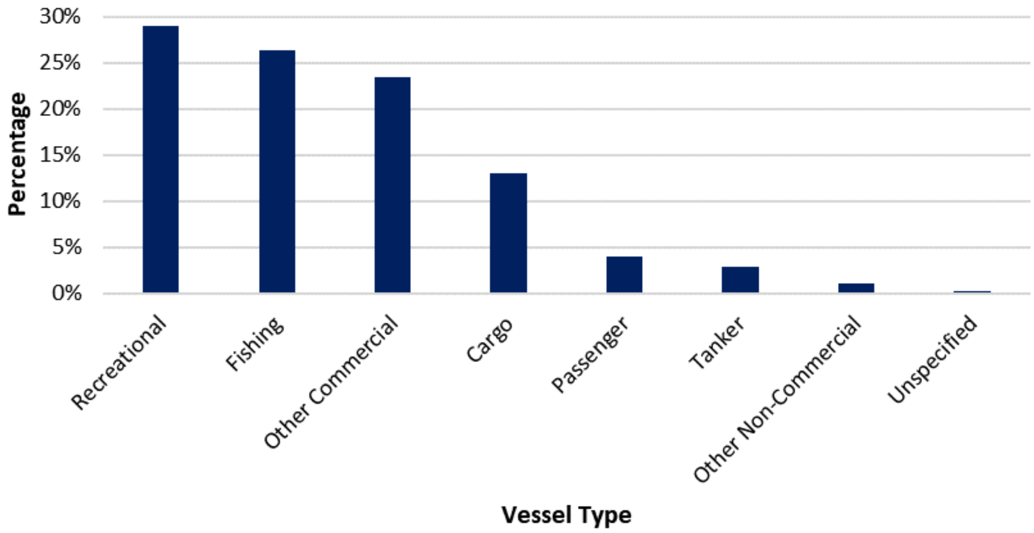


Figure C.9 MAIB Annual Collision Incidents within UK Water (2002 to 2021)

713. 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.

714. The distribution of vessel types involved in collision incidents is presented in **Figure C.10**.



715.

Figure C.10 MAIB Collisions by Vessel Type within UK Waters (2002 to 2021)

716. The most common vessel types involved in collision incidents were other commercial vessels (29%), fishing vessels (24%), non-commercial pleasure craft (23%), and dry cargo vessels (12%).

717. The 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 (2000 to 2019)

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	1

Date	Description	Fatalities
	seriously injured and airlifted to hospital before being pronounced dead later.	
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

718. 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.

719. A total of 119 allision incidents were reported to the MAIB within UK waters between 2002 and 2021 involving 119 vessels.

720. The locations of contact incidents reported in proximity to the UK are presented in **Figure C.11**. The distribution of contact incidents is presented in **Figure C.12**.

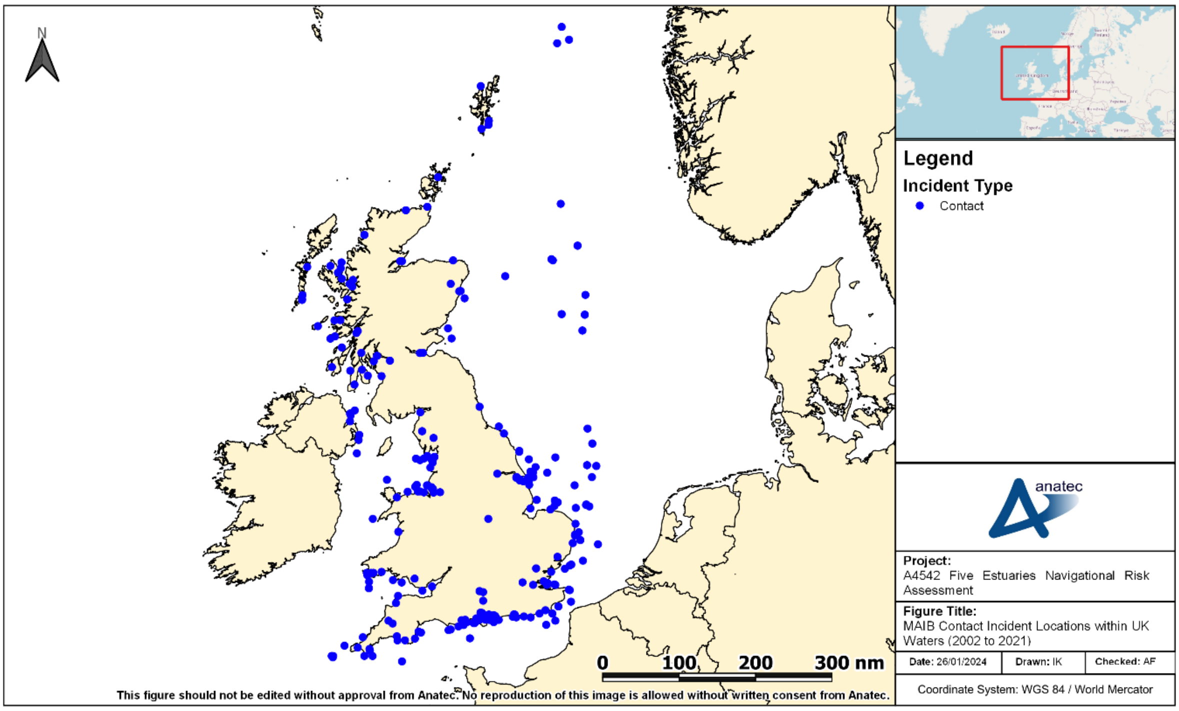


Figure C.11 MAIB Contact Incident Locations within UK Waters (2002 to 2021)

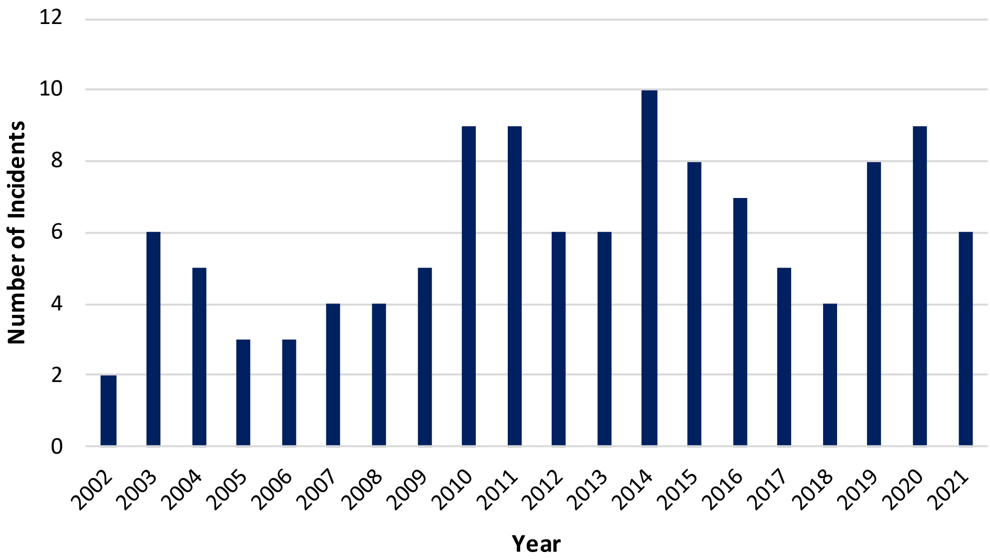


Figure C.12 MAIB Contact Incidents per Year within UK Waters (2000 to 2019)

721. The average number of contact incidents per year was 12. As with collision incidents, there has been an overall slight increasing trend over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

722. The distribution of vessel types involved in contact incidents is presented in **Figure C.13**.

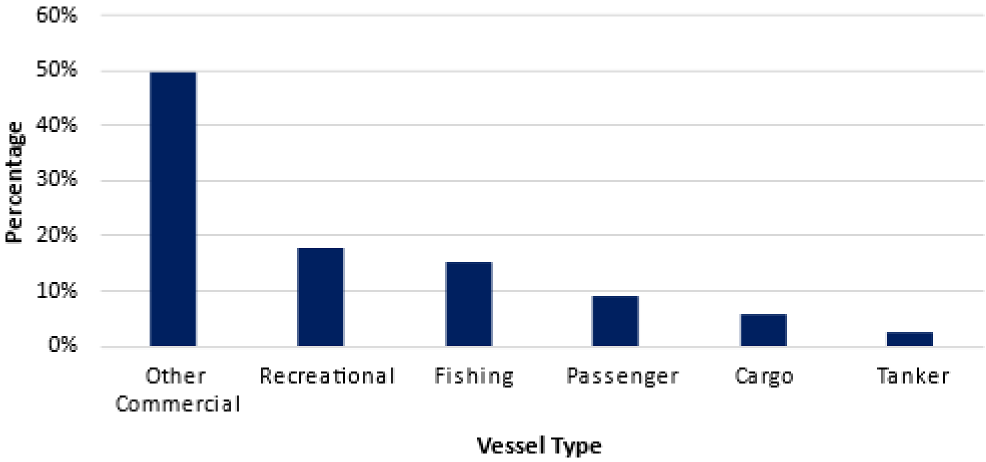


Figure C.13 MAIB Allision Incidents by Vessel Type within UK Waters (2002 to 2021)

723. The most commonly involved vessel types in contact incidents were other commercial vessels (43%), fishing vessels (15%), and non-commercial pleasure craft (13%).

724. One fatality was reported in MAIB contact incidents within UK waters between 2002 and 2021. Details of this fatal incident reported by the MAIB are presented in **Table C.3**.

Table C.3 Description of Fatal MAIB Contact Incidents (2002 to 2021)

Date	Description	Fatalities
June 2012	Contact between RIB and jetty. RIB badly damaged around the bow and fenders on the jetty also damaged. The RIB owner had consumed alcohol and suffered fatal injuries following the impact.	1

C.3 Fatality Risk

C.3.1 Incident Data

725. This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of a fatality in a marine incident associated with the proposed Project.

726. The wind farm structures are assessed to have the potential to affect the following incidents:

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

727. Of these incident types, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in **Section C.2.2** is considered to be directly applicable to these types of incidents.

728. The other scenarios of powered vessel to structure allision, drifting vessel to structure allision and fishing vessel to structure allision are technically contacts since they would involve a vessel striking an immobile object in the form of a WTG. From **Section C.2.3**, it can be seen that only one of the 235 contact incidents reported by the MAIB between 2002 and 2021 resulted in a fatality, with the contact occurring with a jetty in the approaches to a harbour.

729. As the mechanics involved in a vessel contacting a WTG may differ in severity from hitting, for example, a buoy, quayside, or moored vessel, the MAIB collision fatality risk rate has also been conservatively applied for the allision incident types.

C.3.2 Fatality Probability

730. 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.

731. To assess the fatality risk for personnel onboard a vessel (crew, passenger or other) the number of persons involved in the incidents needs to be estimated. **Table C.4** presents the average number of POB estimated for each category of vessel navigating in proximity to the proposed Project. 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.4 Estimated Average POB by Vessel Category

Vessel Category	Sub Categories	Source of Estimated Average POB	Estimated Average POB
Cargo/freight	Dry cargo, other commercial, service ship, etc.	MAIB incident data	15
Tanker	Tanker/combination carrier	MAIB incident data	22
Passenger	RoPax, cruise liner, etc.	Vessel traffic survey data / online information	203
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3
Recreational	Yacht, small commercial motor yacht, etc.	MAIB incident data	3.3

732. It is recognised that these numbers can be substantially higher or lower on an individual vessel basis depending upon the size, subtype, etc. but applying reasonable averages is considered sufficient for this analysis.

733. Using the estimated average number of POB for each vessel type, together with the vessel type information involved in collision incidents reported by the MAIB, there were an estimated 10,533 POB the vessels involved in the collision incidents.

734. Based upon five fatalities, the overall fatality probability in a collision for any individual on board is approximately 6.72×10^{-5} per collision.

735. It is considered inappropriate to apply this rate uniformly as the statistics indicate that the fatality probability associated with smaller craft, such as fishing vessels and recreational vessels, is higher. Therefore, the fatality probability has been subdivided into three categories of vessel as presented in **Table C.5**.

Table C.5 Collision Incident Fatality Probability by Vessel Category

Vessel Category	Subcategories	Fatalities	People Involved	Fatality Probability	Time Period
Commercial	Dry cargo, passenger, tanker, etc.	1	72,408	1.4×10^{-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)

736. The risk is higher by up to two orders of magnitude for POB small craft compared to larger commercial vessels.

C.3.3 Fatality Risk due to the Proposed Project

737. The base case and future case annual collision and allision frequency levels pre and post wind farm for the Array Area are summarised in **Table C.6**, where change refers to the increase in collision and allision frequency due to the presence of the proposed Project (estimated at overall 6.06×10^{-2}, equating to an additional collision or allision every 16.5 years) for the base case. Only the scenario where routeing tankers to/from Milford Haven deviate west of the Array Area is considered, noting that only collision risk (not allision risk) has been modelled for the scenario deviating east of the Array Area.

Table C.6 Summary of Annual Collision and Allision Risk Results[11]

Risk	Routeing Scenario	Traffic Level Scenario	Annual Frequency (Return Period)		
			Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Option A – tankers deviating west of the Array Area	Base case	4.93×10^{-4} (1 in 2,030 years)	7.18×10^{-4} (1 in 1,392 years)	2.25×10^{-4} (1 in 4,444 years)
		Future case (10%)	5.92×10^{-4} (1 in 1,690 years)	8.65×10^{-4} (1 in 1,156 years)	2.73×10^{-4} (1 in 3,663 years)
		Future case (20%)	7.04×10^{-4} (1 in 1,420 years)	1.03×10^{-3} (1 in 971 years)	3.26×10^{-4} (1 in 3,067 years)
	Option B – tankers deviating east	Base case	4.93×10^{-4} (1 in 2,030 years)	9.08×10^{-4} (1 in 1,101 years)	4.15×10^{-4} (1 in 2,409 years)
		Future case (10%)	5.92×10^{-4} (1 in 1,690 years)	1.09×10^{-3} (1 in 913 years)	4.98×10^{-4} (1 in 2,008 years)

[11] Allision modelling results reflect the alternative array layout – see **Section 16.4.1**.

Risk	Routeing Scenario	Traffic Level Scenario	Annual Frequency (Return Period)		
			Pre Wind Farm	Post Wind Farm	Change
	of the Array Area	Future case (20%)	7.04×10^{-4} (1 in 1,420 years)	1.30×10^{-3} (1 in 767 years)	5.96×10^{-4} (1 in 1,678 years)
Powered vessel to structure allision	Option A – tankers deviating west of the Array Area	Base case	-	2.34×10^{-4} (1 in 4,277 years)	2.34×10^{-4} (1 in 4,277 years)
		Future case (10%)	-	2.58×10^{-4} (1 in 3,873 years)	2.58×10^{-4} (1 in 3,873 years)
		Future case (20%)	-	2.80×10^{-4} (1 in 3,573 years)	2.80×10^{-4} (1 in 3,573 years)
Drifting vessel to structure allision	Option A – tankers deviating west of the Array Area	Base case	-	4.79×10^{-5} (1 in 20,875 years)	4.79×10^{-5} (1 in 20,875 years)
		Future case (10%)	-	5.27×10^{-5} (1 in 18,968 years)	5.27×10^{-5} (1 in 18,968 years)
		Future case (20%)	-	5.74×10^{-5} (1 in 17,414 years)	5.74×10^{-5} (1 in 17,414 years)
Fishing vessel to structure allision	N/A	Base case	-	5.96×10^{-2} (1 in 16.8 years)	5.96×10^{-2} (1 in 16.8 years)
		Future case (10%)	-	6.56×10^{-2} (1 in 15.2 years)	6.56×10^{-2} (1 in 15.2 years)
		Future case (20%)	-	7.15×10^{-2} (1 in 14.0 years)	7.15×10^{-2} (1 in 14.0 years)
Total	Option A – tankers deviating west of the Array Area	**Base case**	**4.93×10^{-4} (1 in 2,030 years)**	**6.06×10^{-2} (1 in 16.5 years)**	**6.01×10^{-2} (1 in 16.6 years)**
		Future case (10%)	**5.92×10^{-4} (1 in 1,690 years)**	**6.68×10^{-2} (1 in 15.0 years)**	**6.62×10^{-2} (1 in 15.1 years)**
		Future case (20%)	**7.04×10^{-4} (1 in 1,420 years)**	**7.29×10^{-2} (1 in 13.7 years)**	**7.22×10^{-2} (1 in 13.9 years)**

738. 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 proposed Project for the base case and future cases are presented in **Figure C.14**.

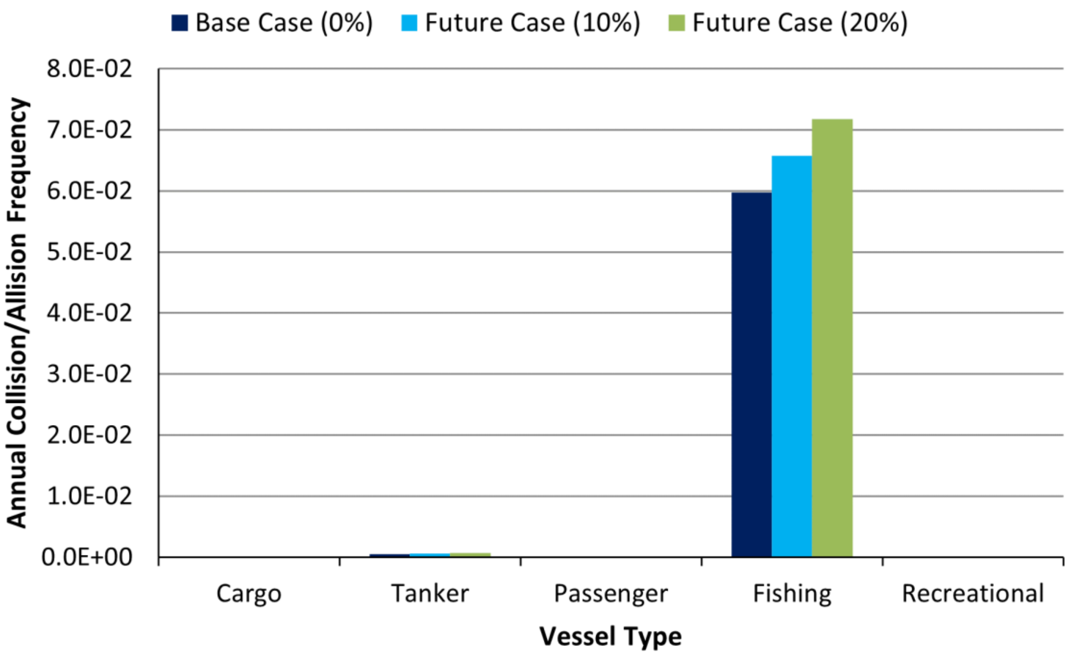


Figure C.14 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

739. It can be seen that the majority of change in collision and allision frequency is associated with fishing vessels, owing to the greater duration of time spent in proximity to Array Area by fishing vessels engaged in fishing activities and the possibility of fishing occurring internally within the Array Area itself. This is highly conservative given that consultation undertaken for commercial fisheries indicates that active fishing is not expected to resume following installation of the proposed Project.

740. Combining the annual collision and allision frequency, estimated number of POB for each vessel type, and estimated fatality probability for each vessel category, the total annual increase in PLL due to the presence of the proposed Project for the base case is estimated to be 4.04×10^{-4}, equating to one additional fatality every 2,477 years.

741. The estimated incremental increases in PLL due to the proposed Project, distributed by vessel type for the base and future cases, are presented in **Figure C.15**.

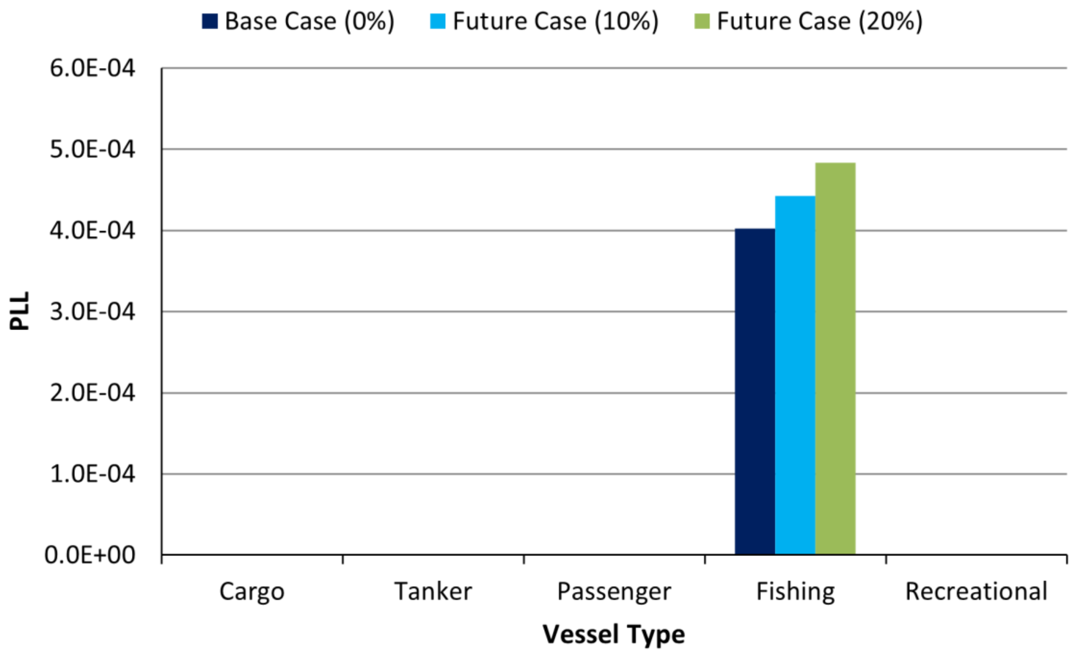


Figure C.15 Estimated Change in Annual PLL by Vessel Type

742. 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.

743. A conversion of the PLL to individual risk based upon the average number of people exposed by vessel type is presented in **Figure C.16**.

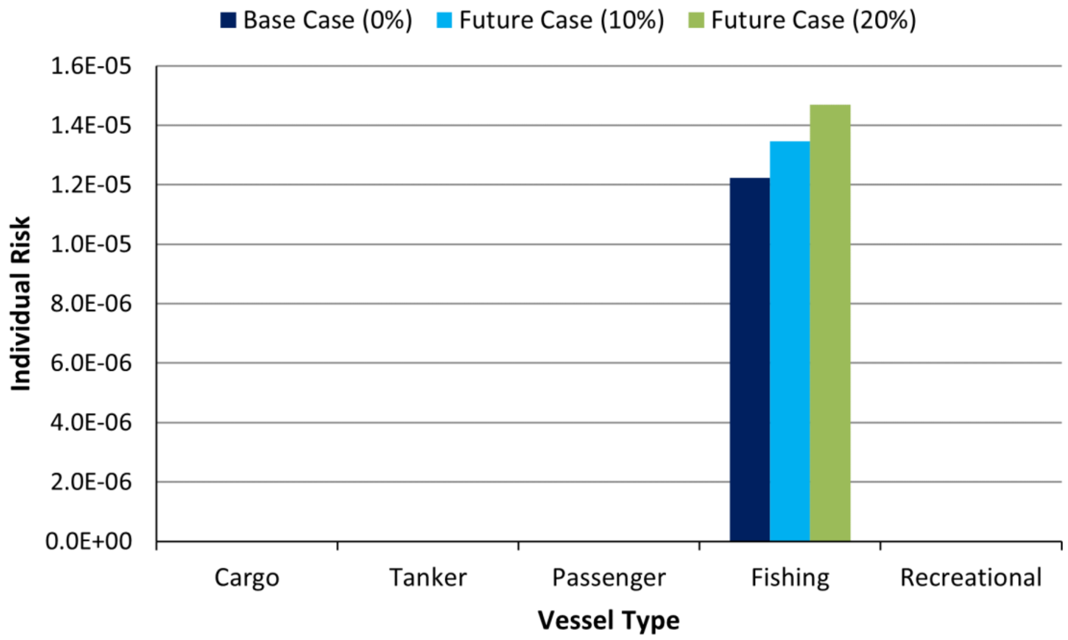


Figure C.16 Estimated Change in Individual Risk by Vessel Type

744. 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

745. In comparison to MAIB statistics, which indicate an average of 20 fatalities per year in UK territorial waters, the overall increase for the base case in PLL of one additional fatality per 2,477 years represents a small change.

746. In terms of individual risk to people, the change for commercial vessels attributed to the proposed Project (approximately 4.05×10^{-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.

747. For fishing vessels, the change in individual risk attributed to the proposed Project (approximately 1.22×10^{-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

C.4.1 Historical Analysis

748. 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).

749. Two types of oil spill are considered within this assessment:

- Fuel oil spills from bunkers (all vessel types); and
- Cargo oil spills (laden tankers).

750. Research undertaken as part of the UK's DfT Marine Environmental High Risk Area (MEHRA) project (DfT, 2001) has been used as it was comprehensive and based upon worldwide marine oil spill data analysis. From this research, the overall probability of a spill incident per accident was calculated based upon historical accident data for each accident type as presented in **Figure C.17**.

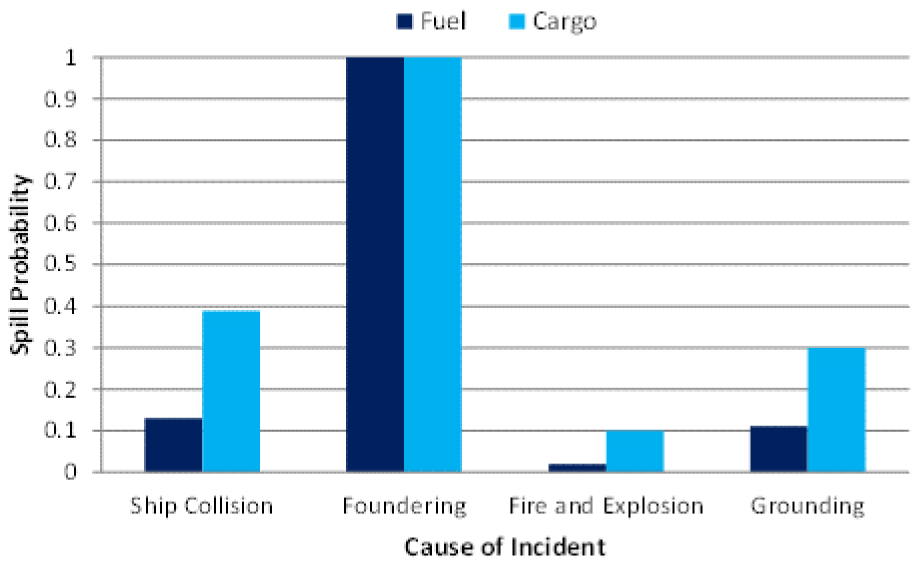


Figure C.17 Probability of an Oil Spill Resulting from an Accident

751. 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.

752. 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.

753. For the types and sizes of vessels exposed to the proposed Project, an average spill size of 100 tonnes of fuel oil is considered to be a conservative assumption.

754. For oil spills from laden tankers, the spill size can vary significantly. The International Tanker Owners Pollution Federation (ITOPF) reported the following spill size distribution for tanker collisions between 1974 and 2004:

- 31% of spills below seven tonnes;
- 52% of spills between seven and 700 tonnes; and

- 17% of spills greater than 700 tonnes.

755. Based upon this data and the tankers transiting in proximity to the Array Area, an average spill size of 400 tonnes is considered conservative.

756. For fishing vessel collisions comprehensive statistical data is not available. Consequently, it is conservatively assumed that 50% of all collisions involving fishing vessels will lead to oil spill with the quantity spilled being on average five tonnes. Similarly, for recreational vessels, owing to a lack of data 50% of collisions are assumed to lead to a spill with an average size of one tonne.

C.4.2 Pollution Risk due to the Proposed Project

757. Applying the above probabilities to the annual collision and allision frequency by vessel type and the average spill size per vessel, the estimated amount of oil spilled per year due to the presence of the proposed Project would equate to 0.29 tonnes of oil per year for the base case. For the future case scenarios, this estimate increases to 0.32 tonnes and 0.34 tonnes for traffic increases of 10% and 20%, respectively.

758. The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base and future cases are presented in **Figure C.18**.

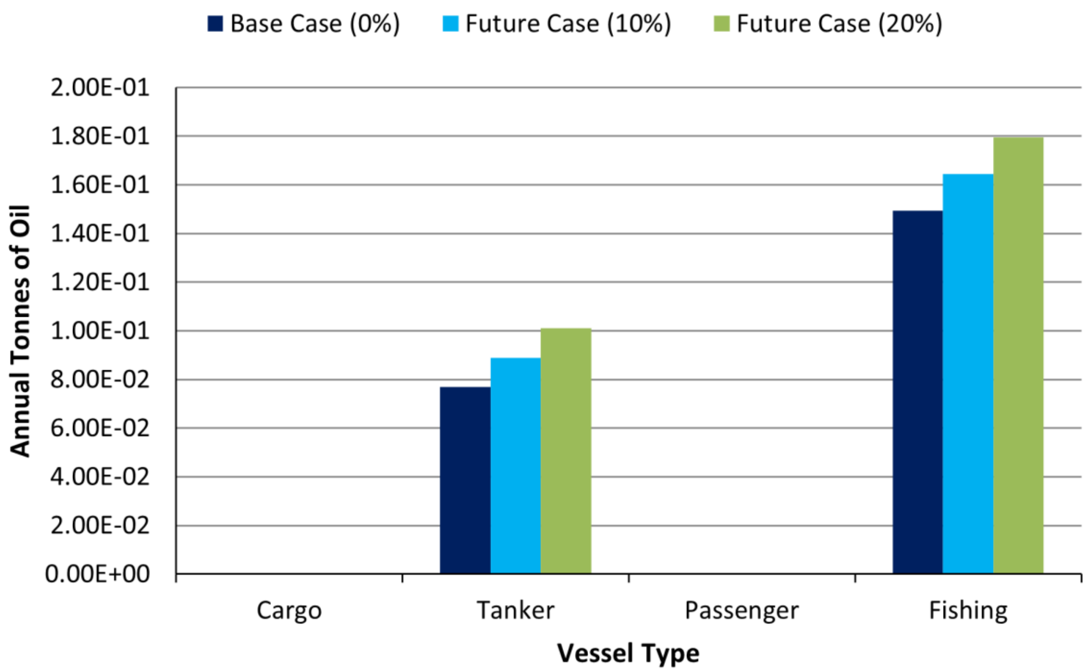


Figure C.18 Estimated Change in Pollution by Vessel Type

759. The majority of annual oil spill results are associated with fishing vessels due to the high annual allision frequency associated with fishing vessels. Tankers 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

760. To assess the significance of the increased pollution risk from vessels caused by the proposed Project, historical oil spill data for the UK has been used as a benchmark.

761. From the MEHRAs research, the annual average tonnes of oil spilled in UK waters due to maritime incidents in the 10-year period from 1989 to 1998 was 16,111 tonnes. This is based upon a total of 146 reported oil pollution incidents of greater than one tonne (smaller spills are excluded as are incidents which occurred within port or harbour areas or as a result of operational errors or equipment failure). Commercial vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

762. The overall increase in pollution estimated due to the proposed Project of 0.23 tonnes for the base case represents a 0.0014% increase compared to the historical average pollution quantities from marine incidents in UK waters.

C.5 Conclusion

763. This appendix has quantitatively assessed the fatality and pollution risk associated with the proposed Project in the case of a collision or allision incident occurring. It is concluded, based upon the results, that the collision and allision risk of the proposed Project on people and the environments is very low compared to the existing background risk levels.

Appendix D Regular Operator Consultation

764. As part of the consultation process for the proposed Project, Regular Operators identified from the vessel traffic survey data were consulted via electronic mail. The Array Area and OfECC presented reflected a previous iteration of each component, which have since been refined as per **Sections 6.1**. An example of the correspondence sent to the Regular Operators is presented below.

Anatec Ltd.
Cain House
10 Exchange Street
Aberdeen AB11 6PH
Tel: 01224 253700
Email: aberdeen@anatec.com
Web: www.anatec.com

Date: 15th June 2023

Stakeholder Consultation on Impacts Relating to Shipping and Navigation for the Proposed Llŷr Project

Dear Stakeholder,

As you may be aware, Floventis Energy (hereafter 'the Applicant') is the developer of the Llŷr Projects. The Llŷr Projects (Llŷr 1 and Llŷr 2) will consist of an area comprising floating offshore wind turbines and associated infrastructure (the 'Array Area'), as well as export cables to shore and an onshore grid connection. The Crown Estate awarded the Llŷr Projects 2×100MW lease areas subject to the Celtic Sea plan level HRA.

The Array Area is located at a minimum distance of approximately 17 nautical miles (nm) (31 kilometres (km)) off the south coast of Wales and covers an area of approximately 15 square nautical miles (nm^2) (50 square kilometres (km^2)). Six to eight wind turbines may be installed within the Array Area for each of the Llŷr Projects, giving an overall maximum of 16 wind turbines. No offshore substation planned.

The coordinates of the Array Area are provided in Table 1 and the location of the Llŷr Project, including the Array Area and Offshore Grid Cable Corridor, is presented in Figure 1.

Table 1 Array Area Coordinates

Latitude (WGS84)	Longitude (WGS84)
51° 22' 33.86" N	005° 31' 07.54" W
51° 22' 23.38" N	005° 25' 36.64" W
51° 18' 00.67" N	005° 22' 34.05" W
51° 18' 03.70" N	005° 27' 40.17" W

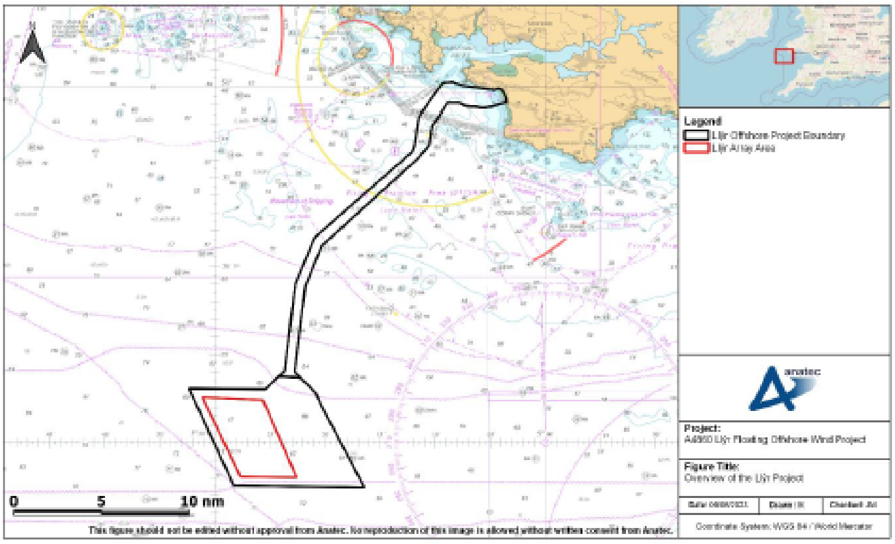


Figure 1 Overview of the Llŷr Project

Further information relating to the Llŷr Project is available here.

Other proposed floating offshore wind farms in the area include:

- **Erebus**, which has been granted consent, located approximately 3nm to the northwest of the Llŷr Array Area;
- **White Cross**, whose consent application has been submitted, located approximately 9nm to the south of the Llŷr Array Area in English waters; and
- **Valorous**, which is in the concept and early planning stage, which not have a lease area allocated from the Crown Estate (and is subject to the Celtic Sea commercial leasing round), located approximately 2nm to the west of the Llŷr Array Area.

An overview of nearby proposed offshore wind farm developments is presented in Figure 2. Also shown are the areas of search defined by The Crown Estate for the Celtic Sea leasing round.

Anatec has been contracted to provide technical support on shipping and navigation during the consenting process, and to co-ordinate consultation with stakeholders. Therefore, we are writing to you on behalf of the Llŷr Project to inform you of our relationship with the Applicant and to kindly request your comments, which will help inform the development of the Llŷr Project.

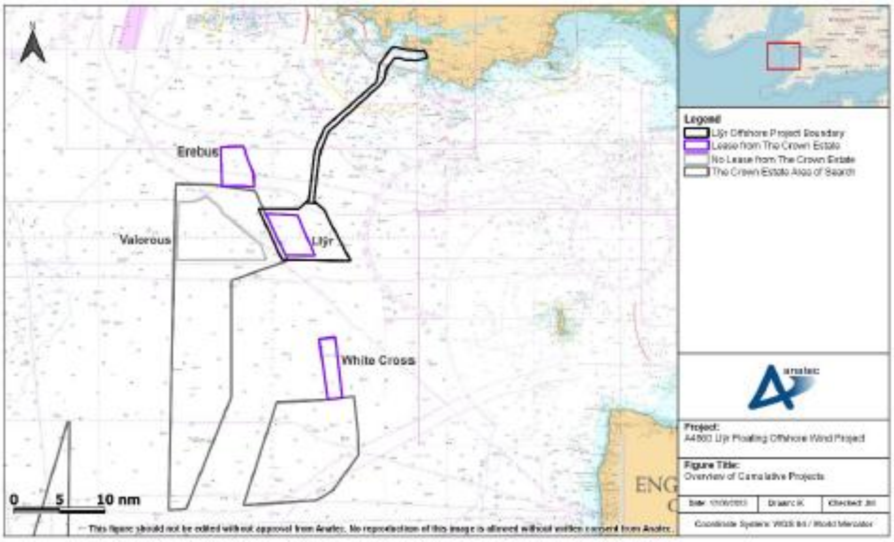


Figure 2 Overview of Proposed Projects and Development Areas in the Celtic Sea

The Environmental Impact Assessment (EIA) process requires the Applicant to identify impacts that the Llŷr Project may potentially have upon shipping and navigation, and to ensure comprehensive consultation is undertaken. To analyse shipping movements within and in the vicinity of the Array Area, Automatic Identification System (AIS), Radar data, and visual observations obtained from vessel-based surveys over 28 days in 2021/22 has been collected and assessed and will feed into the Navigational Risk Assessment (NRA) required by the Maritime and Coastguard Agency (MCA). Figure 3 presents a plot of the vessel traffic survey data collected within a 10nm buffer of the Array Area (the 'Study Area'), colour-coded by vessel type.

Page 3

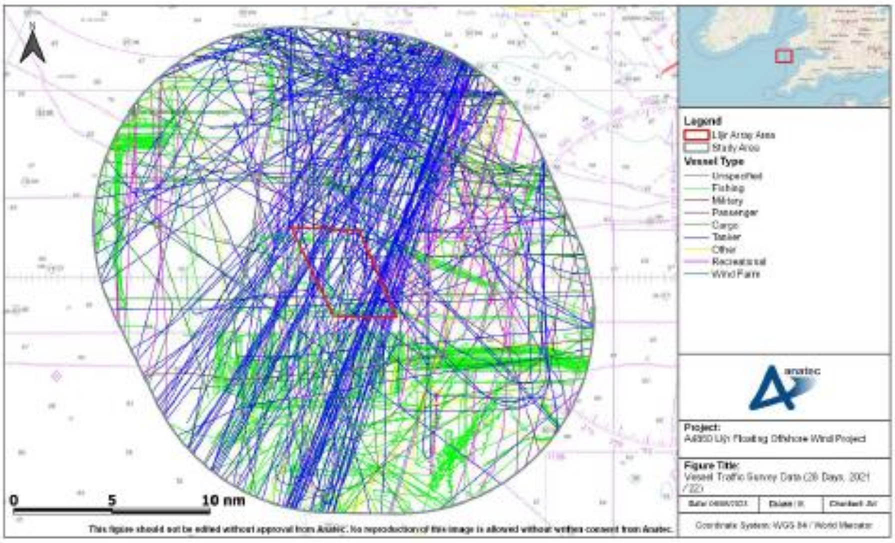


Figure 3 Vessel Traffic Survey Data (28 Days, 2021/22)

According to the assessment of the available datasets, your company's vessel(s) regularly navigates within, and/or in the vicinity of, the Array Area. Consequently, your company has been identified as a potential marine stakeholder for the Llŷr Project. We therefore invite your feedback on the potential development including any impact it may have upon the navigation of vessels.

We would be grateful if you could provide us with any comments or feedback that you may have by **Friday 14th July**. This will allow us to assess your feedback in the NRA submitted as part of the consent application. We would also be grateful if you could forward a copy of this information to any vessel operators/owners you feel may be interested in commenting.

In particular, we are keen to receive comments relating to the following:

1. Whether the proposal to construct the Llŷr 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 Llŷr Project poses any safety concerns to your vessels, including any adverse weather routeing;
3. Whether your responses to questions 1 and 2 above change when considering the cumulative scenario with the other developments in the vicinity of the Llŷr Project;
4. Whether you would choose to make passage internally through the floating array; and
5. Whether you wish to be retained on our list of marine stakeholders and be invited to a shipping and navigation Hazard Workshop to be undertaken as part of the NRA process, where shipping and navigation hazards will be discussed in detail.

Responses should be sent via email to [redacted] Should you have any queries about the published information or require any further information to support your review, please do not hesitate to contact us.

Yours sincerely,

[redacted]

Anatec Ltd.

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Appendix E Long-Term Vessel Traffic Data

E.1 Introduction

765. This appendix assesses additional long-term vessel traffic data for the proposed Project. As required under MGN 654 (MCA, 2021), the NRA and **Volume 3 Chapter 25: Shipping and Navigation** of the ES 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 has also considered a longer-term dataset covering all of 2022 to ensure a comprehensive characterisation of vessel traffic movements can be established, including the capture of any seasonal variation and adverse weather routeing.

766. This approach (i.e., the use of both short-term and long-term data) has been agreed with the MCA and Trinity House and was recommended by the UK Chamber of Shipping during a consultation meeting in February 2023.

E.2 Aims and Objectives

767. The key aims and objectives of this appendix are as follows:

- Identify seasonal variations and adverse weather routeing in vessel traffic via assessment of the long-term data;
- Determine if these are not reflected within the short-term survey data (and therefore should be fed into the NRA baseline); and
- Assess which dataset (long term/survey, or combination of both) should be utilised for each key NRA element that requires vessel traffic data input.

E.3 Methodology

E.3.1 Study Area

768. This appendix has assessed the long-term vessel traffic data within the Study Area, as defined in **Section 3.4**.

E.3.2 Data Collection Summary

769. The long-term vessel traffic data was collected from coastal AIS receivers for the entirety of 2022 (01 January to 31 December inclusive). Downtime from these receivers was observed to be minimal throughout 2022, amounting to a total of approximately 2%.

770. As per the vessel traffic surveys, a number of vessel tracks recorded during the data period were classified as temporary in nature (non-routine) and have been excluded

from the analysis, e.g., survey vessels, to ensure the assessment focusses on routine traffic and activity.

E.3.3 Data Limitations

771. General limitations associated with the use of AIS data (for example, carriage requirements) are discussed in full within **Section 5.4.1**.

E.4 Long-Term Vessel Traffic Movements

E.4.1 Overview

772. An overview of all data recorded during 2022 within the Study Area is colour-coded by vessel type and presented in **Figure E.1**. Following this, the distribution of the main vessel types is presented in **Figure E.2**.

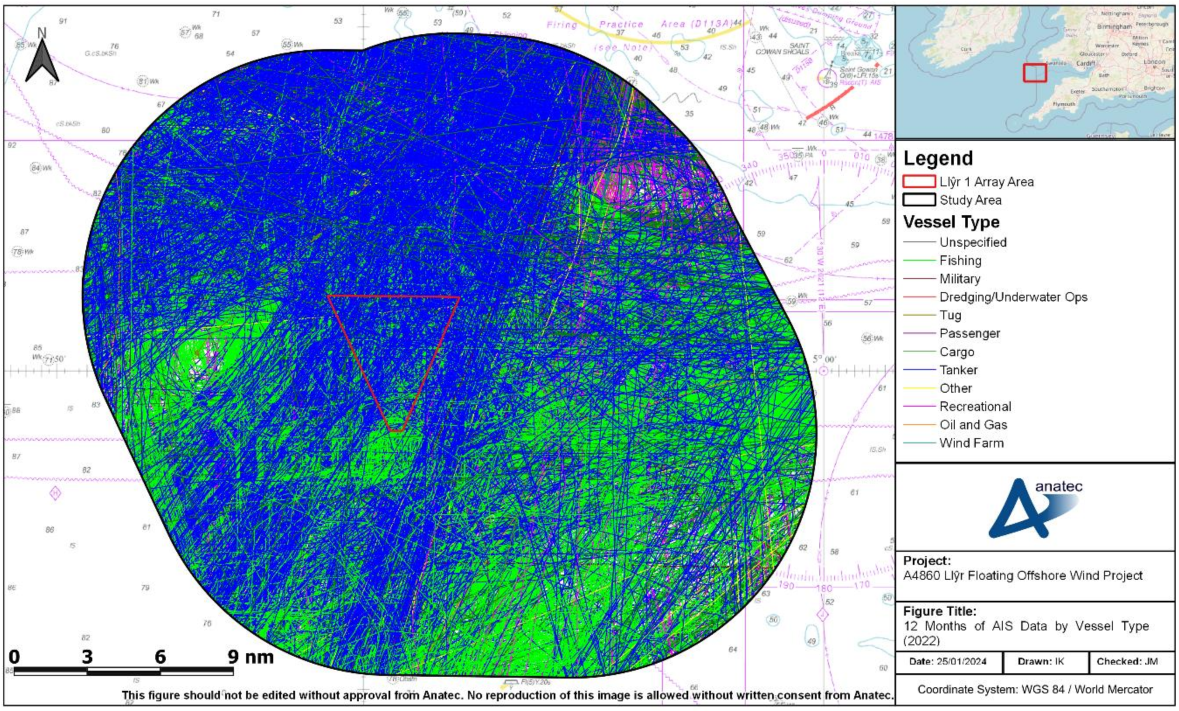

Figure E.1 Distribution of Main Vessel Types (12 Months, 2022)

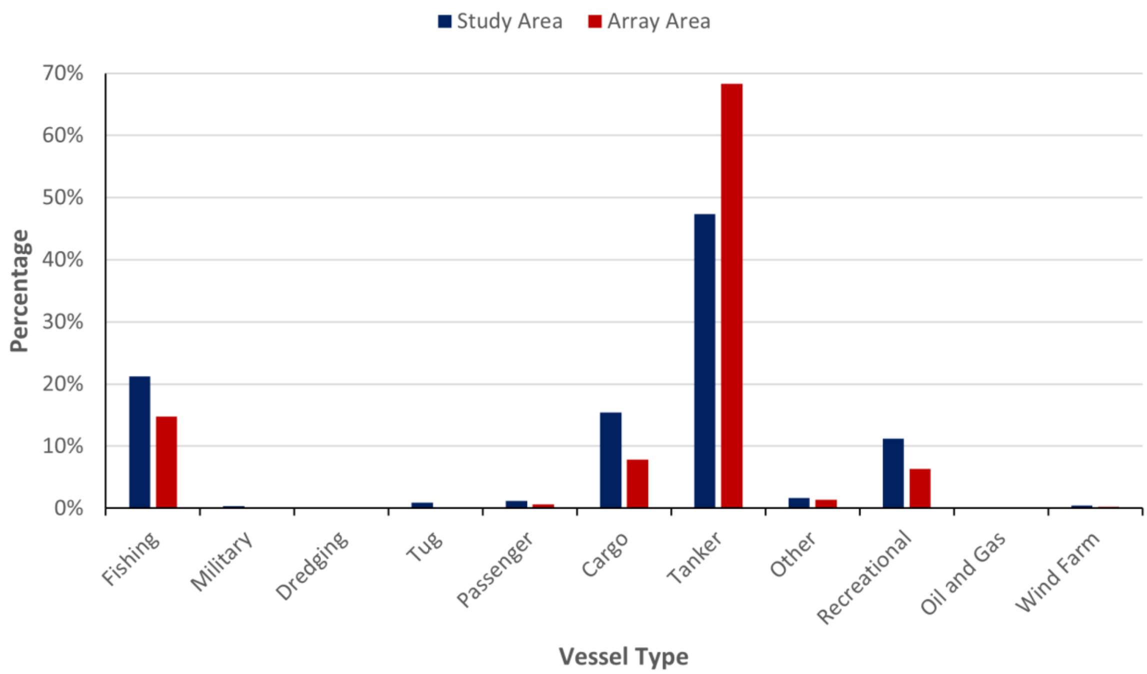

Figure E.2 Distribution of Main Vessel Types (12 Months, 2022)

773. The most common vessel type recorded within the Study Area during 2022 was tanker, accounting for 47% of vessels. This was followed by fishing vessels (21%), cargo vessels (15%) and recreational vessels (11%).

774. Vessels in the 'Other' category and passenger vessels were also present, each accounting for 1%; common vessels in the 'other' category included lifeboats and cable-laying vessels.

775. Additional vessel types were also present in smaller numbers (each accounting for less than 1% of the data); tugs, wind farm support vessels, military vessels, dredgers and oil and gas vessels.

776. A vessel altering route due to adverse weather conditions was identified on one occasion – an Irish Ferries-operated RoPax vessel routeing to Dublin which transited close to coast.

777. More detailed analysis of each of the main vessel types is presented in **Section E.4.4**.

E.4.2 Vessel Density

778. The density of vessels recorded during 2022, within a 0.5×0.5 nm grid, is presented in **Figure E.3**.

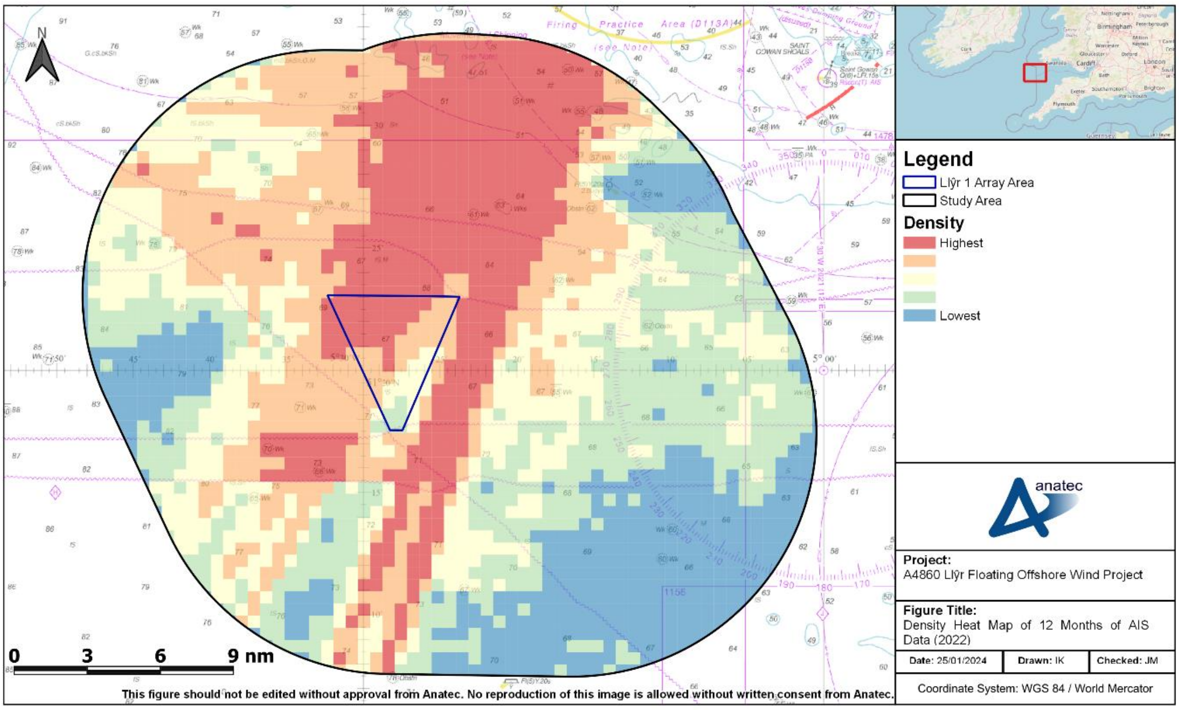

Figure E.3 Density Heat Map of 12 Months of AIS Data (2022)

779. The highest vessel density in the Study Area aligns with two northeast/southwest routes to / from the Port of Milford Haven that each intersect the Array Area, with the route intersecting the southeast of the Array Area being more clearly defined in terms of density. These routes are mainly undertaken by tankers, which are further discussed in **Section 11.2**. Within the Study Area as a whole, vessel density is generally lower to the east of the central high-density route than to the west.

E.4.3 Vessel Count

780. The average numbers of unique vessels recorded per day for each month of 2022 within the Study Area are presented in **Figure E.4**.

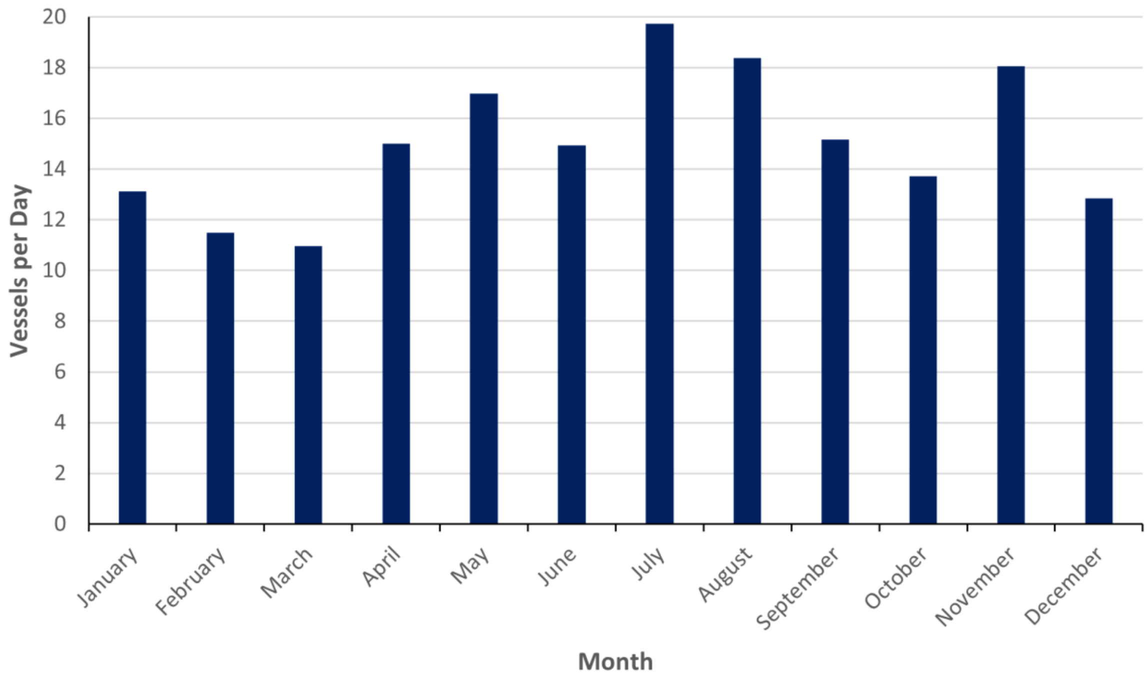

Figure E.4 Average Vessel Counts within the Study Area (12 Months, 2022)

781. There was an average of 15 unique vessels per day recorded within the Study Area during 2022. The busiest month was July, during which an average of 20 unique vessels per day was recorded. The quietest month was March, during which an average number of 11 unique vessels per day was recorded. As with the 28-day survey period, RoPax vessels were recorded in low numbers through the Study Area (see **Section** Error! Reference source not found.), and not characteristic of regular routeing.

E.4.4 Vessel Type

782. This section provides a more detailed analysis of each of the main vessel types recorded within the Study Area during 2022.

E.4.4.1 Tankers

783. The large majority (approximately 72%) of tankers were recorded travelling in a wide range of directions; most of these tankers were likely waiting for orders prior to arriving or after departing the Port of Milford Haven. However, the remaining tankers largely coincided with clearly defined routes.

784. **Figure E.5** presents the tankers recorded within the Study Area during 2022 colour-coded by behaviour i.e., whether routeing or waiting for orders[12]. Following this,

[12] In some instances, vessel tracks do pass directly through the Study Area but may return to the Study Area within the same transit i.e. a track which may appear to be a transit is actually an example of waiting for orders.

Figure E.6 presents the routeing tankers colour-coded by course i.e., northbound or southbound.

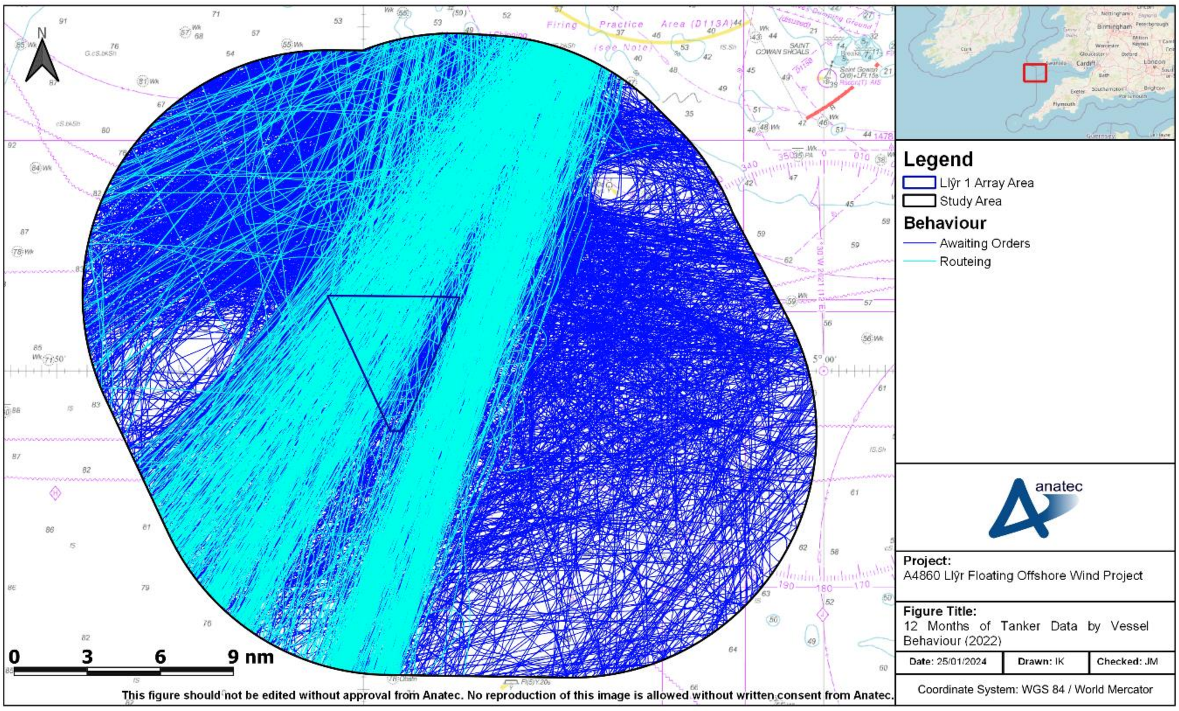

Figure E.5 12 Months of Tanker Data by Vessel Behaviour (2022)

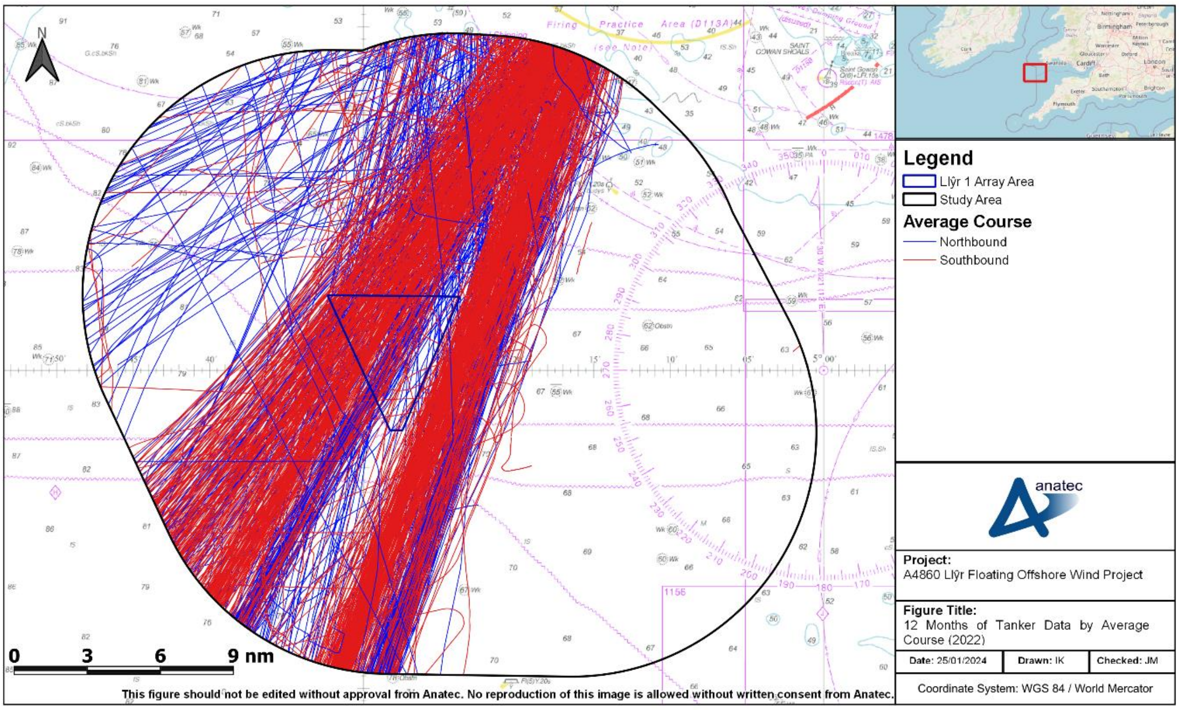

Figure E.6 12 Months of Routeing Tanker Data by Average Course (2022)

785. There was an average of seven unique tankers per day recorded within the Study Area during 2022. For those tankers with a clearly defined course, the majority were heading southbound (62%). Overall, routeing tanker tracks mainly comprised two routes intersecting the Array Area; the southbound tracks coincided closely with these routes while the northbound tracks had a larger proportion taking alternative routes, including towards the northwestern extent of the Study Area. These two main routes navigate between the Port of Milford Haven and one of two TSSs – the TSS off Land's End Between Seven Stones and Longships and the TSS West off the Scilly Isles.

E.4.4.2 Fishing Vessels

786. **Figure E.7** presents the fishing vessels recorded within the Study Area during 2022, colour-coded by average speed. It should be noted that as this assessment is via AIS only, it is likely to be under-representative of actual fishing vessel levels (see **Section 5.4.1**).

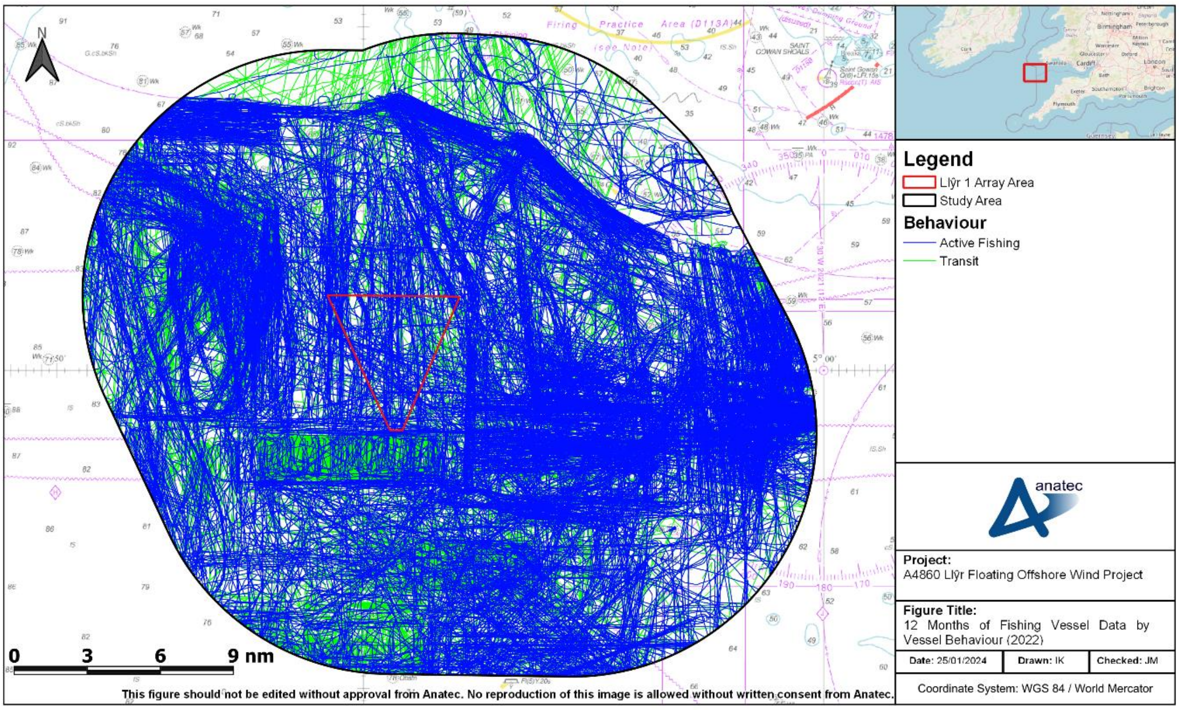

Figure E.7 12 Months of Fishing Vessel Data by Vessel Behaviour (2022)

787. There was an average of three unique fishing vessels per day recorded within the Study Area during 2022. A total of 85% of tracks had an average speed of below 6 kt, which is indicative of active fishing. The charted UK national fishery limits are within the northern portion of the Study Area and the large majority of fishing activity takes place beyond (south of) these limits, noting that non-UK vessels are not permitted to fish in UK territorial waters unless the appropriate licence has been issued by the UK Single Issuing Authority (SIA).

E.4.4.3 Cargo Vessels

788. **Figure E.8** presents the cargo vessels recorded within the Study Area during 2022, colour-coded by vessel length.

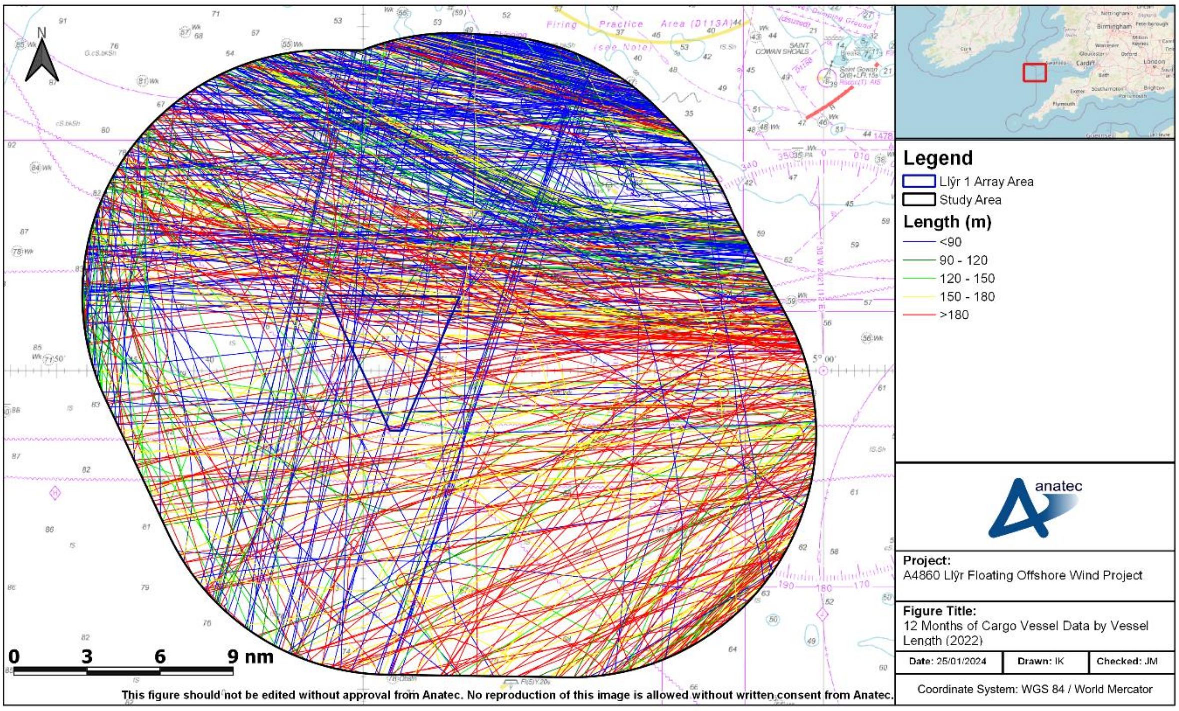

Figure E.8 12 Months of Cargo Vessel Data by Vessel Length (2022)

789. There was an average of two to three unique cargo vessels per day recorded within the Study Area during 2022. The shortest cargo vessels (less than 90 m) were mainly observed accessing the Bristol Channel inshore of the Array Area while the larger cargo vessels were observed further south, again accessing the Bristol Channel. The majority of cargo vessels were seen in east/west transit north of the Array Area, with less frequent routeing north/south out of the Port of Milford Haven (including passing through the Array Area).

790. Although CLdN-operated RoRo vessels were recorded transiting through the Study Area, only nine such instances were noted in the 12-month period.

E.4.4.4 Recreational Vessels

791. **Figure E.9** presents the cargo vessels recorded within the Study Area during 2022, colour-coded by vessel length.

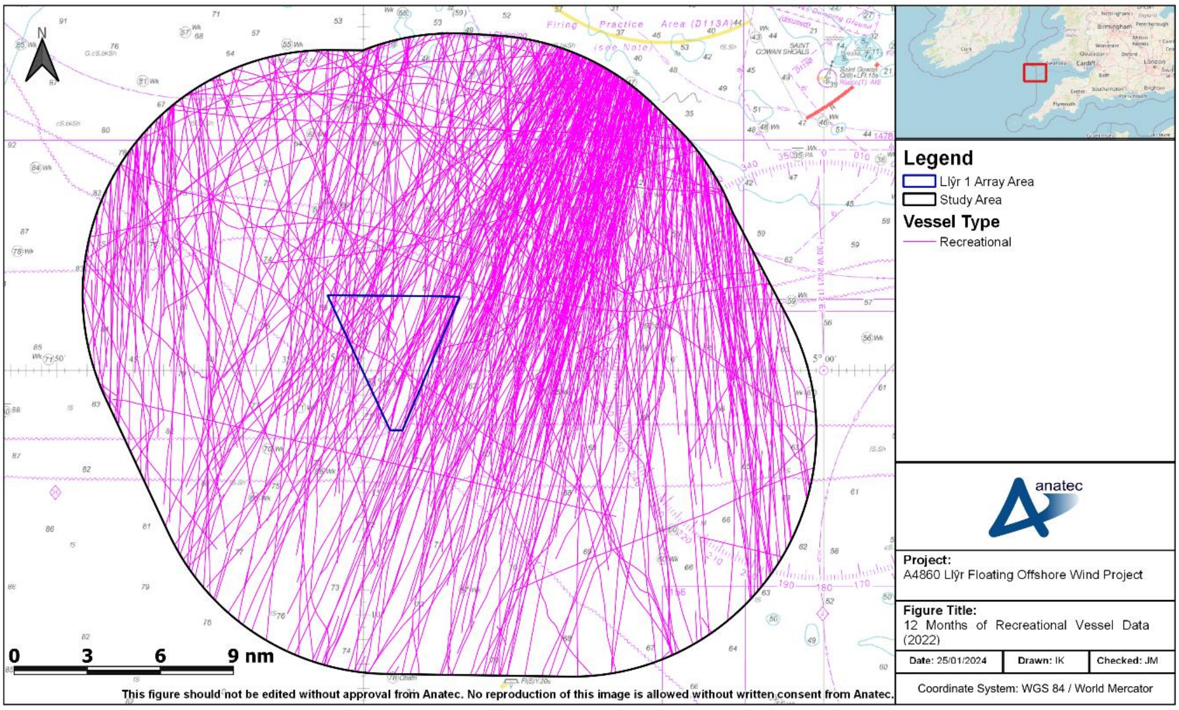

Figure E.9 12 Months of Recreational Vessel Data (2022)

792. There was an average of one to two unique recreational vessels per day recorded within the Study Area during 2022. The majority of recreational vessels were seen in northeast/southwest transit just to the east of the Array Area transiting to / from Milford Haven, with traffic in a north-south orientation to / from Milford Haven also recorded. The number of recreational vessels recorded intersecting the Array Area was relatively low – approximately one to two unique vessels per week.

E.4.4.5 Anchored Vessels

793. Vessels identified as likely to be anchoring within the OfECC Study Area are colour-coded by vessel type and presented in **Figure E.10**.

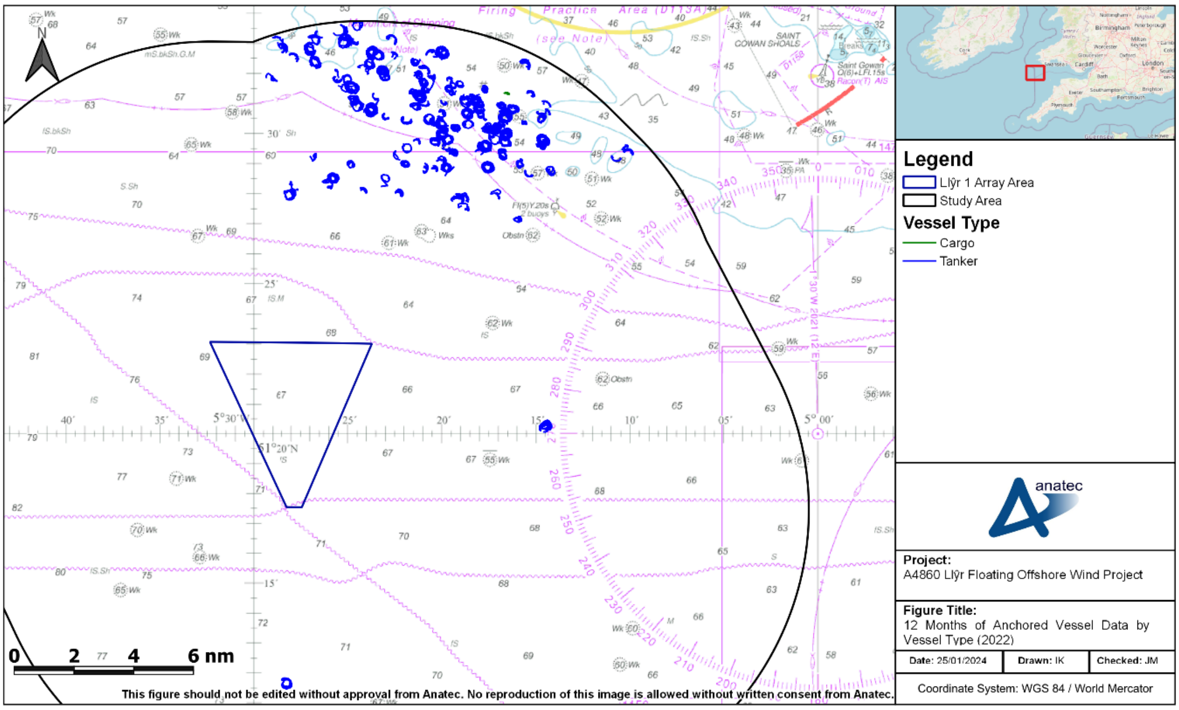

Figure E.10 12 Months of Anchored Vessel Data by Vessel Type (2022)

794. An average of approximately one to two vessels per day were identified as likely to be anchoring within the Study Area, with activity most prevalent in the northeast of the Study Area, in the approaches to Milford Haven. The majority of anchoring vessels were tankers (99%).

E.5 Survey Data Comparison

795. Survey data recorded during the 14-day periods in March 2022 and July 2023 were collected using a combination of AIS, Radar, and visual observation. This subsection provides comparison of the 28-day survey data (winter and summer combined) against the long-term 2022 AIS data.

796. A comparison of the average number of each main vessel type recorded during the long -term 2022 data and the two 14-day survey periods area presented in **Table E.1**.

Table E.1 Average Daily Vessel Counts by Vessel Type for Survey and Long-Term Data

Vessel Type	Long-term 2022 AIS Data (Vessels per Day)			Winter Survey (March 2022)	Summer Survey (July 2023)
	Quietest Month	Busiest Month	Average Vessels per Day	Average Vessels per Day	Average Vessels per Day
Tankers	5	9	7	7	5
Commercial fishing vessels	<1	5-6	3	<1	5-6
Cargo vessels	2	3	2-3	2-3	2
Recreational vessels	<1	5	1-2	<1	5

797. The average daily vessel count within the long-term data was mostly consistent with the survey data. Recreational and fishing vessel transits were substantially higher in the summer survey period compared to either the average of the long-term or winter datasets, although this is to be expected due to seasonality effects.

E.6 Summary and Conclusion

798. A year of AIS data during 2022 has been broken down to validate the winter 2022 and summer 2023 vessel traffic survey data recorded within the Study Area as agreed during consultation.

799. The main vessel types detected within the Study Area during 2022 were tankers (47%), commercial fishing vessels (21%), cargo vessels (15%), and recreational vessels (11%). The main vessel types detected during the winter 2022 vessel traffic survey were tankers (66%) and cargo vessels (26%). Fishing and recreational vessels were noted to be higher during the summer survey period due to seasonal variation.

800. The summer 2023 vessel traffic survey showed this, with the main vessel types recorded being commercial fishing vessels (30%), tankers (28%), recreational vessels (27%), and cargo vessels (12%). Overall, the vessel types detected within the Study Area were similar between the long-term data and the vessel traffic surveys with seasonal effects in fishing and recreational vessels noted.